Routes of the Uruk Expansion

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Michelle de Gruchy

The late fourth millennium B.C. of Mesopotamia is best known for an expansion of material culture from Southern Mesopotamia known as the Uruk Expansion or Uruk Phenomenon. The precise nature of this expansion remains unknown, but at its core it evidences unprecedented levels of interregional interaction whether in the form of colonies, trade diasporas, or otherwise.

This thesis uses quantitative route analysis to examine the hollow ways across the North Jazira region of northern Mesopotamia before, during, and after the Uruk Expansion in the late fourth millennium B.C. to learn more about the phenomenon. To accomplish this, new methodologies were required. A bottom up method for reconstructing land cover was developed and the first velocity-based terrain coefficients were calculated to factor both land cover and slope into the route models. Additionally, the first quantitative method for directly comparing route models to preserved routes was developed to statistically assess the significance of three physical route choice variables: easiest, fastest, and shortest.

First, it is statistically proven that, for the North Jazira, physical variables did not play a major role in route choice, highlighting the importance of cultural variables. Second, it is shown that the routes evidence the formation of polities starting in the late fourth millennium. Thirdly, it is demonstrated that the Uruk Expansion was a disruptive force that broke down previous east-west dynamics, spatially polarizing the population. Furthermore, when east-west movement resumes in the early third millennium B.C., the region remains divided in two distinct sub-regions.

Finally, the poor performance of route models based on physical variables frequently used for predicting route locations has implications for the usefulness of this practice, particularly in areas with flatter terrain. What was important to other cultures cannot be assumed, but must be based on evidence from the cultures themselves.

Routes of the Uruk Expansion

Volume 1 of 3

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List of Abbreviations

ARCANE	Associated Regional Chronologies of the Ancient Near East
ASTER	Advanced Spaceborne Thermal Emision and Reflection Radiometer
DEM	Digital Elevation Model
EJZ	Early Jazira Period
LC	Late Chalcolithic
SRTM	Shuttle Radar Topographic Mission

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Thanks are due to many people who have helped enrich this thesis in various ways. First, I need to thank Graham Philip who has provided invaluable guidance, advice, support throughout the whole degree process, and critical feedback on the many drafts of this thesis. I am also thankful for the advice and feedback by my second supervisors Tony Wilkinson and Rob Witcher. Thank you, Rob, for accepting me as another of your students following Tony's death. It's been very productive having the perspective of someone whose methodological expertise overlaps mine, but whose regional area of expertise does not. Here I must also acknowledge and thank Emma Cunliffe who provided such helpful feedback and comments on what are now Chapters 6 and 7, that when my supervisors read them, they saw almost no faults!

Before moving on, I would also like to thank Joan McIver whose kindness enabled me to first meet my future supervisor, Tony Wilkinson.

In order to complete the research presented in this thesis, it was necessary to develop two new methodologies: one for quantitative route analysis (Chapter 7) and one for reconstructing land cover (Chapter 8).

In my efforts to reconstruct land cover, inspired by the TED Talk video by Eric Sanders about the Mannahatta project, enormous thanks are due to Simone Riehl who has served as my advisor both times I have been based in Tübingen during my Ph.D. (first for a research trip and then on a Teach@Tübingen fellowship), and gave me access to her then-unpublished Archaeobotanical Database of Eastern Mediterranean and Near East Sites (now available at www.ademnes.de). Thanks are due to Katleen Deckers who has also provided helpful advice and comments as I developed and then reconstructed the land cover of the North Jazira. I must also thank both Katleen Deckers and Simone Riehl for their collaboration with me to produce the land covers published in our co-authored article in *Journal of Archaeological Science: Reports*. While those reconstructions are not a part of this thesis, they are important demonstrations of what is possible.

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Solving the problem of directly comparing a route model to a preserved route was not easy. It was Nick Vivyan who set me on the right track to solving the problem by telling me that I need to find a way to turn my lines into numbers. The questions and (contradictory) critique raised by the four anonymous reviewers on my *Journal of Archaeological Method and Theory* article that first published the method were extremely useful and informative. The seven pages of initial critique by the four reviewers also led me to the mathematics department where I presented my methodology and the critiques it had received as a talk in the Stats4Grads seminar series. The audience was attentive and extremely helpful. In the 6 or more hours of discussion that followed, I learned about bootstrapping and confirmed that my use of a two-tailed Z-test was justified. Within this group, special thanks are owed to Thomai Tsiftsi who organised Stats4Grads, and to James Edwards.

In addition to developing two new methodologies, it was also necessary to develop the first velocity- or time-based terrain coefficients. Ed Caswell and James Edwards were my collaborators in this effort and it is no exaggeration to say that we could not have developed those coefficients without each other. Thanks Ed and James for tangibly helping improve the both the quality research and accuracy of results presented in my thesis, and thank you to the Norman Richardson Fund from Ustinov College for providing the necessary funding.

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Finally, to my mother and my grandmother, to whom I have chosen to dedicate this thesis, thank you for all your constant support over the years.

To my grandmother, Elaine Coakley, and my mother, Barbara Coakley

PART 1: Background

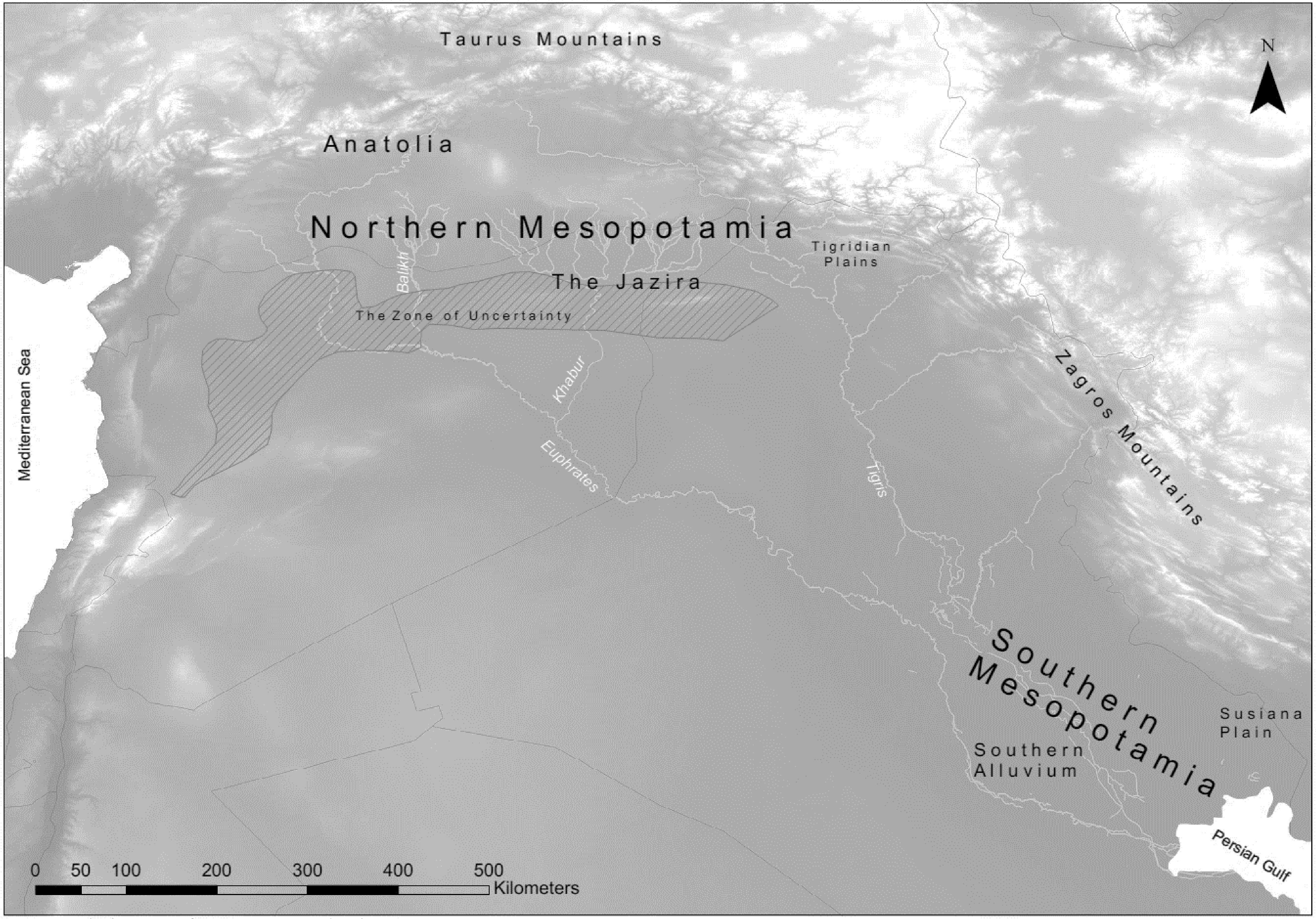

Figure 1.1 The locations of regions mentioned in the text.

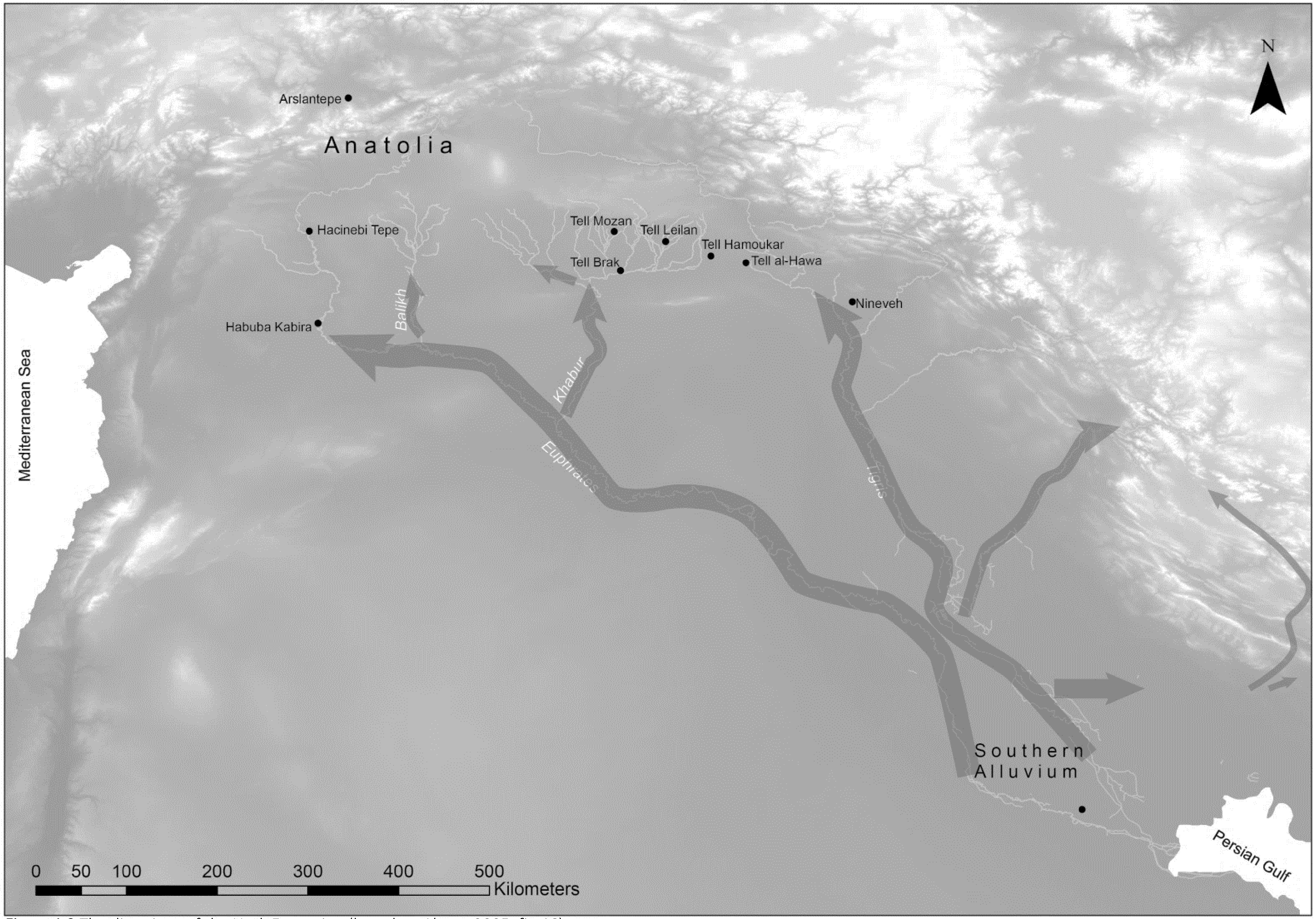

Figure 1.2 The directions of the Uruk Expansion (based on Algaze 2005, fig.46).

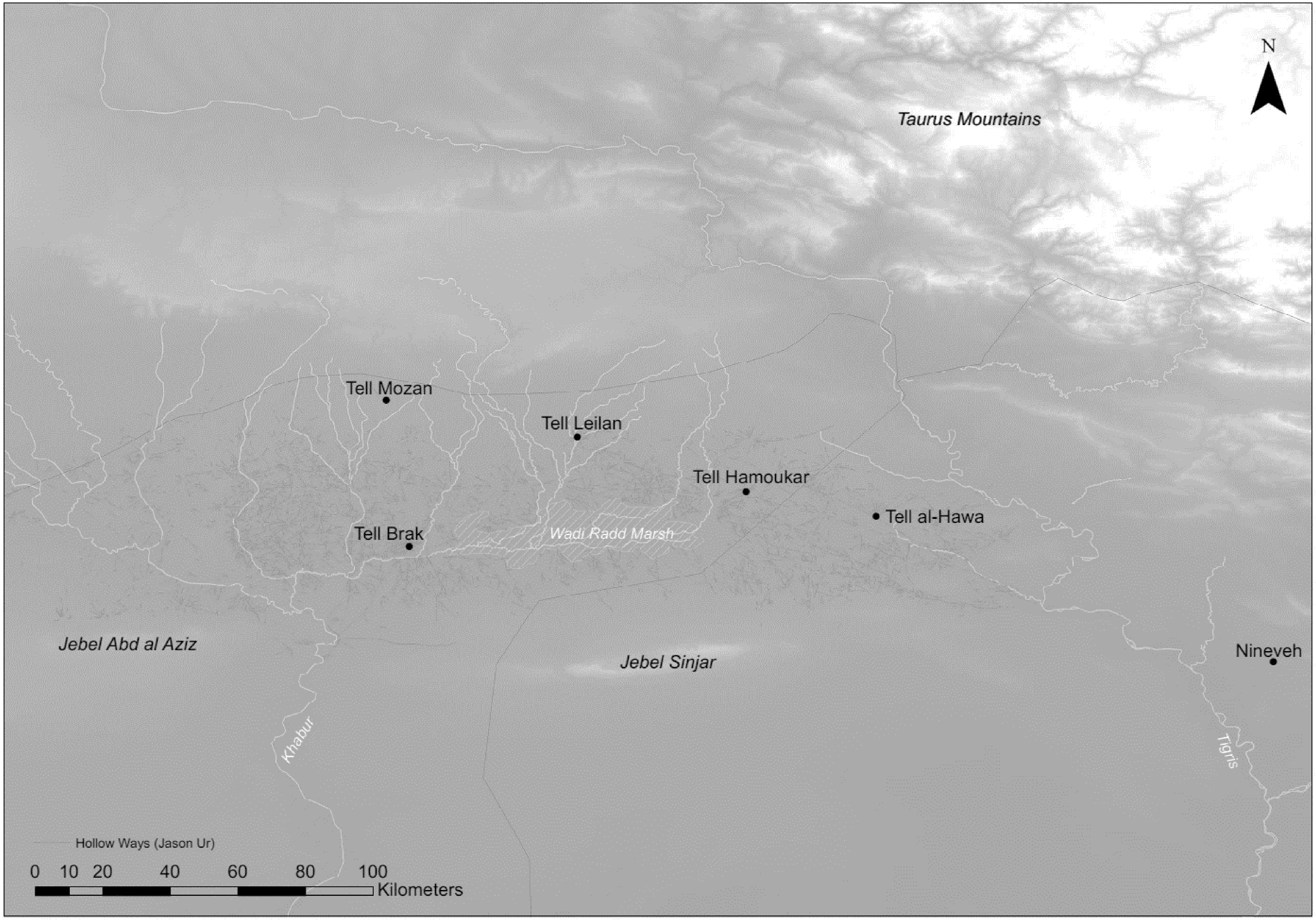

Figure 1.3 The locations of important centres mentioned in the text.

Chapter 1: Introduction

'Although movement through already established routes is often unconscious, circulation through most space involves decision making (consideration of slope, natural obstacles, least resistance, and other physical contingencies of movement), negotiation (where you can and cannot go because of neighbours, land tenure, and other social contingencies of movement), and meaning (the aesthetics, symbolism, ideology, metaphor, and other interpretations of movement).'
- Clark Erickson (2009, 207)

'Movement is an essential part of our lived experience. The discussions of mobility that see individuals as independent of their social and political worlds ignore the richness of the mobility experience; the power relations, meanings, embodiments, and effects of mobility. Culture, society, and ideologies have been constructed through mobilities and it underpins and informs the way we see the world'
- Jim Leary (2014, 16)

'The challenge for archaeology is to develop new methods for examining travel and communication and to problematize and refine theoretical frameworks.'
- Andrew Reynolds (2011, 344)

1.1 Research Aims

The aim of this thesis is to introduce quantitative methods for analysing preserved routes and, through these methods, shed new light on the nature of the Uruk Expansion in the North Jazira region of Northern Mesopotamia. The nature of the Uruk Expansion, as it is currently known, will be introduced after an overview of the specific research objectives and research questions. After, it will be explained why studying routes should be able to shed new light on the nature of the Uruk Expansion. Then, an introduction is provided to the routes preserved archaeologically across Northern Mesopotamia. This is followed by an introduction to the North Jazira region of Northern Mesopotamia and the specific routes preserved in the region.

1.2 Research Objectives

The objectives of this thesis are:

1. to learn what variables were important to travellers of the hollow ways in the North Jazira
2. to discover how travel changed during and after the Uruk Expansion

3. to learn more about the nature of the Uruk Expansion in the North Jazira through a diachronic examination of movement and mobility before, during, and after the phenomenon.

1.3 Research Questions

The research questions are closely tied to the aim and objectives. They are:

1. What do we know about the Uruk Expansion in the North Jazira, specifically?
2. How would people have travelled during this time period?
    a. Were donkeys domesticated or used as domesticates in the fourth millennium B.C.?
    b. If so, what would a fourth millennium donkey caravan look like?
3. What is a least cost path? What is optimal?
    a. Can humans travel optimally? If we can, do we travel optimally or are we satisfied as a species with 'good enough'?
4. How can route models be compared quantitatively to preserved/known routes on the ground?
    a. What variables are important to consider when constructing a route model?
    b. How can additional terrain coefficients, necessary for factoring land cover, be calculated? How can velocity-based terrain coefficients be calculated? (No one calculated velocity-based terrain coefficients before.)
    c. How can we reconstruct land cover for time periods prior to the present climate?
5. What variables were important to travellers choosing routes across the North Jazira during the early fourth, late fourth, and early third millennia B.C.?
    a. Easiest?
    b. Fastest?
    c. Shortest?
    d. A combination of the above?
    e. None of the above?

6. Since the Uruk Expansion is based on interaction and long distance exchange, what can the routes upon which that interaction and long distance exchange took place tell us about the Uruk Expansion?

1.4 The Uruk Expansion

The term "Uruk Expansion" refers to the expansion of material culture items derived from southern Mesopotamia (then in the Uruk Period) into western Iran and Northern Mesopotamia during the fourth millennium B.C.; particularly, a repertoire of ceramics and cylinder seals, which is frequently taken to indicate the spread of either people, or an economic network of Southern Mesopotamian origin (Algaze 1993; Algaze 2005; Algaze 2008). The distribution of this material has been a subject of research since the 1970s (Johnson 1973; Adams and Nissen 1972; Wright 1969). In 1989, Schwartz (1989, 283) summed up the picture to date by arguing that there were four types of sites in Northern Mesopotamia (and both the Central Zagros and Susiana Plains regions could be included in this description): '(1) "colonies" with complete southern assemblages, (2) sites with a substantial portion of southern material culture, but also with local material culture, (3) sites with primarily local, but some southern material culture, and (4) sites with only local material culture'. That same year, however, an important paradigm shift occurred in research of this expansion of southern Uruk material culture.

1.4.1 The Uruk Expansion and World Systems Theory

In 1989, Algaze (1989a, 1989b) described the Uruk Expansion in terms of World Systems Theory, a complex socio-economic theory developed by Immanuel Wallerstein (1974) fifteen years earlier. The aim of Wallerstein in creating this theory was to describe and understand the late 20th century world economic system by tracing its development over the course of four chronologically-ordered volumes starting with 16th century Europe in the first volume titled, *Capitalist Agriculture and the Origins of the European World-Economy in the Sixteenth Century*. In this work, Wallerstein differentiated between a world system and a world economy. Generally, a world economy is a term that describes a spatial economic (rather than political) unit that is larger than any political unit (nation state, city state, etc.), consisting of a core and the core's peripheral regions (Wallerstein 1974, 15–21, 349). While Wallerstein listed examples of past world economies that 'transformed into empires' (China, Persia, and Rome), he argued that the first true world system did not begin until the 20th century A.D. (Wallerstein 1974, 16–17). The modern world system is a socio-economic system (Wallerstein says it is a social system), rather than a strictly economic one (Wallerstein 1974, 351). It is truly global and reinforced through consolidated class systems and what Wallerstein calls 'status groups'[1] that extend beyond political boundaries and are reinforced by the economic conditions, resulting in a more stable system that does not either collapse or transform into a political empire (Wallerstein 1974, 351–57).

Algaze (1989, 1993, 2008) argued that the first world system occurred much earlier, writing in his original article on the subject that:

> 'The expansion of Uruk societies bears some resemblance to the colonial expansion of European societies into less developed areas of the Third World. The Uruk phenomenon may be characterized as an early instance of an "informal empire" or "world system" based on asymmetrical exchange and a hierarchically organized international division of labor that differs from modern examples only by degree' (1989, 571).

This resemblance of the Uruk world system to later time periods requires a very simplified version of world system theory that is reduced to the unequal or asymmetrical trade between a core and its relatively underdeveloped periphery for necessary items, including those needed to maintain the existing socio-political structure of the core and the legitimacy of elite residing in that core (Algaze 1993, 7–9; Algaze 2005, 7–9)[2]. Herein lies a central contrast between Algaze and Wallerstein: their interpretation of the words "need" and "necessity" that for Wallerstein (1974) is

[1] For example, international bankers, but also farmers and many others that identify and unite with each other independent of political boundaries (Wallerstein 1974, 352-53).

[2] In fact, Algaze (1993, 7; 2005, 7) criticizes Wallerstein, writing: 'Perhaps the most important [crucial point] is that Wallerstein does not recognize that the processes of asymmetrical exchange and cross-cultural interdependence that he documents for areas of the Third World transformed by modern European imperialism apply also to earlier periods and non-Western peoples (Chase-Dunn and Hall 1991; Kohl 1979; Schneider 1977).' Algaze then argues that 'Wallerstein (1974, 20-21) establishes a dichotomy between what to him is largely immaterial ancient exchange based principally in "preciosities" and what he considers to have been profoundly destabilizing modern trade founded on bulk staples, bullion, and other essentials' (1993, 7-8, 2005, 7-8).

better described as what is required to provide food, water, and shelter for the masses. When the exchange of goods is cut off, everyone suffers, not just the elite. This central tenet of World Systems Theory is made extremely clear in an explanation of why Poland is considered to be a part of the European world-economy (note: not world system) in the 16th century A.D. as a periphery, but Russia is considered its own world-economy (including both core and periphery), despite the presence of trade between Russia and Europe.

Poland is a periphery of the European world-economy due to the nature of its trade with western Europe and its dependency, as a nation, on that trade:

> ‘The rise of a Polish wheat-exporting economy meant, as we have seen, the rise of large domains with coerced cash-crop labor. It meant also the rise of the political strength of the *nobility*, whose economic interest in removing obstacles to trade matched that of western European merchants. Their combined efforts maintained Poland as an open economy. How dependent the prosperity of the Polish nobility was on this open trade was clearly illustrated by the economic difficulties provoked by the blockade of the Vistula by Gustavus Adolphus of Sweden between 1626-1629, who sought thereby to “cut the nerve” of Poland. The fact that “cereal export via the Baltic ports had rapidly taken on [in Poland] proportions such that it dominated the entire economic structure of the country is used by Jerzy Topolski then to explain the devastating effects of seventeenth-century regression in Poland, effects that varied in different parts of Poland according to the degree to which to the local economy was export-oriented.
>
> It may be objected that the value of the wheat involved is rather small as a proportion of the total product of the European world-economy, but Boris Porchnev replies that “it is not the quantities of merchandise exported (not too great in point of fact) which ought to be the object of the attention of scholars, but rather the rate of profit which was shared between the merchant middlemen and the landed proprietors exploiting the labor of the serfs.” And Stanislaw Hoszowski points out that in the overall inflation of the sixteenth century, not only did Polish prices start to rise even before those of western of

> central Europe, before the impact of American treasure on prices, but also, within Poland, it was the "landed proprietors who obtain(ed) the maximum benefit of [the rise in prices] while peasants and the townsmen only los(t) by it." The counter part of this economic squeeze of the peasants was the frequency of peasant revolts' (Wallerstein 1974, 304–5).

Meanwhile, Russia is in a very different position – despite also being a trading partner of western Europe at the time:

> But what about Russian trade with the West? Did it not parallel Polish trade? …It is true, on first glance, that what was happening in the sixteenth century was that "in her trade with the West, Russia exchanged raw materials and semi-finished goods for manufactured wares." Russia exported various raw materials used for naval stores (flax, hemp, grease, wax) plus furs and imported luxury articles and metal goods (including munitions). But in neither direction does it seem the trade was critical. For western Europe, not until the seventeenth century could it be said that Russia was important as a "reservoir of grain and forest products." T.S. Willan sees Russia's chief value for England, the western country with which Russia traded most in the sixteenth century, "as a source of essential materials for the navy." But he adds: "It is a little difficult to say whether the trade was equally valuable for the Russians. Their equivalent for the naval stores exported to England was perhaps the arms and munitions which the company was alleged to be sending to Russia, especially in the 'fifties' and the 'sixties.'" …A.Attman suggests that the crucial import was not the metal goods but rather silver in form of bullion and of art objects. He offers as verification of this hypothesis the extraordinary accumulation of silver in the churches, monasteries and palaces as well as important finds of metal bars. If one remembers that a major export was that of furs, "then the livery of dignity and wealth," one of the so-called "rich trades," we can consider the major portion of Russian-Western trade in the sixteenth century to be an exchange of preciosities, a method of consuming surplus rather than producing it, hence dispensable at moments of contraction, and consequently not central to the functioning of the economic system. **This is not to say it was**

> **unimportant. Middlemen profited by it. No doubt the state obtained some customs revenue from it. No doubt also it reinforced the system of social prestige accumulation. The point however is that if a blockade had occurred equivalent to that of Gustavus Adolphus of the Vistula in 1626, the impact on Russia's internal economy would have been far less than on Poland's**' (Wallerstein 1974, 306–7, bolded emphasis added).

Compare this to Algaze (1993, 7-8, 2005, 7-8):

> 'Concerning trade, Wallerstein (1974:20-21) establishes a dichotomy between what to him is largely immaterial ancient exchange based in 'precocities' and what he considers to have been profoundly destabilizing modern trade founded on bulk staples, bullion, and other essentials. However, this dichotomy is both false and irrelevant. It is false because, initially at least, the economic impetus for the early European voyages of discovery was not provided by demand for staples, but by the appetite of increasingly affluent European elites for exotic commodities, such as spices, sugar, and precious metals (Scammell 1989: 53). And while some of these commodities (e.g., sugar) were eventually transformed into staples (Mintz 1985), that transformation was itself a consequence of the expansion. Moreover, early exchange was by no means limited to what Wallerstein would categorize as precocities. In the case of ancient Mesopotamian civilization, for instance, evidence derived from archaeological and textual sources indicates that imports historically consisted not only of "luxuries" for elite consumption, but also of commodities such as copper and wood that must by all accounts be considered essential to the maintenance of complex social organizations in the resource-impoverished alluvial environment of southern Iraq…'

Algaze (1993, 8, 2005, 8) complained that 'Wallerstein's definitions are unnecessarily restrictive.' Nonetheless, as already seen with the contrast between Poland and Russia, in World Systems Theory, the presence or absence of trade in items, precious or bulk, is not what qualifies a nation's inclusion within a world economy, it is the nature of that trade and how central it is to the internal economy of the nation in question (Poland vs. Russia).

Regardless of its adherence to the original World Systems Theory, this entirely new paradigm through which to understand the Uruk Expansion, has shaped and influenced research of the Uruk Period ever since.

Almost immediately, the idea of an Uruk World System was critiqued, most notably by Stein (1990a) who argued alongside Wattenmaker in the very next issue of *Current Anthropology* that:

> 'Clearly, interregional exchange with Syria, Anatolia, and Iran has played an important role in Mesopotamian history, but it cannot be seen as more significant than endogenous factors in the maintenance and collapse of Mesopotamian complex societies…One can argue that […] internal dynamics structured the organization of long-distance trade rather than vice versa' (Stein and Wattenmaker 1990a, 66).

Nonetheless, Algaze expanded his theory soon after with the now classic book *The Uruk World System*, which has since been updated in a second edition (Algaze 1993; Algaze 2005). After its publication, others also engaged with and critiqued Algaze's world system paradigm.

Joan Oates (1993) agreed that locations like Habuba Kabira, which have southern assemblages and are located at strategic route locations, can be viewed as established trading settlements, but 'in [other] situations where local polities already control developed networks' she supported the trade diaspora model developed by Curtin (1984) rather than Algaze's (1989, 1993) world system. She also acknowledged the similarities in ceramic styles across northern Mesopotamia from Kurban Höyük to Nineveh as evidence for 'widespread northern social and economic interactions' (J. Oates 1993, 415). Four years later, Oates and Oates (1997) together argued, largely based on their excavations at Tell Brak, for the independent development of cities and complexity in northern Mesopotamia that was not dependent on contact with the south.

Meanwhile, Henrickson (1994) examined patterns in the Central Zagros and, similarly, found a correlation between sites with southern assemblages and strategic route locations. Like Oates, Henrickson (1994) found a different explanation for the presence of Southern Mesopotamian assemblages other than colonies. She argued the number of southern Uruk people present relative to the local population would have entailed a more equal economic arrangement, citing Algaze's (1989, 591) own description of the situation at Godin Tepe where he envisioned 'a group of commercial specialists settled as aliens with their hosts' approval in a foreign community' and further described how 'these lowland strangers would have had to reach a clear "understanding" quickly with the local village leadership' (Henrickson 1994, 95). The southern Mesopotamians did not colonize the area and take control of the local copper mines, they simply positioned themselves strategically along the routes where they could obtain such resources (Henrickson 1994, 95–98).

One thing that has not changed since Algaze's influential (1989) publication, however, is the accuracy of Schwartz's (1989) four types of site in the area of expansion outside the southern Mesopotamian alluvium. This is despite another important development in the mid-1990s, which distinguished the local, Northern Mesopotamian ceramic chronology and defined what is now commonly known as the Sante Fe Chronology consisting of the Late Chalcolithic periods (LC 1 to 5)(Rothman 2001b). Prior to this chronology, it was impossible for researchers conducting surveys to distinguish the local ceramics dated to before the Uruk Expansion from the local ceramics of the later fourth millennium B.C.

1.4.2 The Uruk Expansion after the Sante Fe Chronology

Since the defining of this new chronology, evidence has gradually shifted to support a more diverse picture of how the Uruk Expansion was manifest in different regions beyond the southern alluvium (Stein 1999a; Stein 1999b; Frangipane 1997; Rothman 2001b).

Stein, for example, followed up his initial critique of Algaze's application of World Systems Theory with multiple publications arguing that the expansion of Southern Mesopotamian (Uruk) material culture represents the presence of trade diasporas as exemplified by compelling evidence from Hacinebi Tepe in Anatolia (Stein et al. 1996;

Stein 1999a; see also Pearce 1999). Meanwhile, Frangipane (1997), working at Arslantepe further north in Anatolia, has argued that the presence of southern material culture at the site represents emulation by local elites of the southern Mesopotamians whom they encountered as trade partners.

Stein's direct critique of the application of World Systems Theory to the Uruk Period of Mesopotamia culminated in the publication of the book *Rethinking World Systems* (Stein 1999b). Arguing for a balance between internal development and external influence, Stein critiqued the World Systems paradigm that evolved, writing that:

> 'Core-controlled exchange networks of the world-system variety are just one in a range of possible economic and political relations between two different regions. The extent to which a core area can influence the development of other polities is mediated by such factors as transportation economics, technological differences, the organization of production, and the balance of military power between the core and the periphery' (Stein 1999b, 4).

Wallerstein (1974) would almost certainly agree, after all he does not deny the existence of other core-periphery type models prior to the world system, and even outlines pre-world system models through time starting with the 16th century A.D. and continuing on through later centuries in additional volumes (Wallerstein 1980; Wallerstein 1988; Wallerstein 2011).

As alternatives to the world system paradigm, Stein (1999b) suggested, like Oates (1993) before, trade diasporas and, additionally, distance-parity models. The distance-parity model is based on the simple principle that 'power decays with distance' (Stein 1999b, 61). The exact distance and rate at which power decays will be dependent on many factors, but it cannot be assumed that a core's influence on its surrounding periphery is sufficient to ensure that the peripheral region develops a dependence (like Poland) on the core. The degree of influence the core has on the periphery will be dependent on the relative development of both regions and the distance between them (Stein 1999b, 62). However, the sociocultural complexity of the core is described as more developed than that of the periphery (Stein 1999b, 62). The specific model by Stein (1999b, 62) is described as follows:

> ‘Under conditions of technological and demographic parity between two regions at different levels of sociocultural complexity, the power of the more developed (“core”) region to control its “periphery” will decay with distance, leading to the following:
>
> 1. A decline in core control over interregional exchange, causing a shift from asymmetric to increasingly symmetric conditions of exchange between the two areas.
> 2. A progressive reduction in the importance of long-distance exchange relative to local exchange and subsistence production in the political economy of the periphery.
> 3. A progressive reduction in the exchange of bulk goods relative to the proportion of prestige goods due to the latter’s high ratio of value to bulk/weight.
> 4. A progressive reduction in economic pressures/incentives toward the specialized production of surplus craft or subsistence goods for export.
> 5. A progressive restriction of core influence to peripheral elites, rather than the peripheral population as a whole.
> 6. Increasing restriction of the ability of the core to use its military, economic, and political influence in the periphery….
> 7. A progressive decline in the degree to which interregional interaction affects the organization and development of political systems in the periphery’ (Stein 1999b, 62).

Since the Sante Fe chronology and many intervening publications, Algaze has revised his initial arguments about the nature of the Uruk Expansion, particularly in reaction to the new evidence from Northern Mesopotamia at sites like Hacinebi Tepe and Arslantepe (rather than the southern alluvium or the Zagros and plains to the east of the alluvium). In the second edition of *The Uruk World System*, Algaze (2005) added a new chapter for the specific purpose of addressing areas where his ‘earlier interpretations need to be expanded, modified, or reconsidered altogether’ (Algaze

2005, ix). Mainly, considering the evidence since the first edition, Algaze acknowledged that 'until the onset of the fourth millennium B.C. southern Mesopotamia was but one of several competing regions across the ancient Near East where parallel strides toward complexity were taking place' (Algaze 2005, ix).

Nonetheless, Algaze (2005) maintained his view that Southern Mesopotamia is superior in development. In the very next sentence after he acknowledged the complexity present in other regions, he wrote: 'This makes the emergence of multiple competing city-states across southern Mesopotamia in the fourth millennium all the more noteworthy, as this was the first time that the southern polities, both singly and in the aggregate, surpassed contemporary societies elsewhere in southwest Asia in terms of their scale and degree of internal differentiation, both social and economic' (Algaze 2005, ix). Therefore, the world system theoretical paradigm is kept with the south as the core and surrounding regions as the periphery.

The spatial variability in the nature of the Uruk Expansion is also increasingly recognized, though the significance of distance as a factor in the nature of the Uruk Expansion has been long argued for by Stein (1999b). **Figure 1.4** maps the locations from which different interpretations of the nature of the Uruk Expansion are derived.

Additionally, Algaze (2008, 68-70) has described a two-phase expansion to the Uruk Expansion. In the first phase, small trading diasporas expanded outwards to the peripheries seeking profits potentially as independent agents belonging to trading families. In the second phase, existing centres in the periphery (Algaze specifically notes Tell Brak and Tell Hamoukar in the North Jazira) were taken 'possibly by coercive means' (Algaze 2008, 68). This Algaze (2008) supported with evidence from excavation at one of Tell Brak's satellite sites, Tell Majnuna, where mass graves of individuals, mainly adolescents and young adults, were found (see McMahon, Sołtysiak, and Weber 2011). Based largely on the age profiles of the individuals buried and evidence suggesting they were buried at the same time within weeks of death, it is hypothesized that they died as a result of conflict (McMahon, Sołtysiak, and Weber 2011). In addition, throughout the expansion area urban sites were established in strategic locations where no previous site existed – Habuba Kabira and Jebel Aruda (Algaze 2008, 69–70).

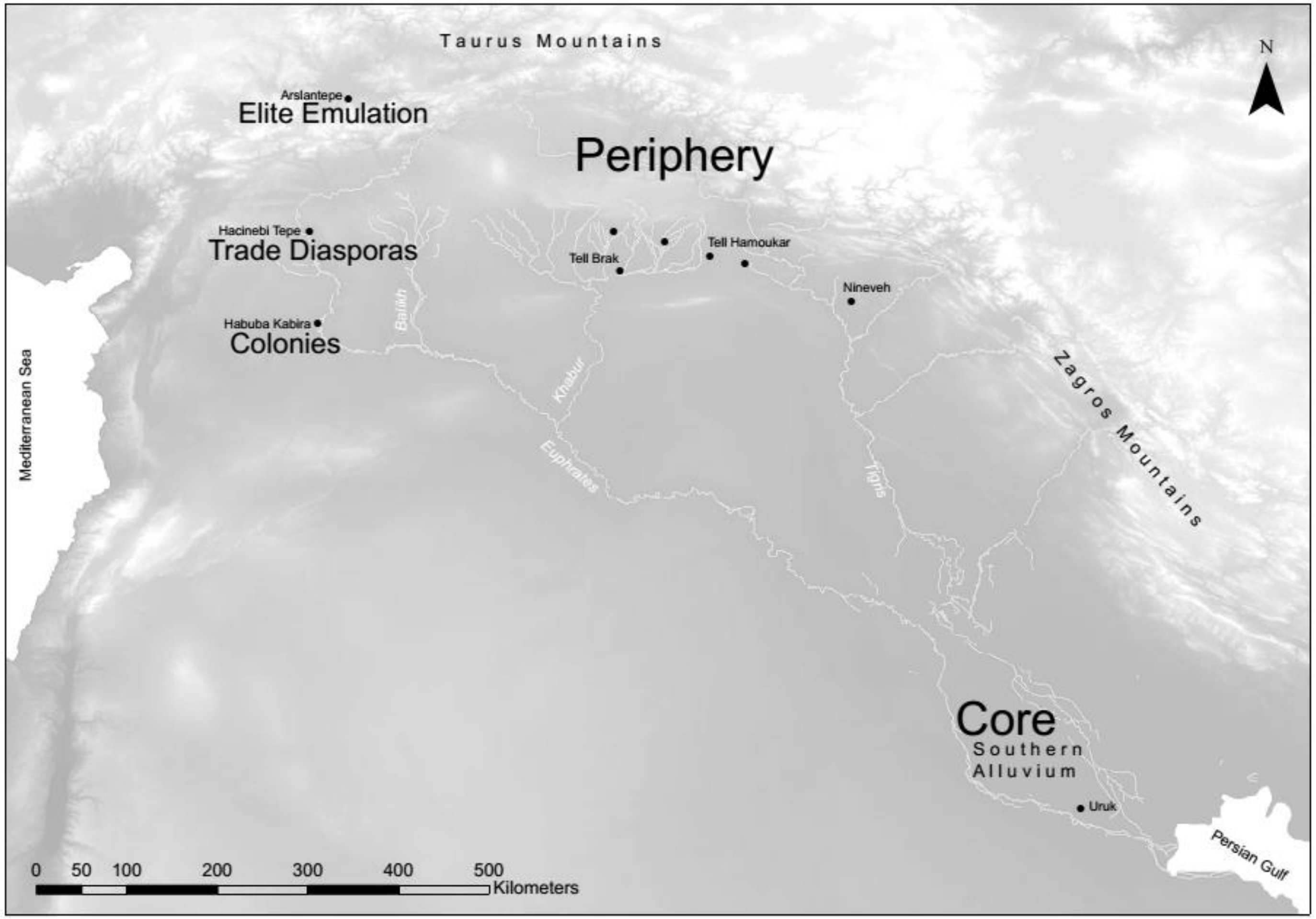

Figure 1.4 Interpretations about the nature of the Uruk Expansion mapped spatially.

Still, the nature of the Uruk Expansion remains the subject of discussion and debate. In 2016, an issue of *Journal of Archaeological Science Reports* (vol. 7) contained multiple articles presenting the latest research into the nature of the Uruk Expansion through analysis of various artefacts. The results of these different research projects demonstrate that locals were making southern Mesopotamian forms at many sites, not just Arslantepe (Frangipane 1997; Wright 2016; Minc and Emberling 2016). In fact, most of the southern wares found outside southern Mesopotamia appears to have been locally produced, based on evidence from trace-element and isotopic characterization (Wright 2016; Minc and Emberling 2016). This alone is interesting, but requires more investigation. Local production could be interpreted as local emulation/adoption of Southern Mesopotamian types, or production due to demand by a local Southern diaspora population.

The research thus far on the Uruk Expansion has focussed on the nature of the relationship between Southern Mesopotamian city states and the polities in the "periphery" (Northern Mesopotamia and western Iran): whether there were colonies, whether there were trade diasporas, and whether the Southern Mesopotamian material culture signifies the import of these products (either via exchange or via Southern Mesopotamians bringing familiar items with them) or whether the Southern Mesopotamian material culture merely represents emulation by local populations. This has been approached through excavation, settlement patterning, material/artefact studies, but never through a study of the preserved routes themselves.

1.5 Why Examine the Uruk Expansion through its Routes?

Throughout this ongoing debate and the developing evidence, two constants remain: long distance trade is at the centre of the Uruk Expansion and sites with higher proportions of southern material culture tend to be located strategically along routes. It follows, then, that a useful source of evidence for learning about the phenomenon would be the routes people travelled in order to interact, including both the navigable rivers and the hollow ways preserved across Northern Mesopotamia that were eroded into the earth by those who engaged in long distance trade and interaction.

1.5.1 Extracting Behaviour from Footprints

Unpaved overland routes, as existed in the fourth and third millennia B.C. in Northern Mesopotamia, created by innumerable footprints (and hoofprints) eroding the earth, can be viewed as trace fossils: a term normally applied in palaeontology to preserved tracks or footprints of dinosaurs and other animals. In palaeontology, these tracks are valuable for the information they store about the individuals who created them, including heights estimated based on proportions,[3] and relative speed.[4]

In Britain, where Mesolithic footprints are exposed by waves along the coasts, archaeologists conduct analyses similar to those of palaeontologists studying tracks and, through these analyses, can provide height and actual speed estimates. Additionally, it is possible to reconstruct behaviours of the individuals who created the tracks from the shapes of the paths formed by the footprints.

The introduction to *Past Mobilities* begins with such a behavioural description of individuals from Mesolithic footprints along the British coastline excavated by Roberts, Gonzalez, and Huddart (1996):

> 'On a warm summer's day, four young adults set off along the edge of an estuary foreshore. They walk alongside one another heading southeast. With every step their bare feet sink into the soft estuarine mud which squeezes and squelches as they move. They stride at a brisk pace. At one stage, one of them sees something and veers left, crossing the paths of the others and causing them to momentarily bunch together before spreading out once more. Four lines of flow: weaving, interacting and mingling together…Nearby a child of three or four plays with someone a few years older; perhaps a sibling. The younger of the two playfully, absent-mindedly, dances around the other leaving noticeably deeper traces in the ground. Elsewhere a person steps out across the estuary in a straight line heading west. They walk at a steady pace,

[3] In exactly the same manner archaeologists estimate the heights of individuals who walked along the British coast during the Mesolithic from their preserved footprints.

[4] Relative speed differs from speed in that it only informs about which animal was faster or slower, not the actual kilometres per hour or miles per hour of the individual.

> despite sliding twice in the mud, and halt momentarily, feet side-by-side, before continuing' (Leary 2014, 1).

Likewise, Robert Macfarlane (2013, 359) described a different set of Mesolithic footprints uncovered by waves on the sands of another British beach:

> '…two sets of prints, walking northwards. A man and a woman companionably close, moving together, shore-parallel, at around four miles per hour: journeying, not foraging. This much we know: that the man was around 6'3" tall, and the woman just under a foot shorter…That red deer and roe deer were also out, moving over the intertidal silts, leaving their crisp slots. And that children were there too, a group of children, playing together, mud-larking, making a gaggle of small footprints.'

The ages (child vs. adult), heights, and speeds of the individuals of Mesolithic footprints can be calculated by analogy to modern humans based on foot size and stride length (see, for example, G. Roberts, Gonzalez, and Huddart 1996). However, it is the shape of the paths formed by the footprints that enable interpretations of movement: the linear path of the adults versus the 'gaggle' of footprints from the children. The origin and destination of these paths would be informative, but it is through examining the shapes of the paths themselves that the nature of past mobility is accessed.

The same logic (that the shapes of paths inform about the behaviour of the people who created them) can be applied to the hollow way routes preserved across northern Mesopotamia, enabling them to shed light on the variables that guided the people who travelled them. Unlike the British Mesolithic footprints, the hollow ways are the manifestation of many individuals whose individual footprints are indistinguishable, so analysis of their shapes will examine the travel practices of the populations who walked along the hollow ways and thus societal-scale behaviours. This idea that the shapes of paths can inform about the nature of travel is scalable to a population level, because travel and route choice are cultural practices.

1.5.2 Travel and Route Choice as Cultural Practices

In modern, western culture time is a valued and finite commodity. Our language reflects this with common phrases. We can 'use time wisely', 'waste time', and even ‘run out of time.’ It is known ‘we only have so much time on this planet’, ‘life is short’, and this is a justification for not ‘wasting time’ on mundane tasks like commuting. ‘Wasting time’ doing anything is doubly important to avoid when conducting business in modern western society, because ‘time is money.’ Fortunately, navigation systems are now a common feature of cars to aid people in travelling the fastest routes accounting for distance, speed limits, traffic, and other variables. For those without navigation systems, there are websites like Google Maps, which automatically identify the fastest routes for people whether they are driving, taking public transport, walking, or cycling. If an archaeologist in the future were to examine our routes, they would easily see our preoccupation (as a population) with saving time, even if we sometimes choose more leisurely routes on weekends, holidays, and vacations. Many modern western cultures have terms and stereotypes for these phenomena, too: “Sunday driver”, “old man in a hat”, “grandma”, and “bloody tourists” to name a few. Nonetheless, it would be incorrect to assume that people in all cultures for all time share(d) this same preoccupation with time or even the concept of time as a finite resource.

For example, the Hopi of North America have a very different traditional view of time where past, present, and future are all happening now (Whorf 1950). It is for this reason that they have no tenses in their language to distinguish past from present or present from future, nor any words for ‘past’, ‘present’, ‘future’, or even ‘time’ (Whorf 1950). Rather, to borrow an analogy from Marcel Danesi (2003), for the Hopi space and time on Earth is much like modern astrophysicists conceive of it for the distant universe: connected. When looking out into space and observing a supernova, the astrophysicist knows that the supernova is so many light years away (a measure of distance in a unit that describes how far light travels during a year), and therefore the supernova is both far away and long ago. The light is only just reaching us on Earth now. Likewise, for the Hopi:

> ‘What happens at a distant village, if actual (objective) and not a conjecture (subjective) can be known *here* only later. If it does not happen *at this place* it does not happen *at this time*; it happens at *that* place and at *that* time. Both the *here* happening and the *there* happening are in the objective,

corresponding in general to our past, but the *there* happening is the more objectively distant, meaning, from our standpoint, that it is further away in the past just as it is further away from us in space than the *here* happening' (Whorf 1950, 71).

Unsurprisingly, traditional Hopi routes are very different and journeying along them can have strong connections with the past and ancestors (for a full discussion, see Ferguson, Berlin, and Darling 2009).

Snead (2009, 44), however, was correct to highlight that physical variables like time (or physical ease) are not the only variables that might be important to a population, instead 'interpreting trails must partake equally in the structures of culture and the structures of movement, an approach that [he has] called contextual experience…context includes not only topography, architecture, and other factors of the physical environment, but also the cultural knowledge required to interpret such a setting.' In other words, 'contextual experience is a landscape archaeology of cultural traditions, an ethnogeography of the past' (Snead 2009, 44).

James Snead was not alone in this resurrection of ethnogeographical approaches to movement. In the same volume, Darling (2009, 63-64) argued that 'trails and trail systems are elements of the built environment', a social space that goes beyond physical features. Furthermore, he argued, 'networks of trails are part and product of a functioning infrastructure which relates social space to landscape' (Darling 2009, 82). Later still in the volume, Erickson (2009, 223) argued that the causeway-canals preserved in the Amazon jungle in Bolivia 'represent engineered networks for social interaction,' and the shape of these causeway-canals is important: 'the straightness and basic form imply a shared concept of a "proper" earthwork' (Erickson 2009, 229).

This idea that there is a 'proper' way to do things within a culture and that there are both structures of culture and structures of movement that come into play in the creation/use/formation of trails has links to Bourdieu's (1977) practice theory and concept of habitus.

In fact, the entire point of habitus is that our daily practice, movements, and ways of doing things, are mediated by our culture and embodied and perpetuated by ourselves (Bourdieu 1977; Bourdieu 2002, 29–39). Bourdieu (2002, 53) defined habitus as 'systems of durable, transposable dispositions, structured structures predisposed to function as structuring structures, that is, as principles which generate and organize practices and representations that can be objectively adapted to their outcomes without presupposing conscious aiming at ends or an express mastery of the operations necessary to attain them. Objectively "regulated" and "regular" without being in any way the product of obedience to rules, they can be collectively orchestrated without being the product of the organizing action of a conductor.'

In the original text introducing habitus, *Outline of a Theory of Practice*, Bourdieu (1977) provided an example of habitus within the context of walking, using his ethnographic work in the Kabylia region of Algeria as a case study:

> '…The oppositions which mythico-ritual logic makes between the male and the female and which organizes the whole system of values reappear, for example, in the gestures and movements of the body, in the form of the opposition between the straight and the bent, or between assurance and restraint. "The Kabyle is like the heather, he would rather break than bend." The man of honour's pace is steady and determined. His way of walking, that of a man who knows where he is going and knows he will arrive in time, whatever the obstacles, expresses strength and resolution, as opposed to the hesitant gait (*thikli thamahmahth*) announcing indecision, half-hearted promises (*awal amahmah*), the fear of commitments and the incapacity to fulfill them. At the same time, it is a *measured* pace: it contrasts as much with the haste of the man who "throws his feet up as high as his head", "walks along with great strides", "dances" – running between weak and frivolous conduct – as it does with the sluggishness of the man who "trails along". The manly man stands up straight and honours the person he approaches or wishes to welcome by looking him right in the eyes; ever on the alert, because ever threatened, he lets nothing that happens around him escape him, whereas a gaze that is up in the clouds or fixed on the ground is the mark of an irresponsible man, who has nothing to fear because he has no responsibilities in his group. Conversely, a woman is expected to walk with a

slight stoop, looking down, keeping her eyes on the spot where she will next put her foot, especially if she happens to have to have to walk past the *thajma'th*; her gait must avoid the excessive swing of the hips which comes from a heavy stride; she must always be girdled with the *thimeḥremth*, a rectangular piece of cloth with yellow, red, and black stripes worn over her dress, and take care that her headscarf does not come unknotted, revealing her hair. In short, the specifically feminine virtue, *laḥia*, modesty, restraint, reserve, orients the whole female body downwards, towards the ground, the inside, the house, whereas male excellence, *nif*, is asserted in movement upwards, outwards, towards other men' (Bourdieu 1977, 94).

Regardless of the currency or accuracy of this account of the specific ways culture is expressed in the movement of people in Kabylia,[5] the larger argument remains: that habitus extends to movement – that culture influences the ways people walk and travel. In this light, habitus, gives a name to the process of how walking becomes a cultural practice and is guided by larger cultural ideals. It is by the transmission of memes, to borrow Dawkin's (1976) term for a unit of cultural information, that people learn their place (even if individuals choose to misbehave) in society and the expected behaviour for someone in their place whether it is walking, the roles they take on in society, or any other facet of life.

Applying habitus to the example of modern western society, it could be argued that it is through reminders not to dally, to keep up, admonishing when we fail to complete all our errands, and constant pressures to complete more tasks in our day, that our culture ensures we are travelling fastest routes – even if on our relatively few days off (2 out of every 7 for most people) we break from this practice and enjoy other sorts of travel.

Snead (2009, 43-44) argued that 'landscapes are overwhelmingly social constructions,' but also cautions that considering informal movements [as in informal paths vs. formal paved roads] as exclusively driven by "rational" concerns such as the

[5] Reading his work (Bourdieu 1977), it appears he never actually spoke to a woman or consulted with a female colleague about the women in the culture, preferring instead to learn about them and their gendered spaces only through the lens of male informants.

minimization of cost is often to reduce it to insignificances, converting those who walk these ways into culture-free abstractions.' There is an assumption that the rational concerns are culture-free, but there are so many rational concerns a traveller could choose to prioritize and not all of them will be driven by biological needs (such as access to water). For example, not trespassing on property or enemy territory that would result in punishment or death is a rational concern for a social construction (private property). Additionally, there is no reason to assume that prioritization of physical variables is culture-free, for example, the concern in modern western culture with time as a commodity.

A final important point to consider when examining routes for population scale behaviour is the longevity of some routes. While some routes are abandoned over time, others continue to be used and useful for millennia. For example, Hoskins (1955, 236-237) described the English highway A423:

> '…which began as a prehistoric ridgeway along the watershed between the Cherwell and the Evenlode. It ran from a crossing of the Thames at or near Oxford (perhaps ultimately from the Berkshire Ridgeway) northwards to join the Jurassic Way near Banbury. There are remains of long barrows and of megalithic tombs at various points along its course. Later it was taken over and paved by the Romans from a point north of Oxford to Sturdy's Castle, where it met the east-west road of Akeman Street. Medieval charters along its course refer to it as "the ridgeway". It apparently remained in continuous use throughout medieval times; it figures as the main road from Oxford to Banbury in Ogilby's road-book (1675); it was turnpike in the eighteenth century and it still follows its original course after some three thousand years. Because it has remained in use all this time, and has been continually adapted to heavier traffic, it has lost its original character except in two respects. It still commands extensive and airy views over the valleys to the east and west, and in places its broad grass verges betray something of its original width before the road was metalled.'

An important point to consider, then, when examining a route is who shaped it and, therefore, whose route choice is being investigated?

It can be considered that if a route is no longer useful, it will fall out of use, but that a route can endure for millennia suggests that a single road can (with modification such as paving) satisfy the travel needs of multiple distinct cultures who might be hypothesized to have different travel priorities. At the same time, the phenomenon of route inertia should be acknowledged – that existing routes can be favoured over new routes unless a new route would be significantly better (see for example, Bogers et al. 2007). It also raises the possibility that multiple variables might account for a single shape and that all we may find out as archaeologists is what variables *could* have guided route choice decisions in the past. This does not, however, negate the very important ability to discover which variables *could not* have guided route choice in the past and thus narrow the range of possibilities for what was.

1.5.3 Using Routes to Learn about the Uruk Expansion

The Uruk Expansion involved the expansion of Southern Mesopotamian material culture into both Iran, across the whole of Northern Mesopotamia, and into Anatolia. Evidence from sites, such as Hacinebi Tepe, prove that individuals from Southern Mesopotamia travelled to these same regions and set up households. There is little doubt that the reason for this expansion was an effort by Southern Mesopotamian city-states to secure access to raw materials unobtainable in the southern alluvium of Iraq like timber, stone, and metal. The nature of the expansion, *how* this was achieved, however, is still debated. Nonetheless, it should be possible to use the shapes of the routes/hollow ways to learn about the behaviour of the travellers on a population scale, just as individual behaviours can be inferred from the shapes of British Mesolithic footprints.

Examining the whole of Northern Mesopotamia and even the entire alleged periphery around the supposed core of southern Mesopotamia would be useful, but beyond the scope of this thesis. Instead, with an aim to analyse the shapes of preserved routes to learn more about the nature of the Uruk Expansion, the best location to study north or east of southern Mesopotamia is the North Jazira region of Northern Mesopotamia where thousands of route segments are preserved as hollow ways.

1.6 The Hollow Way Routes of Northern Mesopotamia

Hollow ways are long linear features dozens of meters wide and up to several kilometres long. They were first recorded in the 1920s by Antoine Poidebard (1934). Initially believed to represent ancient roads or routes (Poidebard 1934; van Liere and Lauffray 1954; Buringh 1960), this was questioned in the 1990s due to the observation that the features have a tendency to radiate out from mounded tell sites in an efficient manner for drainage (McClellan and Porter 1995). Wilkinson (1990a, 1993, 2003a), Ur (2003, Ur and Wilkinson 2008), and others (Altaweel and Hauser 2004) continued to argue that these features were routes, and this was eventually proven when three of the hollow ways around Tell Brak were finally excavated that it became clear their primary formation was due to erosion from traffic (Wilkinson 2003a; Wilkinson et al. 2010).

In the modern landscape, the hollow ways have infilled after centuries or even millennia of disuse such that they are only shallow depressions much more easily observed from the air than on the ground (Ur 2009; Wilkinson et al. 2010). While the earliest observers of the features relied on aerial imagery, modern researchers make use of Cold War era CORONA satellite imagery declassified in the mid-1990s (Ur 2003; Wilkinson 2003a; Casana 2013). The hollow ways appear on imagery (aerial and satellite) as dark lines with light borders. The dark colour is due to increased moisture from captured run-off in the middle of the features, resulting in more abundant vegetation, and the light borders are from increased evaporation on the sloping sides leaving behind higher amounts of calcium carbonate (Wilkinson et al. 2010; Casana 2013; Ur 2009). The increased moisture in the middle of the hollow ways also allows for their identification using multi-spectral imagery (Altaweel 2005).

Generally, hollow ways measure 50 to 120 m wide and up to about 5 km long, but only around 50 cm deep in the centre (Wilkinson et al. 2010; Casana 2013). Jason Ur (2002) has observed that the narrower hollow ways correspond to later, Islamic sites, while the wider hollow ways – typically 70 to 120m metres wide – are older, connecting tell sites. However, Jesse Casana (2013) found that the hollow ways connecting sites tend to be narrower than those leading to fields or pasture. Additionally, Casana distinguished morphological differences between hollow way type features across different areas of Northern Mesopotamia and Southwestern Iran. In a particularly unusual case study area in the Orontes River Valley, he observed that the paths are relatively short (up to 1km), narrow (up to 15m wide), and all connect sites (Casana 2013, 263). Undoubtedly, as Casana stated, these 'roadways were produced by very different systems of settlement and land use practices' than the hollow ways in other areas of Northern Mesopotamia or Southwestern Iran.

In the North Jazira region of Northern Mesopotamia, stretching from the Khabur River in the west to the Tigris in the east, there are three length-based (rather than width-based) categories of hollow way:

1. hollow ways leading from sites to surrounding agricultural fields,
2. hollow ways leading from sites to pastures beyond the fields, which tend to simply fade out beyond the agricultural area of sites, and
3. long distance hollow ways that connect sites (Wilkinson 2003a, 111–20).

These different types of hollow way were interpreted as corresponding to the Akkadian terms *huīlu* for routes to field or pasture and *harranu* for long distance routes between sites (Wilkinson 2003a, 118–20). The long distance hollow ways are the focus of the present study, because they are the routes that provide information about inter-site interaction and have the most to offer for furthering a discussion about the Uruk Expansion that centres on interregional interaction and trade.

Tens of thousands of hollow ways have been mapped over the last decade with the aid of CORONA imagery across much of Northern Mesopotamia from the Khabur Region in the west, across Northern Syria and Northern Iraq, through Kurdistan in the east (Ur 2003).

In 1999 and 2005, the first examinations of hollow way features took place by cleaning the sections of trenches dug by the local municipality for grain storage conveniently located through three hollow ways around Tell Brak numbered 40, 50, and 61 (Wilkinson et al. 2010, 746). Hollow way 61 was sectioned first and informed the published observations made in Wilkinson's 2003 volume *Archaeological Landscapes of the Near East*, which first clarified that hollow ways are route features (Wilkinson 2003a, 111–12). Hollow ways 40 and 50 were sectioned later, and soil samples gathered from hollow way 40 allowed for micromorphological analysis of the fill layers (Wilkinson et al. 2010, 746–48).

These three 'hollow ways contained significant quantities of pottery, usually well rolled, dating back to the 3rd and 4th millennia B.C.', but at the base of hollow way 40 were sherds diagnostic of the third millennium and it is from this evidence that the oldest hollow ways have been proven to date to at least the third millennium B.C. (Wilkinson et al. 2010, 762–63). The exact age of the hollow ways depends on how long it took for the features to reach their final depths, a duration of time that will be dependent on: frequency of use, volume of traffic (including any animals), type of soil, and the frequency and strength of natural erosional processes (especially from hydrology). This uncertainty led Wilkinson et al. (2010, fig. 13) to simply place question marks next to guessed ages (4th millennium B.C.?, 5th millennium B.C.?). An experimental study local to the hollow ways is still required to evaluate the rate of erosion and provide better age estimates for the features.

1.7 The North Jazira Region of Northern Mesopotamia

1.7.1 The Location, Physical Geography, and Climate of the North Jazira

The North Jazira, as defined by Wilkinson and Tucker (1995, 12), extends from the Khabur in the west to the Tigris in the east. To the north are the foothills of the Taurus Mountains and along its southern edge are the Jebel Abd al-Aziz and Jebel Sinjar (see **figure 1.1** and **1.3**). A historically important east-west route runs through the North Jazira, connecting sites in the Tigridian plain of Northern Iraq to Western Syria where it meets the north-south route along the Euphrates leading to valuable resource locations in Anatolia and to the urban centres of Southern Mesopotamia (Barjamovic 2011, 57–61, map 7, map insert 'Map of Anatolia 1880 BC").

1.7.1.1 Topography

The North Jazira is a large flat region that forms a shallow basin (Wilkinson and Tucker 1995, 3). SRTM and ASTER digital elevation models (DEMs) reveal the basin slope to be less than three degrees (**figures 1.5** and **1.6**). (In Chapter 8, it will be shown that slopes under five degrees are qualitatively flat.) Punctuating this landscape are tell sites, mounded settlements that have increased in height over the millennia with

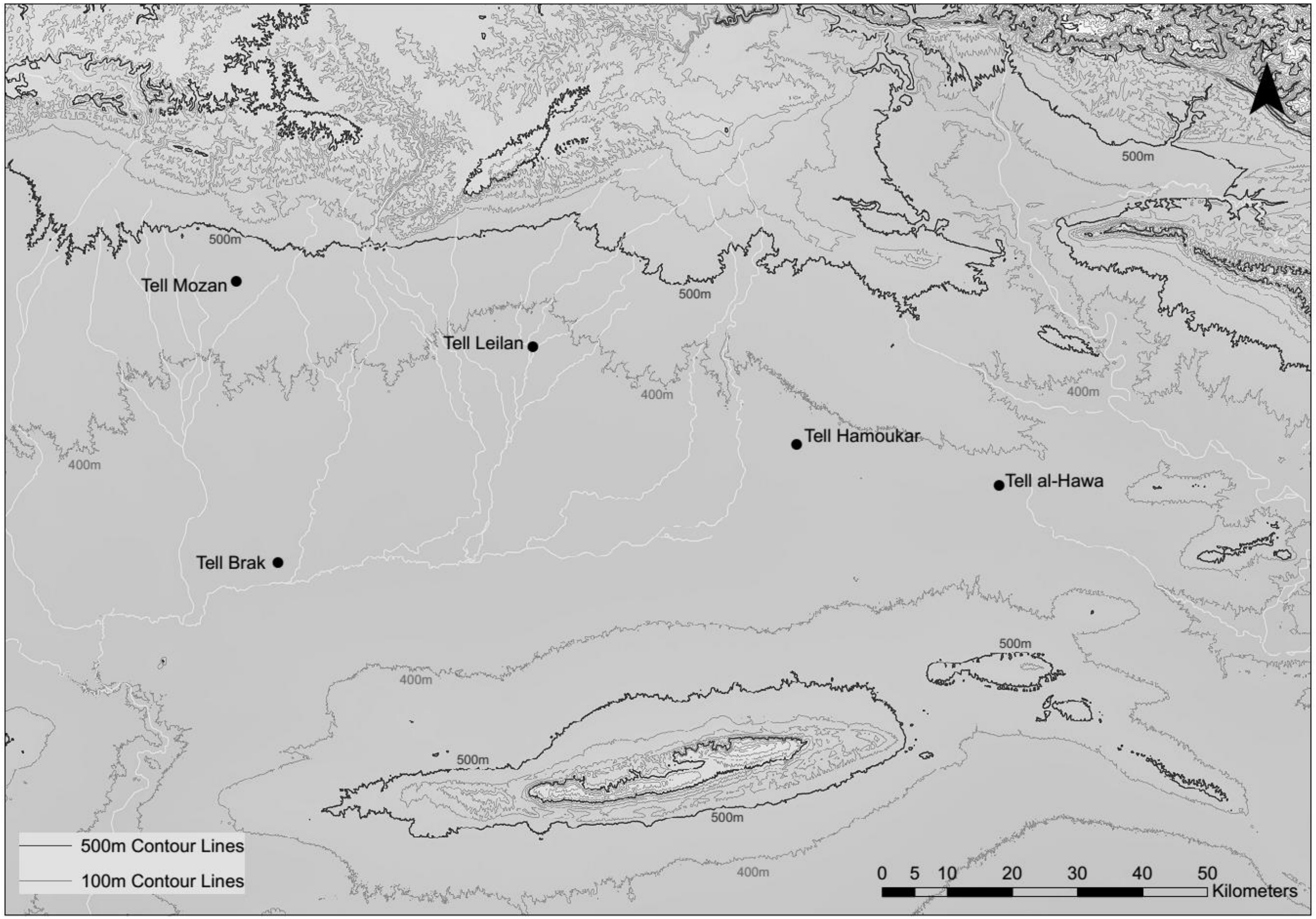

Figure 1.5 The topography of the North Jazira shown with 100m and 500m contour lines.

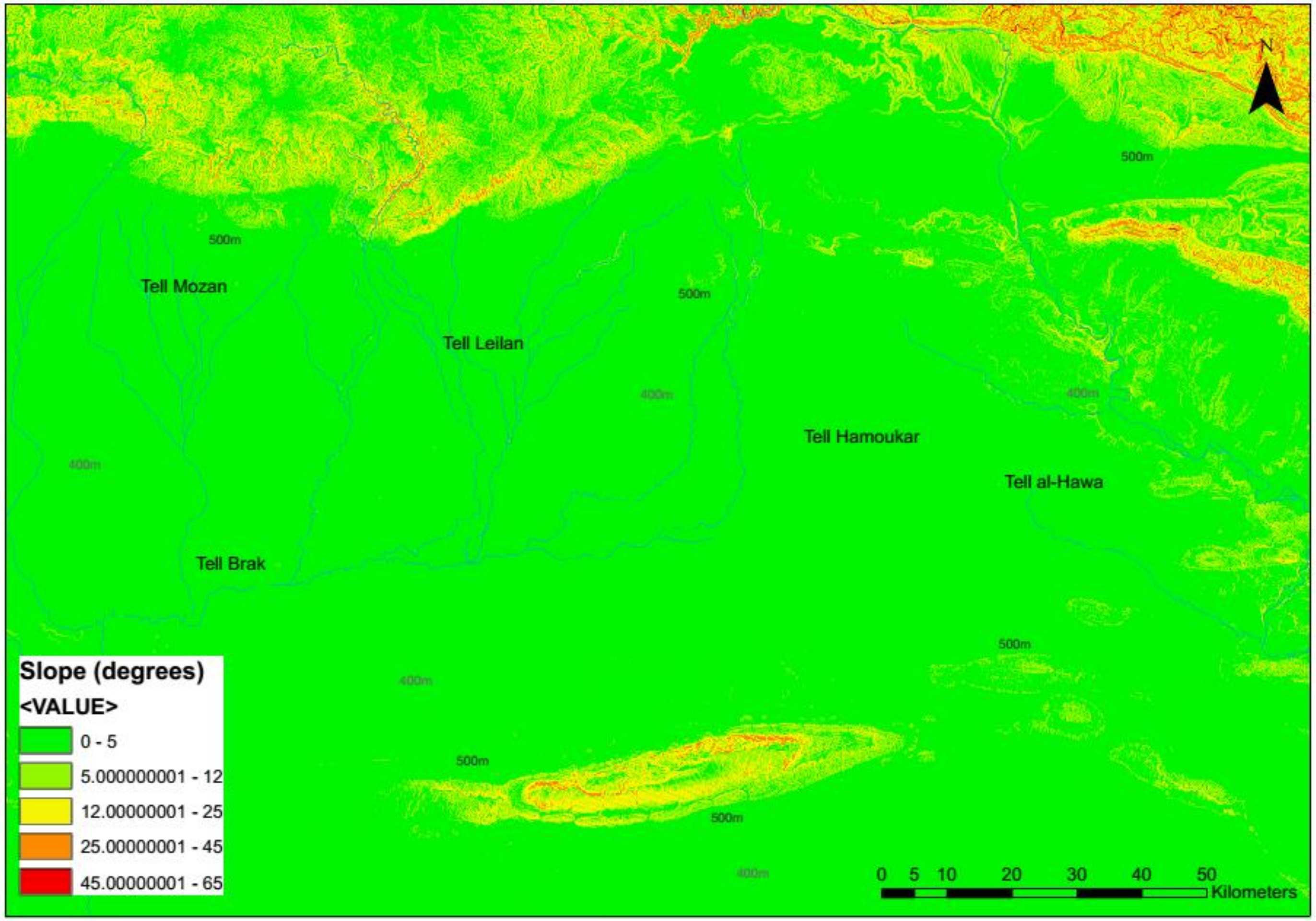

Figure 1.6 A map of the degree of slope in the North Jazira. In Chapter 8, it is shown that slopes under 5 degrees are qualitatively flat.

each successive phase of construction. Already by the fourth millennium B.C. some of the largest mounds would have been quite prominent. The 5th millennium B.C. Ubaid level at Tell Brak is described as ’12 m above the modern plough’ (Oates 1985, 178), while in 33 test trenches mid-Uruk/mid-fourth millennium B.C. levels were consistently encountered only 2-3.5 m below the surface along the edge of the main mound (Emberling et al. 1999, 16, 24). These levels suggest the tell could have been around 20 m high by the mid-fourth millennium B.C. even without factoring any elevation gain of the surrounding plain from erosion off the tells or sediment transported into the plain via wadis from the Taurus Mountains over the last 5,000-6,000 years.

1.7.1.2 Waterways

The Khabur river flows through the North Jazira and there is evidence to that both the Wadi Jaghjagh and Wadi Jarrah had higher discharge rates and were both perennial waterways between the mid-fourth and mid-third millennia B.C. (Deckers 2011; Riehl and Deckers 2007; Wilkinson 2003a, 101). The precise locations of these waterways, however, have shifted over time (Deckers 2011; Heyvaert and Baeteman 2008; Riehl and Deckers 2007; Wilkinson 2003b, 103; Verhoeven 1998; Wilkinson and Tucker 1995, 4–5). Additionally, it is important to note that while the Khabur was probably a navigable river, it is not clear whether the Wadi Jaghjagh and Wadi Jarrah were also navigable. While there would have been rivers connecting the North Jazira to the Euphrates, much of the east-west traffic between the Euphrates and Tigris rivers through the Jazira would probably have been overland.

In addition to permanent waterways, hundreds, if not thousands, of wadis act as natural watercourses during the rainy season (Hald 2008, 7). The most significant of these are the Wadi Jaghjagh and Wadi Jarrah, already mentioned, and the Wadi Radd that feeds into the Radd marshes, an extended marshy area between Tell Barri and Tell Hamoukar (see **figure 1.3**, Hald 2008, 7; Riehl and Deckers 2007, 337).

1.7.1.3 Climate

The modern North Jazira experiences a warm, arid climate with temperatures typically ranging from -10°C in the winter to 35°C in the summer (Hald 2008, 5; Wilkinson and Tucker 1995, 6). The rainy season lasts from October through April,

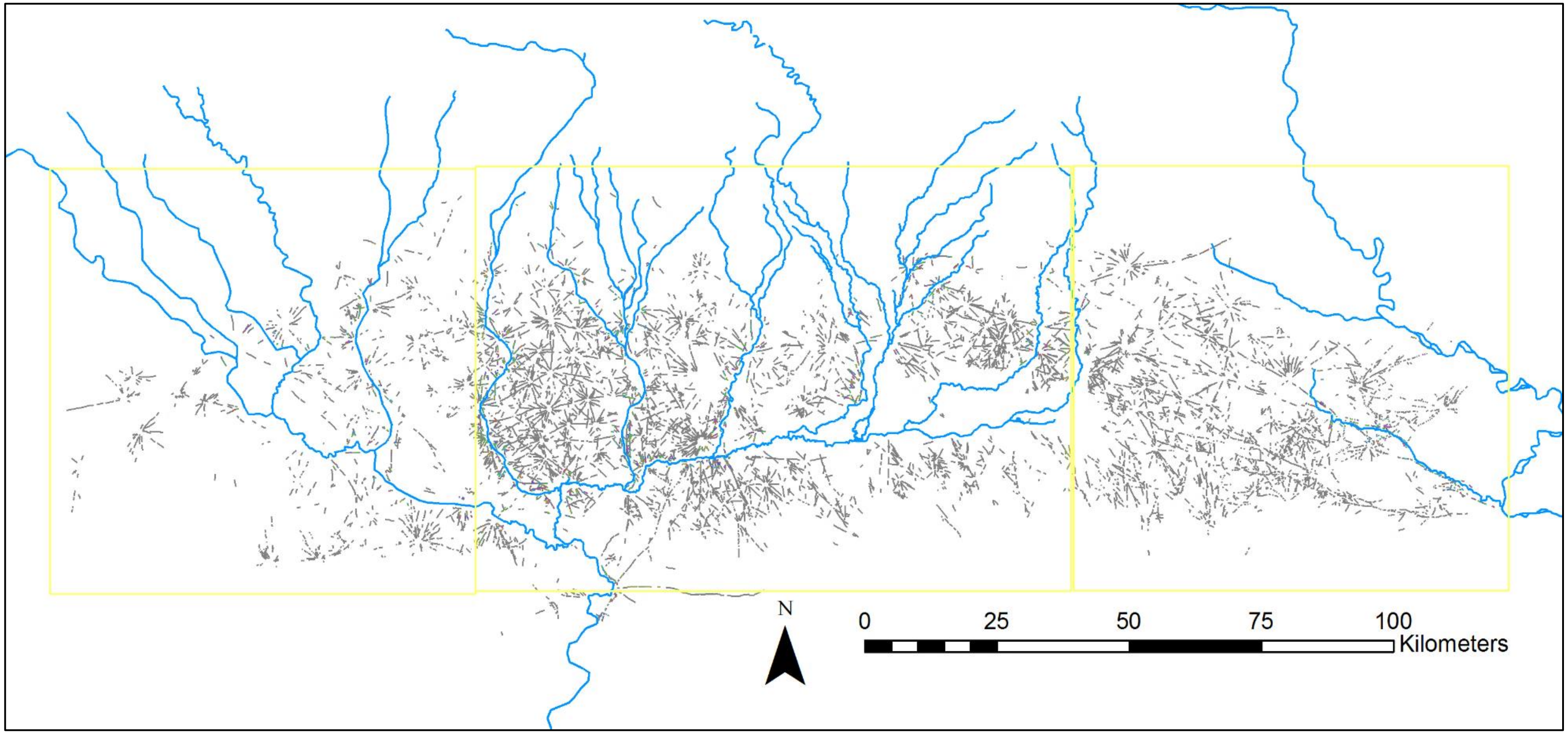

Figure 1.7 Three zones of hollow ways are visible: an area to the west that is poorly preserved, a middle area of primarily radial routes, and an eastern area featuring long-distance routes running northwest to southeast.

with most precipitation (including some snow in the winter on the Jebel Sinjar) falling between December and February. In total between 200 and 450 mm of precipitation falls annually with more rain in the northern North Jazira and less rain to the south (Hald 2008, 5–7; Wilkinson and Tucker 1995, 6–9, 150). Drought years occur at a rate of one or two every ten years (Wilkinson and Tucker 1995, 7; Charles, Pessin, and Hald 2010, 186).

1.7.2 The Preservation of Hollow Ways

Jason Ur (2010b, 134-145) has visually contrasted the preservation and character of hollow ways in six defined sub-regions across the Jazira: the Eastern Upper Khabur Basin, the Central Basin, the Western Basin, Northern Flanks of the Jebel Abd al-Aziz and the Upper Khabur River, the Middle Khabur Region, and the plain north of the Jebel Sinjar.

The region, however, can be more simply generalized in three parts (**figure 1.7**). First, the area of hollow way preservation to the west of Tell Beydar, which is relatively poor but features scatters of routes in radial patterns, as would be expected around sites and some possible, poorly preserved long distance routes leading to/from the Wadi Avedji. Second, a middle area from Tell Beydar to the Wadi Rumeilan (including Tell Brak) and extending south of the Wadi El Radd, which contains a dense preservation of radial routes. Third, the area from Tell Leilan southeast to the Tigris, including both Tell Hamoukar and Tell al-Hawa, which features radial routes but is unique for very clearly preserved, long distance, routes oriented northwest-southeast. The last two areas, represent the densest, best studied collection of recorded hollow ways and, importantly, these hollow ways connect numerous sites dated to the time periods before, during, and after the Uruk Expansion. Therefore, it is these preserved routes that are the focus of this thesis.

1.8 Thesis Structure

This thesis is divided into three volumes. Volumes 1 and 2 contains the main text, including the bibliography. Volume 3 is the three appendices. The main text of the thesis is divided into four parts. The first part is composed of three chapters.

This first chapter has described the aim and research questions posed by this thesis. Chapter 2 addresses chronology. The regional chronology for the fourth millennium B.C. requires a full research project devoted to its re-examination, however a working chronology is necessary. Fortunately, the completion of the Associated Regional Chronologies for the Ancient Near East (ARCANE) project examining the third millennia B.C. provides a useful *terminus ante quem* (Lebeau 2011a). Chapter 2, therefore, presents the chronology utilized by this study, which may vary slightly from the various chronologies adopted by others.

Chapter 3 narrows focus to describe the archaeological surveys that inform the specific case study areas selected within the North Jazira for study and the preserved routes of the region (the hollow ways), which are the subject of this thesis.

The second part of this thesis has two chapters and focusses on the people who are the subject of the study: their ways of life and settlement patterns before, during, and after the Uruk Expansion.

Chapter 4, in particular, describes culture and life during the fourth and early third millennia B.C. of people across the three case study areas based on existing evidence from survey and excavation. Chapter 5 addresses transport technology, including the existing evidence for donkey domestication and what a fourth millennium donkey caravan may have looked like, if they existed. This information is presented separately from Chapter 4, because the presence of donkeys in the fourth millennium B.C. has not yet been firmly established, but the increasing evidence warrants consideration of their use in a study about routes and travel, since mode of travel is a factor that affects movement costs and limitations.

The third part of the thesis focusses on the preserved routes and extracting information directly from them, in a manner analogous to the Mesolithic footprint examples provided above, but on a different scale. It consists of three chapters.

Chapter 6 presents the theory that enables the methodology for quantitative route analysis explained in Chapter 7. Some of the core information in both chapters has been published in de Gruchy (2016), but there is additional and new information in both as well. Unlike the case study presented in de Gruchy (2016), the case studies in this volume factors land cover as an additional cost to slope. For this reason, Chapter 8 presents a new bottom-up methodology for spatial reconstruction of contemporary land cover inspired by the Muir Web approach developed by the Mannahatta Project (Sanderson 2009). This methodology differs from the top-down approach developed by Soto-Berelov et al. (2015) in that it factors archaeobotanical data and allows for the possibility that different ecoregions may have existed in the past that are not represented in the modern environment.

The fourth and final part of the thesis covers the results and conclusions in three chapters.

First, Chapter 9 presents and analyses the direct results from applying the methods described in Part 3. Chapter 10 combines the evidence from Part 2 and Chapter 9 to achieve the central aim of the thesis: to use the routes to shed new light on the Uruk Expansion. Chapter 11 is the conclusion.

Chapter 2: Chronology and Chronological Divisions

The Sante Fe (Late Chalcolithic periods 1 to 5, abbreviated LC 1, LC 2, ..., LC 5) and ARCANE (Early Jazirah periods 1 to 5, abbreviated EJZ 0, EJZ 2, …, EJZ 5) chronologies are the two current chronological systems for the fourth and third millennia B.C., respectively (Rothman 2001b; Lebeau 2011a). Both chronologies are based on numerous radiocarbon dates, as well as comparison of diagnostic artefacts, especially (but not exclusively) ceramic types. Therefore, this thesis utilizes established chronological systems.

2.1 Chronological Groups

The published survey data from the Tell Brak, Tell Leilan, Hamoukar, and North Jazira Surveys are insufficient to divide sites into precise divisions of LC 1, 2, 3, 4, 5, and EJZ 0, 1, 2, 3a. Therefore, this thesis considers three blocks of time: the early fourth millennium B.C. (LC 1-3), the late fourth millennium B.C. (LC 3-5), and the early third millennium B.C. (EJZ 0-3a).

The LC 3 period appears in both groups, because there are few diagnostic ceramic types specific to LC 3 for surveys to utilize for identifying an LC 3 site. Instead, some types span LC 2 and LC 3, while others span LC 3 and LC 4 (see Ur 2010, 233, Fig.B.8).

2.2 The Tell Brak Surveys

The Eidem and Warburton (1996) survey presents only 'Uruk' period sites, which in this case refers to the Northern Uruk chronological system in place before the development of the Late Chalcolithic system, which was divided into Early, Middle, and Late, but favours identification of Middle and Late Northern Uruk period sites when easily recognisable southern wares appear. Now the Early Northern Uruk equates to periods LC 1 and LC 2, the Middle Northern Uruk is periods LC 3 and LC 4, and the Late Northern Uruk is LC 5 (Rothman 2001a, 7, table 1.1).

The Wright et al. (2006-7) survey post-dates the Sante Fe chronology, but the published preliminary results do not cover the entire fourth millennium B.C., only a map labelled 'Mid 4th Millennium B.C.' (Wright et al. 2007, fig. 3). This is defined as

Brak Phase G, which equates to LC 4-5 (Wright et al. 2007; Ur, Karsgaard, and Oates 2011).

Therefore, the available survey data for the Tell Brak area during the fourth millennium B.C. covers mainly LC 3-5, though it is possible that some of the sites from the Eidem and Warburton survey may prove to be LC 2 in date, since some diagnostic ceramic types are now known to span both LC 2 and LC 3 (Ur 2010, 216–17, 232–49). It is unlikely that any of their identified sites would date to LC 1, since this would have been distinguishable at the time of the survey as Terminal Ubaid.

Only Eidem and Warburton (1996) have published results for the early third millennium B.C., labelled the Ninevite V period. This now equates to EJZ 0-3a (Rova 2011, 52–57) .

2.3 Tell Leilan

The 1995 Results of the Tell Leilan Regional Survey were re-evaluated according to the Sante Fe chronology for the fourth millennium B.C. (Brustolon and Rova 2007) and the Early Jazirah chronological system developed by ARCANE for the third millennium B.C. material (Arrivabeni 2010).

In practice, however, Brustolon and Rova (2007) had to divide the fourth millennium B.C. material into six groups due to some uncertainty with the LC 3 period. Group 1 is LC 1, Group 2 is LC 2, Group 3 is ‘early LC 3’, Group 4 is LC 3-4, Group 5 is LC 4, and Group 6 is LC 5 (Brustolon and Rova 2007, 8). In this thesis, the early fourth millennium B.C. is Groups 1 to 3 (before the Uruk Expansion), while the late fourth millennium is Groups 4 to 6 when southern material culture appears (during the Uruk Expansion).

The early third millennium B.C. defined as EJZ 0-3a equates to the former Ninevite V period, but Arrivabeni notes that EJZ 1-2 can be difficult to distinguish and EJZ 3a to 3b can be difficult to separate (Arrivabeni 2010, 26–27). She writes that some types were not considered EJZ 3a indicators if there was a ‘total absence of EJZ 1-2 phase diagnostics’ or ‘a preponderance of later types’ (Arrivabeni 2010, 27). All sites identified as EJZ 0-3a by Arrivabeni (2010) were included as early third millennium B.C. sites in this thesis.

The re-periodized early fourth, late fourth, and early third millennium B.C. sites from the 1995 Tell Leilan Survey results are listed by time period in Appendix A.

2.4 The Tell Hamoukar Survey

Conducted after the Sante Fe chronology, the Tell Hamoukar Survey divided the fourth millennium into Period 4 (LC 1-2), Period 5a (local wares dated to LC 3-5), and Period 5b (southern wares dated to LC 4-5) (Ur 2010, 232–49). In this thesis, Period 4 is considered early fourth millennium B.C., while Periods 5a and 5b are late fourth millennium B.C.

Preliminary results of the ARCANE chronological division of the third millennium B.C. into EJZ 0-5 already existed at the time of the survey, however, Ur (2010, 49) describes the difficulties of separating the ceramic assemblage into these phases. Instead, the decision was made to continue to distinguish the first half of the third millennium using Ninevite 5 pottery sherds (Ur 2010, 249–50). Period 6, therefore, equates to the Ninevite 5 period (Ur 2010, 249–50), which in turn equates to EJZ 0-3a and the early third millennium B.C.

2.5 The North Jazira Survey

The North Jazira Survey took place before either the Sante Fe or ARCANE chronologies were developed. The initial results were reassessed by Lupton (1996) based on excavation sequences into three categories: pre-contact period, contact period, and post-contact period. Nonetheless, the updated understanding of ceramic periodization that accompanied the development of the Sante Fe and ARCANE chronologies, warranted a second re-periodisation of sites. This was accomplished by revisiting the original ceramic forms where ceramics are described by their type number and frequency, and by using Jason Ur's ceramic typology for the Tell Hamoukar survey for reference. Sites with types that correspond to LC 1-3 (including types that date to LC 2-3 and LC 3) were included in the early fourth millennium B.C. Sites with types corresponding to LC 3-5 (including LC 3 and LC 3-4) were included in the late fourth millennium B.C. The results of this re-periodization of sites are presented in Appendix A.

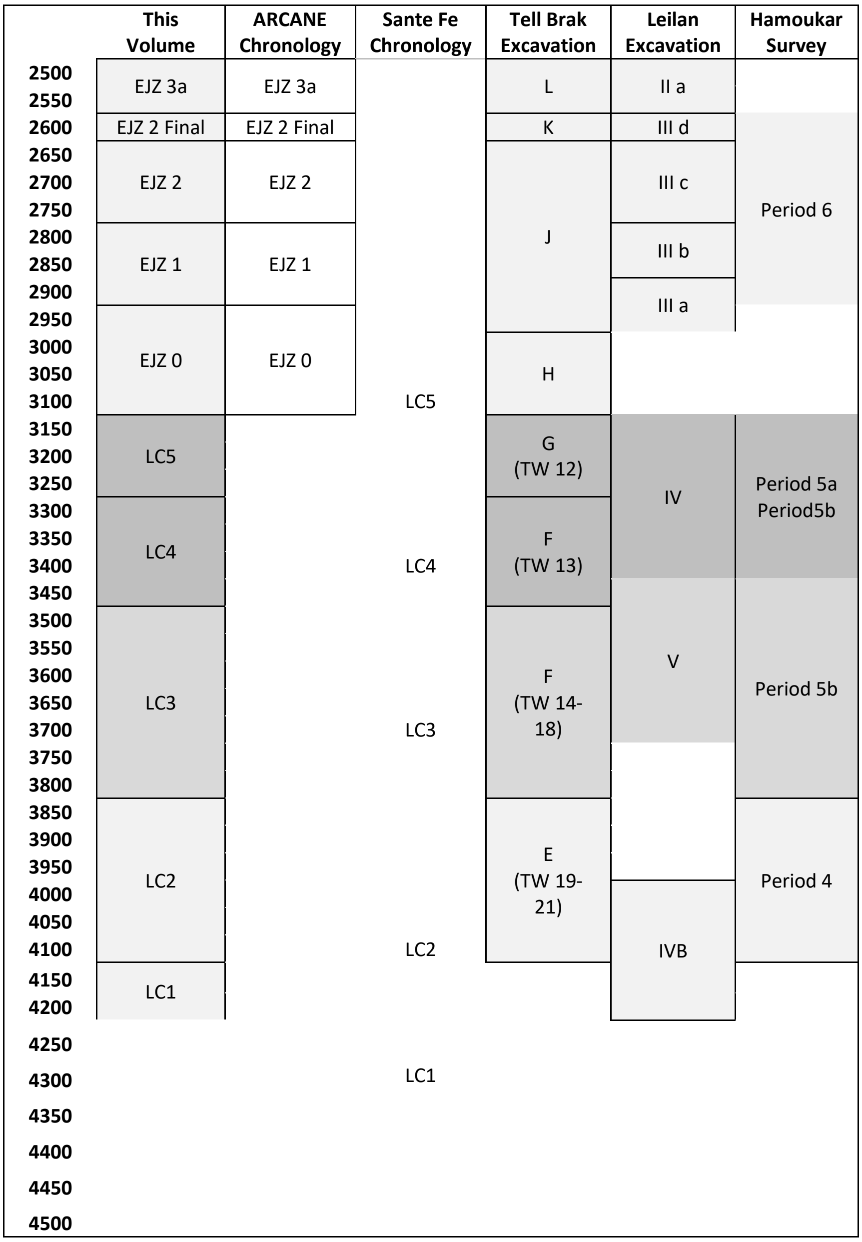

Figure 2.1 The chronological relationship between the established Sante Fe and ARCANE chronologies, the excavation chronologies of Tell Brak, Tell Leilan, and the Tell Hamoukar Survey (Rothman, 2001a; Brustolon and Rova, 2007; Arrivabeni, 2010; Ur, 2010; Lebeau, 2011a).

Chapter 3: Introduction to the Case Study Areas

Within the North Jazira region of Northern Mesopotamia, the spatial focus of this study is across five survey areas, which sample the North Jazira from west to east: two overlapping surveys in the area of Tell Brak, the Tell Leilan Survey, the North Jazira Survey area, and the Hamoukar Survey area[6] (**figure 3.1**). The two Tell Brak surveys are considered together as the first of three case study areas, the 1995 results of the Tell Leilan Regional Survey comprises the second case study area, and, with less than 5 km separating them, the Hamoukar and North Jazira surveys examined together form the third case study area. Together, the case studies areas capture a representative sample of the hollow ways, containing 1,915 out of around 6,532 recorded hollow ways.

3.1 Tell Brak Surveys

Methodology

Both the earlier survey by Eidem and Warburton (1996) and a partially published later survey by Wright et al. (2007) surveys of the area around Tell Brak provide data on the settlement from the fourth through early third millennia B.C. (**figure 3.2**). Eidem and Warburton (1996) surveyed an area measuring 170 square km, including Tell Brak, the juncture between the Wadi Radd and Wadi Jaghjagh, and Tell Barri in its extent. The Eidem and Warburton (1996) survey boundary shown in figures throughout this thesis is estimated based on the locations of sites found.

A decade later, Wright et al. (2006-7) published the results of a second survey, overlapping in area with the Eidem and Warburton survey, but more than twice in size at 'nearly 500 km^2' (Eidem and Warburton 1996, 7). This survey utilized CORONA imagery and historic photographs, as well as, Landsat, to locate sites, then site boundaries were determined by field walking in transects (Wright et al. 2007, 9).

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[6] The Tell Beydar Survey area was originally included, but was omitted following Tony's death when access to the original records became complicated.

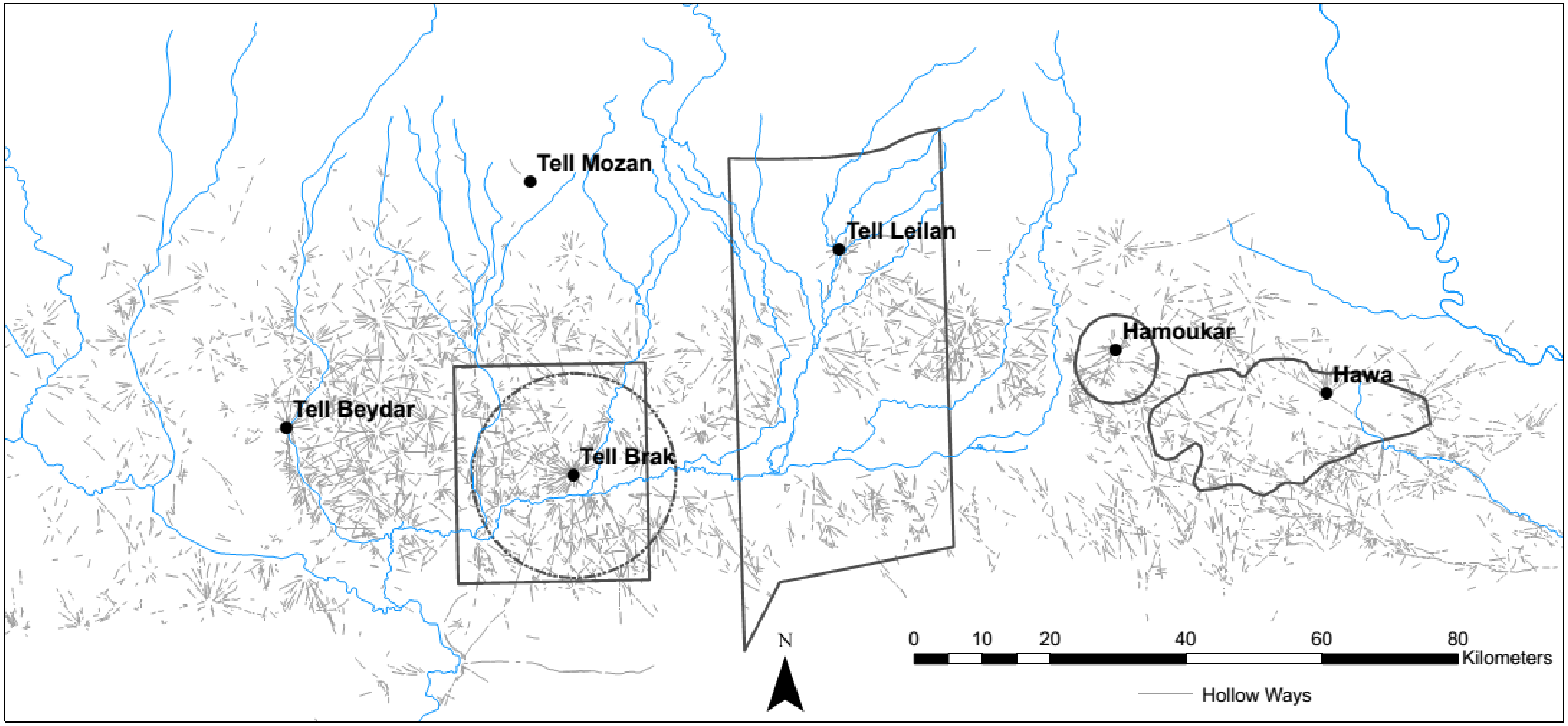

Figure 3.1 The location of the survey areas that form the three case study regions.

Both surveys were informed by the pottery chronology developed from the extensive excavations at Tell Brak (Eidem and Warburton 1996; Wright et al. 2007).

Results

In total, the Eidem and Warburton survey found 25 Uruk period sites and 15 Ninevite V period sites, most of which are located along the wadis (Eidem and Warburton 1996). The later Wright et al. survey found 244 sites dated to the mid-fourth millennium B.C., including many more sites located away from the wadis (Wright et al. 2007).

Excavation of Tell Brak

The first excavation at Tell Brak in 1928 was directed by Antoine Poidebard (Oates and McMahon 2013; Mallowan 1947), the same pilot described before as first discovering hollow way features while conducting an aerial survey over Syria. Poidebard's sounding was followed by more extensive excavation at the site under the direction of Max Mallowan from 1937-38 that reached fourth millennium B.C. levels and uncovered the Eye Temple (Mallowan 1947). After a long hiatus, David and Joan Oates began a new excavation project in 1976 with the specific aim of establishing a chronology (Oates and McMahon 2013). Over the next 30 years until 2006, the Oates continued excavation at the site, including soundings to fourth and fifth millennium levels during the 1980s (Oates and McMahon 2013). From 2006, Augusta McMahon became director until the present hiatus in excavation starting in 2011 (Oates and McMahon 2013). No other site dated back to the fourth millennium B.C. has been so extensively excavated and the resulting sequence is important for both the Khabur region and understanding broader dynamics across the North Jazira region and Northern Mesopotamia (Rova 2011; Rothman 2001b).

3.2 Tell Leilan Regional survey

Methodology

The Tell Leilan Regional Survey took place over two seasons in 1995 and 1997, covering 1650 km^2, but only limited access was granted south of Wadi Radd (Ristvet 2005, 36). However, the survey did not rely exclusively on ground survey. Sites were also recorded via remote sensing using satellite imagery (SPOT, as well as possibly

LANDSAT and CORONA) and from a series of 1:50,000 scale maps that, based on their description, probably belong to the Levant Series (Ristvet 2005, 36; Brustolon and Rova 2007, 1; Weiss 2003, 601). If the maps used do belong the Levant Series, then they were produced during the Second World War and record tells, Roman sites, and any ruins. Finally, the Tell Leilan Regional Survey also incorporated known sites found during previous surveys by Meijer, Weiss, and Stein and Wattenmaker (Ristvet 2005, 35; Brustolon and Rova 2007, 1).

The Meijer survey, conducted over three years between 1976 and 1979, recorded sites that were 'immediately visible' as mounds by the team from the windows of a vehicle as it drove around designated 20 km^2 sectors (Meijer 1986, 3). When a mound was spotted, the team surveyed on foot from the mound, 'more or less systematically', and searched for additional sites (Meijer 1986, 3).

A few years later, in 1984, Weiss surveyed a 15km area around Tell Leilan with a particular focus on third millennium B.C. sites (Weiss 1986, 87). Sites were located from a vehicle whilst driving (Weiss 1986, 87).

The survey by Stein and Wattenmaker in 1987 used a different methodology. The small team conducted an 'intensive walking survey' along transects running 10 km north and 10 km south of Tell Leilan along the Wadi Jarrah (Wattenmaker and Stein 1989, 283; Stein and Wattenmaker 1990b, 11). According to their map, the transects extended about 2 km on either side of the Wadi Jarrah (Stein and Wattenmaker 1990b, fig. 4). Additionally, the team made controlled surface collections at sites identified by the two previous surveys by Meijer and Weiss (Wattenmaker and Stein 1989, 283; Stein and Wattenmaker 1990b, 12).

While the Leilan Regional Survey used a variety of methods in its approach, the immediate 15 km around Tell Leilan has been much more frequently and intensively surveyed than the remainder of the region. Combined with the limited access permitted to the team south of the Wadi Radd, it can be expected that some survey bias may be present in the data with many more sites recorded in the northern half of the regional survey than in the southern half.

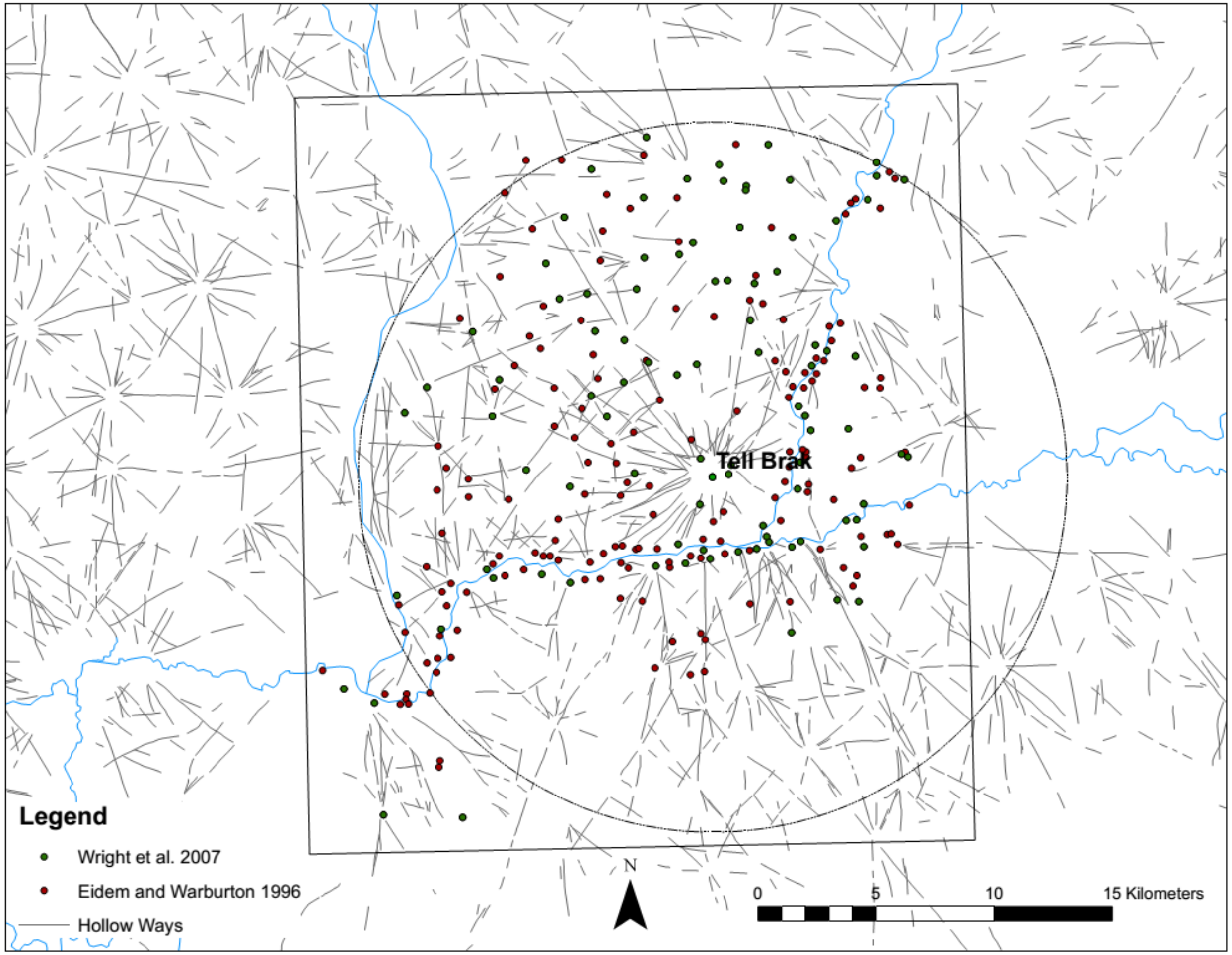

Figure 3.2 All sites located by the Eidem and Warburton (1996) survey and the late fourth millennium B.C. sites found by the partially published Wright et al. (2006) survey illustrating their overlapping survey areas.

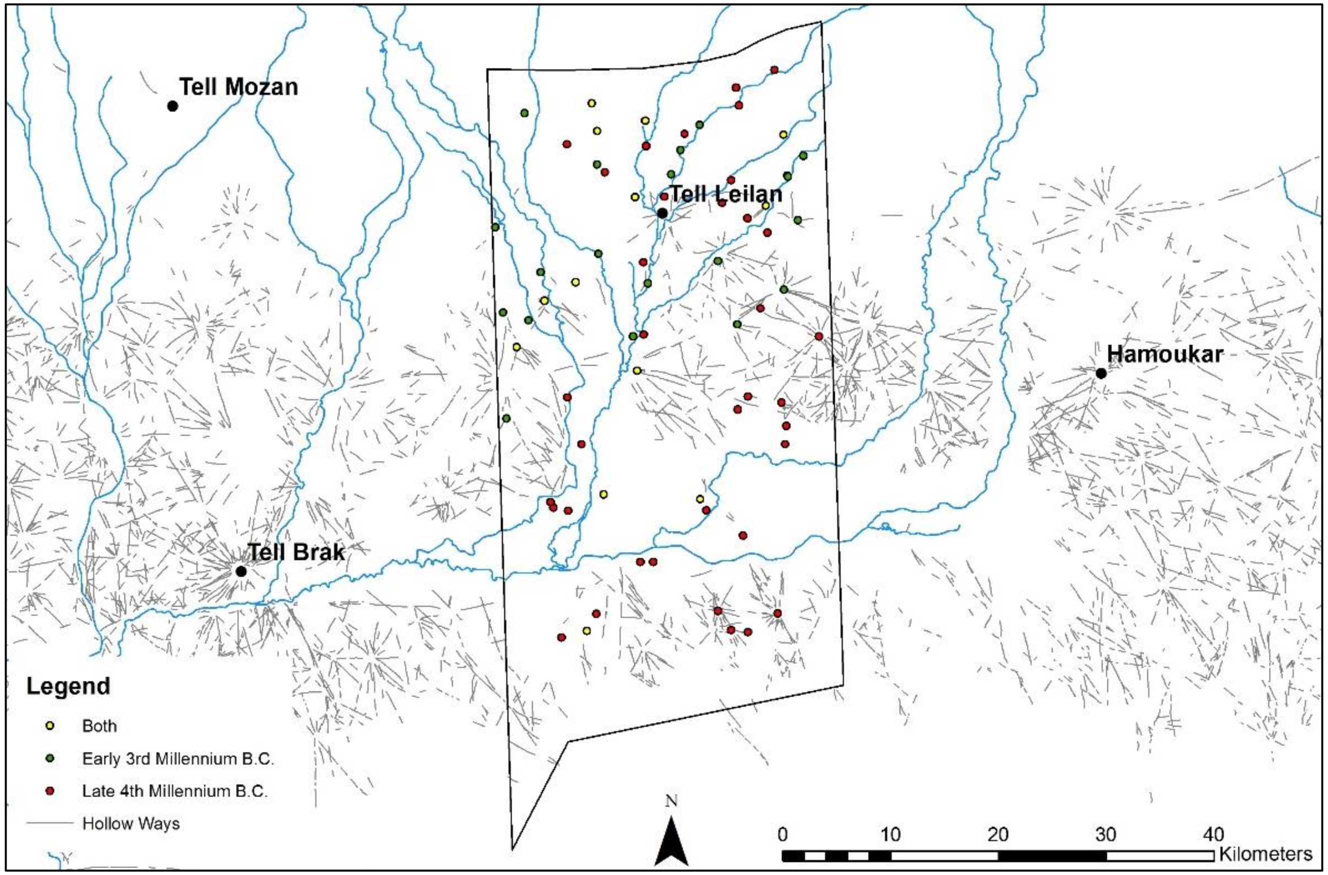

Figure 3.3 The Tell Leilan Survey area and results for the late fourth and early third millennia

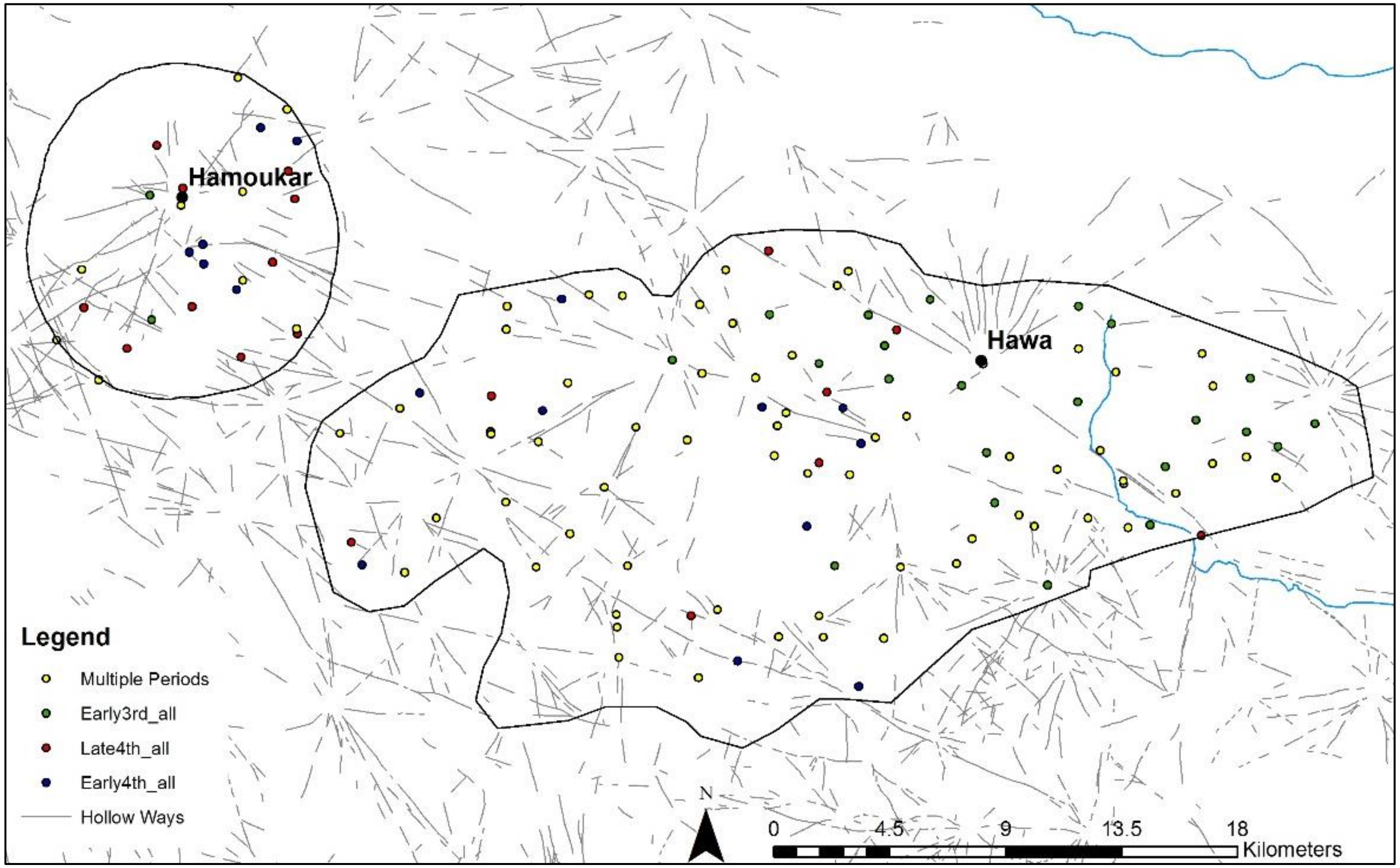

Figure 3.4 The Hamoukar and North Jazira Survey areas showing the results for early fourth, late fourth, and early third millennia B.C. sites.

Results

Preliminary results of the survey, categorizing sites containing Southern Uruk material culture, dated to the LC 5 period, or the Ninevite V period were published by Weiss (2003) (**figure 3.3**). Since, Brustolon has re-examined the results of the 1995 season survey through reanalysis of Late Chalcolithic ceramics, refining the typology and periodization of sites into LC 1-2, early LC 3, late LC 3-LC 4, and late LC 4-LC 5 (Brustolon and Rova 2007). While Arrivabeni (2010) similarly refined the typology of third millennium B.C. ceramics into divisions of EJZ 1, EJZ 2, EJZ 3, EJZ 4, and EJZ 5.

The results of the re-evaluations differ considerably from the preliminary results published by Weiss (2003), but it is unclear if the discrepancies are due to the omission of the 1997 survey results from the later re-evaluations or if they are true changes. Since false positives would inflate the number of routes and increase the risk of a Type I error (falsely rejecting a null hypothesis), only the re-evaluated 1995 survey data are incorporated into route reconstructions.

3.3 The Hamoukar Survey and North Jazira Survey

Methodology

Over three seasons from 1999 to 2001, an intensive full-coverage, pedestrian survey was conducted within an approximately 6km radius around the site THS 25, Khirbat al-Fakhar, south of Hamoukar (Ur 2010, 2–3). Additionally, CORONA imagery was used to locate smaller sites and unmounded sites that can be more difficult to detect on the ground, followed by ground truthing (Ur 2010, 2–3). Sites were assigned periods by the presence or absence of diagnostic sherds from a typology originating from the Tell al-Hawa project, but improved and updated over time (Ur 2010, 213–98).

The North Jazira Survey is located 5 km southeast of the Tell Hamoukar Survey area (**figure 3.4**) and covers an area measuring approximately 475 km^2 (Wilkinson and Tucker 1995, 1–2). The entire area was surveyed along 500m transects 'by car and on foot' (Wilkinson and Tucker 1995, 17). Although the project would not have had access to CORONA imagery to identify sites, it did make use of aerial photographs, LANDSAT imagery, and an extraordinary set of Chinese maps with extremely detailed, one-meter interval topographic information that predated the irrigation schemes of the 1980s (Wilkinson and Tucker 1995, 1–2, 16–17; de Gruchy and Cunliffe forthcoming). The North Jazira Survey made use of an earlier version of the typology used by the Hamoukar Survey from before the Sante Fe chronology to assign periods to sites (Ur 2010, 213–98).

Results

The Hamoukar Survey found 14 LC 1-2 sites, 24 LC 3-5 sites including sites both with and without the Uruk material culture that arrives starting in the LC 4 period, and 4 Ninevite V (or EJZ 0-3a) sites.

The original results of the North Jazira Survey found 74 Uruk period (or Late Chalcolithic) sites and 38 Ninevite V period sites, however, a re-evaluation of the periodization of sites was required (Appendices A and B). The re-evaluation found 69 LC 1-3 sites, 65 LC 3-5 sites, and 50 Ninevite V (EJZ 0-3a) period sites (see Appendix B).

3.4 The Nature of the Data

All three case study areas have been remotely sensed for sites, but the intensity of survey on the ground varies considerably from the limited access in the southern half of the Tell Leilan Regional Survey on the one hand to the intensive Tell Hamoukar Survey on the other. As with any regional analysis, it is important in the forthcoming chapters to consider the potential that some apparent patterns in the data may be a product of differences between survey methodologies. **Table 3.1** compares the different surveys. Notably, the Tell Leilan Regional Survey recorded about half the number of sites that would be expected if site density would be equal to other areas. Almost certainly, this suggests an underrepresentatation of smaller sites.

Furthermore, the ceramic chronology of the region, used to periodize sites, has developed significantly over the years that the surveys took place. As a result, sites have had to be re-periodized either by re-examining the collected ceramics directly (Brustolon and Rova 2007; Arrivabeni 2010) or through re-categorization based on types recorded on ceramic forms (Appendix B). However, as mentioned in Chapter 2, there remain few known ceramic types diagnostic of LC 3 – a critical period for understanding the impact of the Uruk Expansion on the region. It would be useful to have separate site size estimates for the LC 3, but the only site this is possible for is Tell Brak. There, the team note that types diagnostic of LC 3-5 extend across and enormous area of the tell, but types diagnostic of only LC 4 and/or LC 5 are much more limited (Ur, Karsgaard, and Oates 2011, 6–9).

Survey	Survey Area (ha)	Project Duration	Site Density	Supporting Material
Eidem and Warburton	17,000	1 Season Spring 1988	approximately 1 site every 303-304 ha	
Wright et al.	50,000	2 Seasons 2002 and 2003	approximately 1 site every 186-187 ha	Corona, Landsat, and 'other photographs'
Leilan Regional Survey	165,000	2 Seasons 1995 and 1997	approximately 1 site every 507-508 ha	Syrian 1:50,000 maps, SPOT, Landsat?, Corona?
Hamoukar Survey	12,500	3 Seasons 1999-2001	approximately 1 site every 208-209 ha	CORONA,1:200,000 Levant series maps, Syrian topographic maps
North Jazira Survey	47,500	4 Seasons 1986-1990	approximately 1 site every 258-259 ha	Aerial photographs, SPOT, Chinese maps

Table 3.1 Comparison of the five surveys that compose the three case studies (Eidem and Warburton 1996; Wright et al. 2007; Ristvet 2005; Ur 2010; Wilkinson and Tucker 1995).

PART 2: The People and Animals

Chapter 4: Protohistory in the North Jazira

Inhabiting the sites of the case study areas were people and animals. It was the erosion caused by their movements out of their settlements and across the landscape to the fields, pastures, and other sites that formed the hollow ways and it was their route choice decisions that shaped the hollow ways. Therefore, it is not only worthwhile, but essential to consider what is known about these people, their culture(s) and ways of life over time from the early fourth millennium B.C. though the early third millennium B.C.

Among this data lies evidence for:

- increasing socio-political and economic stratification and increasing disparity,
- how that increasing socio-political and economic stratification took place,
- conflict associated with this growing inequality,
- who the actors of that conflict were,
- socio-cultural ties across the region and the breakdown of those ties,
- the existence of polities (extended territorial control by centres),
- increasing settlement hierarchies,
- and the demography of sites through time.

It is through detailed examination of this evidence that it is possible to gain an understanding of mobility: who was travelling the routes, how were they travelling, where were they travelling, when were they travelling, why were they travelling.

Most of the available archaeological data for the region derives from survey data. As a result, much of what is known and can be known at this time about the people derives from calculations and models that relate measurements of settlement size and density to demographics and sustainability. Whenever possible, excavated sites are discussed to shed further light on the lives of people. This information is organized into three chronological sections: early fourth millennium B.C. (LC 1-3), late fourth millennium B.C. (LC 3-5), and early third millennium B.C. (EJZ 0-3a). Each section is divided into a series of themes, including: settlement patterning and hierarchy, and population demographics and workforce. These themes are followed by detailed descriptions of the important centres at that time. By dividing the data first chronologically and secondly by site, it is easier to compare and contrast the contemporary centres and determine to what extent there is evidence (beyond routes) for social, political, economic, or ideological connections across the region. (This data will also be used in conjunction with the results from route analysis to present new arguments in Chapter 10 about travel and interaction, extent of power, the nature of the Uruk Expansion in the North Jazira, and, ultimately, World Systems Theory.) Each chronological section concludes with a summary about trade and interaction.

There are two key terms central to this region, across all time periods covered here (and beyond) that require definition. These are the Zone of Uncertainty and pastoralism, as it is expressed traditionally in this area of the world.

4.1 Two Key Terms: The Zone of Uncertainty and Pastoralism

4.1.1 The Zone of Uncertainty

Defined as the area located between the 180/200 and 300 mm precipitation isohyets, the Zone of Uncertainty refers to a geographical area in which annual fluctuations in rainfall determine whether or not rain fed agriculture is feasible (Wilkinson 1994; Wilkinson 2000b; Wilkinson et al. 2014, 53). In years with lower precipitation, pastoralism becomes a more viable economic strategy than agriculture. To manage the year-to-year uncertainty in this zone, populations plan for agriculture, planting grain; but should the crops fail, the fields can be used to pasture the herds (Wilkinson 2000b, 4). Since the Zone of Uncertainly is defined by a precipitation range, its precise location has likely shifted slightly over time. In the fourth and third millennium B.C., which were cooler and wetter (see Chapter 8), this area was likely shifted slightly further south than it is today.

In the current climatic regime, the Zone of Uncertainty forms a band whose northern edge is situated less than 100 km south of Tell Brak (see Wilkinson et al. 2014, fig.3) and continues eastwards through the western half of the North Jazira Survey

(Wilkinson 2000b), before turning south and running roughly parallel with the Zagros mountain chain (**figure 1.1**).

4.1.2 Pastoralism

Pastoralism is a broad term that simply refers to an economic strategy based on animal husbandry in which animals are grazed in pasture (Barfield 1993, 12). Generally, pastoralists can be sedentary, semi-sedentary, semi-nomadic, or nomadic. The animals selected for pastoralism are partially environmentally determined in that they 'must be well adapted to the regional ecological conditions so that large numbers can be supported' (Barfield 1993, 10). For the Near East, the animals upon which pastoralism is historically based are sheep and goat (Barfield 1993, 93–130), although (pre)historically cattle tend to be a secondary animal that is regularly kept in much smaller numbers. This selection of animals for pastoralism extends back millennia before historical records, evidenced by very high proportions of sheep/goat followed by cattle and, to a lesser extent, pigs in faunal remains in the archaeological record (Wilkinson and Tucker 1995, 2; Wilkens 2000; Weber in Emberling and McDonald 2003, 22–26).

Describing the structure of nomadic pastoralism based on sheep and goat in southwest Asia from a historical and anthropological perspective, Barfield (1993, 94) wrote:

> 'What makes this zone distinct is that pastoralism here is embedded within a larger sedentary regional agricultural economy. Nomads have close symbiotic relationships with farmers in surrounding villages and merchants in local bazaars. While they may appear to be radically distinct from their sedentary neighbors because of the primacy they give to animal husbandry, their use of tents in seasonal migrations, and their tribal political organization, they are in reality pastoral specialists who trade milk products, meat, wool, and hides for the grain that makes up the bulk of their diet.'

This embeddedness extends so far that pastoralists are even encouraged by agriculturalists to graze their sheep and goat on the remains of harvested fields, so that the dung of the animals fertilizes the soil (Barfield 1993, 98).

Early breeds of sheep, including those available in the fourth and early third millennia B.C., did not grow wool continuously. Genetic evidence suggests sheep evolved to grow wool year-round sometime in the second millennium B.C. (Breniquet 2014), although there is evidence sheep grew wool by the fourth millennium B.C. (McCorriston 1997, 521), perhaps as woolly undercoats. Iconographic evidence consistently depicts sheep as hairy animals through the fourth and third millennium B.C. (Vila and Helmer 2014, 30-33). Textual evidence from the Old Assyrian period tells us that these hairy sheep were plucked once a year in May/June (Sallaberger 2014, 110). Coincidentally, this also marks the end of the wet season when crops would be harvested (Charles, Pessin, and Hald 2010, 186) and when agriculturalists would want to encourage pastoralists to bring their herds to feed on the remaining stubble.

Raw wool is therefore an early summer product. Meanwhile, flax for linen would be most easily processed in the wet season over the winter months when the fibres, which require retting in a pool or slow moving stream (Baines 1985), could be submerged in the wadis. It follows that production of wool textiles may have taken place during the summer and autumn, followed by production of linen textiles during winter and spring. Conveniently, this also matches when it would be preferable to wear both types of textiles: the woollen textiles would be ready in time for the cooler winter months and the linen textiles for the warmer summer months.

In Southern Mesopotamia, wool replaced linen as the primary textile starting in the fourth millennium B.C. (Algaze 2008, 78).

Whether separate nomadic or semi-nomadic pastoral populations existed during the fourth and early third millennia B.C. in the North Jazira is the subject of debate. As will be seen below, the archaeological evidence remains unclear – occasionally hinting at the possibility for nomadic or semi-nomadic pastoralists, but never strong enough to prove it. Barfield (1993, 95) argued that being ‘a successful pastoralist requires both productive animals for subsistence (sheep and goats) and transport animals for movement (donkeys, horses, camels),’ but, as will be shown below, the need for a transport animal may not always be necessary.

4.2 The Early Fourth Millennium B.C. (LC 1-3)

4.2.1 Settlement Patterning and Hierarchy

Settlement during the first half of the fourth millennium appears at first glance to have been fairly ubiquitous across the North Jazira based on currently available evidence from the re-evaluated 1995 Leilan Regional Survey material, the Tell Hamoukar Survey, and re-evaluation of the North Jazira Survey results (Brustolon and Rova 2007; Ur 2010, 98-99; see also Appendix B) (**figure 4.1**). All sites were under 3 ha in size with only three exceptions: THS25 in the Hamoukar Survey area, Tell al-Hawa, and Tell Brak (Ur 2010, 98–99; Wilkinson and Tucker 1995, Appendix C; Ur, Karsgaard, and Oates 2011; Lupton 1996, 24–25).

THS25 is located immediately south of Hamoukar. The total area of the site is estimated to be about 300 ha in extent. Within this 300 ha, there is a 31 ha low mound of settlement and a further 77 ha of lighter soil dispersed across the site, and visible in remote sensing, which is consistent with the remains of buildings (Ur 2010, 98). This means the site area was at least an order of magnitude larger than all but two other settlements (Tell Brak and Tell al-Hawa) and it was larger by two orders of magnitude when accounting for the full area of the site, a significance that is not entirely understood, but is hypothesized to be an experiment with urbanism (Ur, Khalidi, and Quntar 2011). The site was certainly on an urban scale, comparable in size to urban sites in the third millennium B.C., but was abandoned by the end of the early fourth millennium B.C. at the same time that Tell Hamoukar was founded.

Meanwhile, Tell al-Hawa was estimated by Lupton (1996, 24-25, 127) to be 33 ha during the early fourth millennium B.C. Over this time period, the site shrinks, such that in the late fourth millennium B.C., it was estimated to be only 20 ha in area (Lupton 1996, 128). Unfortunately, however, very little can be said about Tell al-Hawa during the early fourth millennium B.C., because its excavation pre-dates the Sante Fe Chronology, before it was possible to separate the earlier local fourth millennium B.C. material culture from that of the later local fourth millennium B.C.

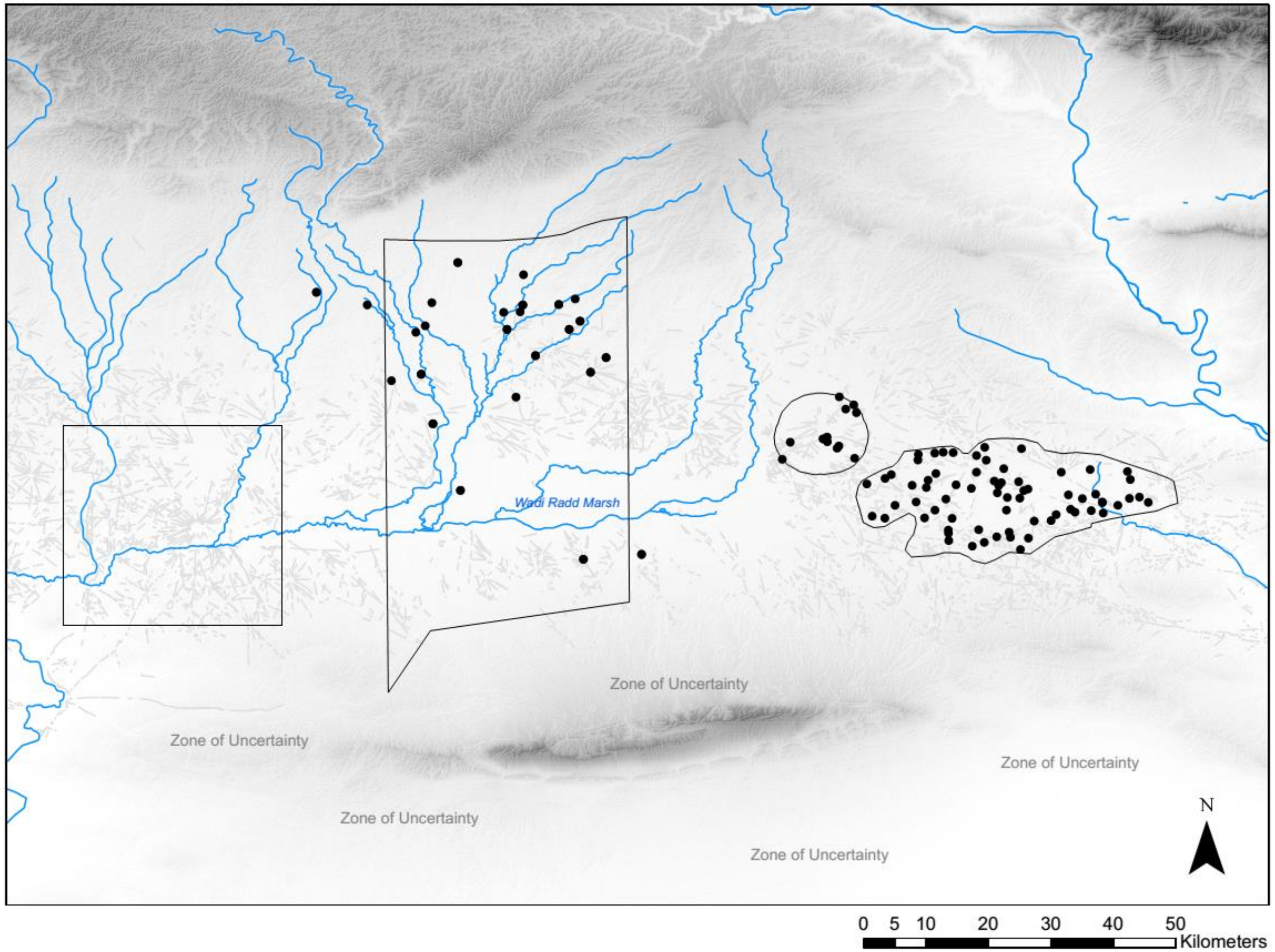

Figure 4.1 Settlement during the early fourth millennium B.C. in the Leilan Regional Survey area, the Tell Hamoukar survey area, and the North Jazira survey area (which recorded two early fourth millennium sites outside the official survey boundary). No data is published for the area around Tell Brak. The grey lines represent the hollow ways (routes) mapped by Jason Ur.

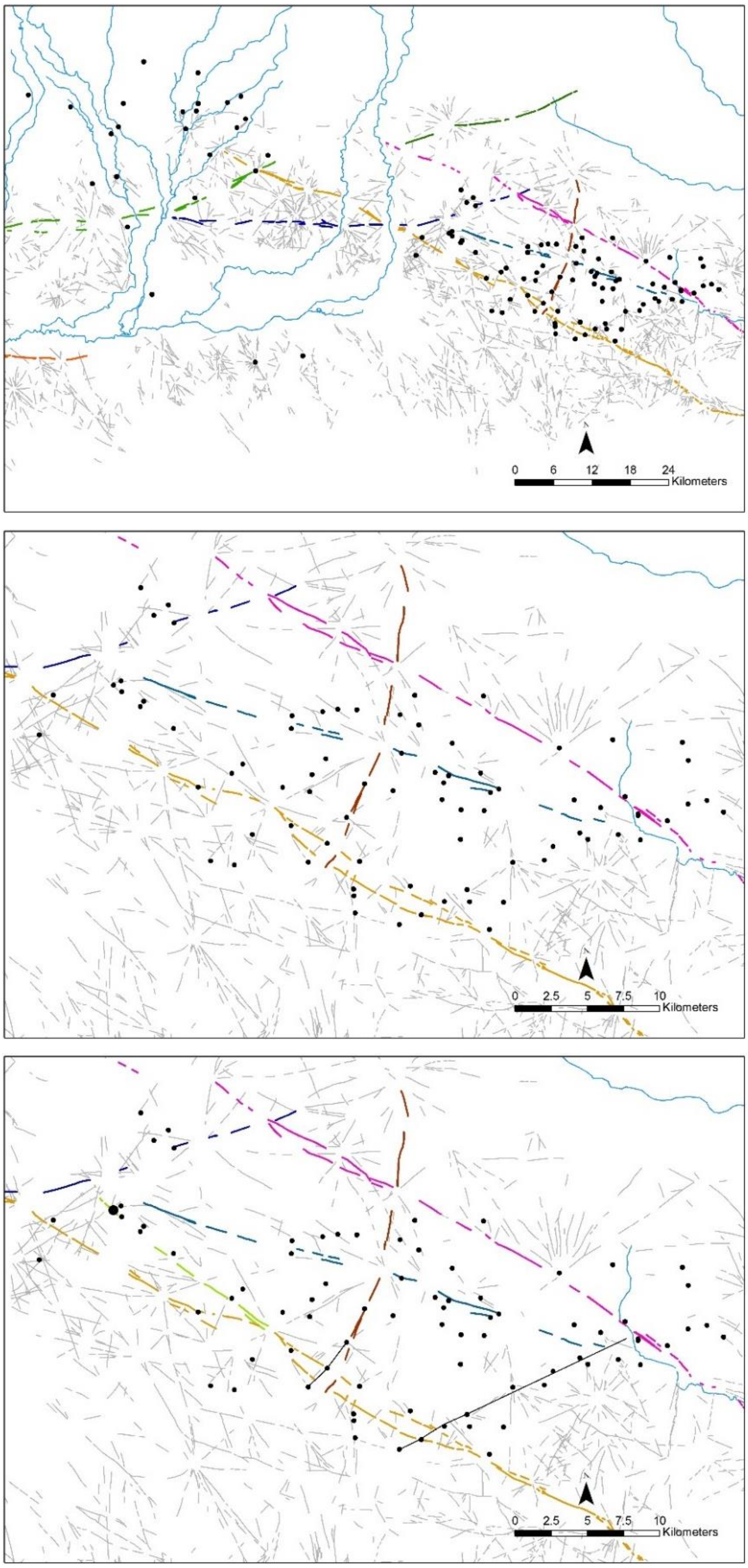

Figure 4.2 (a) Settlements appear to be situated along routes preserved as hollow ways already in the early fourth millennium B.C.; (b and c) in the North Jazira and Hamoukar survey areas, some settlements appear to be arranged linearly, suggesting the presence of routes that are not preserved as hollow ways; (c) the route Jason Ur (2010) observed may have been in use during the early fourth millennium B.C. is shown in green.

Finally, Tell Brak is estimated to be 55 ha in size at this time (Ur, Karsgaard, and Oates 2007). Also of urban proportions, Tell Brak continued to grow, more than doubling in size by the late fourth millennium B.C. (Ur, Karsgaard, and Oates 2011).

Overall, the settlement pattern for the North Jazira during the early fourth millennium B.C., before the Uruk Expansion, was one of small agricultural villages punctuated by three large centres.

A final important note regarding settlement patterning regards Jason Ur's (2010, 99) observation that it was during the Late Chalcolithic 1-2 period in the Hamoukar Survey area that sites first begin to show linear alignments suggestive of placement along routes running northwest-southeast. The sites that form this linear alignment were not contemporaneously inhabited at any point in time after the early fourth millennium B.C. (Ur 2010, 96–128). Upon closer examination, this pattern can also be seen in the neighbouring North Jazira Survey area and, to a lesser extent, in the 1995 Leilan Regional Survey area (**figure 4.2c**). Significantly, the linear alignment observed by Ur (2010) and other linear alignments that appear in the survey areas correspond to long distance routes known from preserved hollow ways segments. This raises the possibility that while the hollow way features may belong to a later time period, the routes they record may have already been in use during this time period. Additionally, the linear alignments of sites that do not correspond to preserved hollow ways could signify routes did not have sufficient density of traffic over a long enough period to form the features.

4.2.2 Population Demographics and Workforce

For the Jazira, population density estimates vary between 100 people per hectare and 200 people per hectare, with nearer 100 people per hectare more likely for larger, urban sites (Wilkinson 1990a table 1; Wilkinson 1994; Ur 2010, 153–54; Widell et al. 2013). Using these figures, almost all sites during the early fourth millennium were small villages that had fewer than 600 and possibly fewer than 300 people each. The exceptions to this trend, once again, are THS25, Tell al-Hawa, and Tell Brak. At these sites, as demonstrated below, large populations could support thousands of specialists and administrators. The numbers involved imply organisation beyond family groups, but not necessarily larger than (possibly constructed) kinship ties or tribal affiliation (see Porter 2012, 36–39).

Estimating the population of THS25 is complicated due to its unusual nature. If only the 31 ha low mound is taken into consideration, the area of the site undoubtedly inhabited by a sedentary and permanent population, then THS25 had a population of between 3,100 and 6,200 people. If settlement density was similar to the modern village located at Tell Hamoukar, the site was home to 5,300 people (Ur 2002b, 18–19). If, however, the full site area is considered there may have been up to 21,600 people. Tell al-Hawa and Tell Brak (55 ha), as typical tell sites for the region, are less complicated. Using the standard population density estimates for the area, Tell al-Hawa would have had between 3,300 and 6,600 inhabitants, while Tell Brak would have had between 5,500 and 11,000 inhabitants.

The small villages did not have a sufficient population size to support full-time specialists. Rather their populations would have been engaged primarily in agricultural and/or pastoral activities. The larger centres, however, were different. Using population age distribution values from modern underdeveloped countries as an estimate,[7] then it is possible to reconstruct the scale of the potential available workforce. These values were selected, because they have the general profile expected of a prehistoric population: more than one living child per adult (replacement rate), resulting in a demographic profile with more young people than old people. The resulting estimates below are approximate values, but are useful for their scale: 100 versus 300 or 500, 1000 not 5000 or 10,000, and so on.

THS25 would have had an adult population, a potential workforce, between 1,860 and 3,720 male and female adults, but possibly much higher. It can be expected that about half these people were female, though, and it is uncertain what roles they would have played outside the household during this period.

[7] Using the UN list of least developed countries and World Bank age distribution statistics, it was calculated that in underdeveloped countries the proportion of the population 14 years old or under is about 40 percent (mean = 41.14, median = 42.31, standard deviation = 5.67, minimum = 24.91, maximum = 50.09, *N* = 47) (TheWorldBank 2016; IndexMundi, n.d.). The division between adult and child at 14 years old reflects The World Bank data age categories of 0-14, 15-64, and 65+ years old.

Site	Size (ha)	Population	Agricultural Workers Required	Available Workers
THS25	31-108	3,100-21,600	299-2,919	1,240-8,640
Tell al-Hawa	33	3,300-6,600	319-892	1,320-2,640
Tell Brak	55	5,500-11,000	531-1,486	2,200-4,400

Table 4.1 The estimated size, population, and workforce for each of the three centres during the LC 1-3 periods in the North Jazira.

Tell al-Hawa would have had a potential workforce of between 1,980 and 3,960 male and female adults (990-1,980 male) and, lastly, Tell Brak would have had a potential workforce of between 3,300 and 6,600 male and female adults (1,150-3,300 male).

Wilkinson (1994, 496) observed that a 5 km field radius requires the labour of about 2,620 workers, or about one worker for every 3.7 ha. Widell et al. (2013) estimated an average consumption of 250 kg/person/year of grain. Furthermore, it has been observed that in the North Jazira, crop yield rates are between 500 kg/ha/year and 700 kg/ha/year (Widell et al. 2013; Wilkinson 1990b). Together these figures predict that between 24 and 34 percent of the total adult population of a site would be needed to work in the fields. If adult females are excluded from the workforce, then 48 to 68 percent of the workforce at a site (regardless of size) is required to work in the fields. In terms of real numbers, a small one-hectare site would have few spare workers (40), especially if women were required to maintain households (reducing the estimate to 20 spare workers) and accounting for elderly people no longer able to work. As the site size becomes larger, however, the numbers of spare workers who could become full-time specialists increases linearly in proportion to site size and population (with a slope change once the maximum field radius is reached).

Applying these figures to the three LC 1-3 centres (**table 4.1**) reveals that each centre would have had an excess of more than a thousand workers. Evidence from excavation described below shows that at THS25 many (most?) of these specialists would have worked in the lithic industry, while the specialists at Tell Brak worked in many different industries.

4.2.3 THS25 – Khirbat al-Fakhar

An extensive site unlike others discovered in the region, THS25 is argued to resemble an urban-sized village (Ur, Khalidi, and Quntar 2011, 153). It is estimated to cover an area of about 300 ha, but with settlement concentrated in the southeast quadrant of the site on a 31 ha low mound (Ur, Khalidi, and Quntar 2011, 153; Ur 2010, 96). In total 10 soundings and four trenches were excavated (Ur, Khalidi, and Quntar 2011, 153–57).

The soundings were clustered slightly west of the spatial centre of the site, immediately west of the low mound, (Ur, Khalidi, and Quntar 2011, fig. 2). These soundings revealed that the extensive scatter of sherds and obsidian that comprise most of the approximately 300 ha site define an area with 'a shallow deposit of occupation' (Ur, Khalidi, and Quntar 2011, 153). Similarly, remote sensing using CORONA imagery[8] revealed this extensive area surrounding the low mound contains a total of 77 ha of lighter soils indicative of decayed mudbrick and believed to represent low density settlement (Ur, Khalidi, and Quntar 2011, 168–69). It is this extended area of shallow deposits and 77 ha of lighter soils that complicates population estimates, as already seen.

In 2002, Ur noted that 'settlement in the early 4th millennium may have been similar in layout to the modern village at Tell Hamoukar, where roughly 750 persons live in groups of houses scattered over 40 hectares (19 persons per hectare)…if the same persons per hectare figure is applied to the early 4th millennium settlement, the ancient population might have been as low as 5,300 people, assuming all parts of the site were settled simultaneously' (Ur, Khalidi, and Quntar 2011, 18–19). In 2011, Ur et al. updated this estimate, writing that 'if we assume these areas [the 31 ha low mound and 77 ha of lighter soils] were settled at densities comparable to later Mesopotamian settlements, a fully sedentary settlement could have contained

[8] CORONA satellite imagery is panchromatic (black and white, covering the visible spectrum of light) and dates between 1967 and 1974 when it was used by the US for spying during the Cold War. It was declassified in the 1990s (for more information, see NASA 2013; Galiatsatos 2004, 44–48)

10,000-20,000 persons' (Ur, Khalidi, and Quntar 2011, 168). Another possibility is that the people inhabiting the 77 ha of lighter soils were not sedentary, but were transhumant mobile pastoralists (Ur, Khalidi, and Quntar 2011, 169; Ur 2010, 147–48; Wilkinson 2002, 101).

The 31 ha low mound undoubtedly represents sedentary occupation. Of the four trenches, ZM and ZD 3/4 present the most compelling evidence. Trench ZI revealed a dump area and ZD 1/2 contained 'linear scatters of LC pottery sherds and baked brick fragments, which were possibly the remains of ephemeral structures' along with various artefacts, including clay hut symbols or eye idols (Ur, Khalidi, and Quntar 2011, 153–54).

The structures in Trench ZM were interpreted as 'a domestic context with an associated obsidian workshop' (Ur, Khalidi, and Quntar 2011, 154). The features found were: a round oven with an ash pit, a bin, and a subterranean storage pit that contained 'a large number of obsidian cores and large flakes' (Ur, Khalidi, and Quntar 2011, 153–54) Additional artefacts found in Trench ZM include: 'two intact hut symbols of the closed-eye type, as well as a number of the standard hut symbols with wide-open eyes,' as well as a sealing that corresponds to a seal found in Trench ZD (Ur, Khalidi, and Quntar 2011, 154).

Trench ZD 3/4 had three levels dated to LC 1-2 and one level dated to an earlier period. The earliest sublevel of the earliest level (Level 3) in this trench contained a large, multi-room building reminiscent of an LC 2 building found at Tell Brak in Area TW, level 20. It had a courtyard with a large basin that the excavators hypothesized was possibly used to mix clay, a room with a small tannur, a room with a fire pit or hearth, a room with 'a couple' of wide flower pots, animal bones, and an obsidian blade core, a room with a black stone seal, and an additional room with a wide flower pot (Ur, Khalidi, and Quntar 2011, 155). Outside, to the west of the building, was an ashy midden that 'contained a large quantity of animal bones, pottery sherds, obsidian blades and debris, hut symbols, and piles of baked and unbaked bricks' (Ur, Khalidi, and Quntar 2011, 155). The building was renovated over the subsequent two sublevels, but retained evidence for craft activities. In the next sublevel three rooms were demolished and 'a large thick-walled kiln or oven', 3 metres in diameter was installed, which is believed could have been used to fire ceramics (Ur, Khalidi, and Quntar 2011, 155–56). An additional 'fire installation' was constructed in the latest of the three sublevels and the excavators found two small post holes they believe could have supported a loom (Ur, Khalidi, and Quntar 2011, 156). Two hoards were found between walls. One contained 'obsidian preparation flakes knapped from the same core, stone pestles, a black hemispherical seal, and a large slab of sealing clay' (Ur, Khalidi, and Quntar 2011, 156). The second had 'a whole vessel, an obsidian core, spindle whorls, and a hut symbol' (Ur, Khalidi, and Quntar 2011, 156).

Over the subsequent two levels of Trench ZD 3/4, this building was abandoned and 'the area was turned into an open work area of pits and sherd scatters' (Ur, Khalidi, and Quntar 2011, 156). The building also contained a pit kiln, 3.5 meters in diameter that contained ash, ceramic sherds, slag, 'an obsidian blade core and a number of bladelets, two sealings, and three hemispherical black stone seals' (Ur, Khalidi, and Quntar 2011, 156–57). The excavators described that 'sherd scatters were irregularly distributed, possibly delimiting activity areas. A substantial quantity of obsidian representing the entire blade core reduction sequence recovered on various surfaces, in dump areas, and in pits, demonstrates that this outdoor activity area became a major locale for obsidian knapping' (Ur, Khalidi, and Quntar 2011, 156).

In total, over 5,000 obsidian blades were excavated, comprising 70% of the obsidian lithic assemblage (Ur, Khalidi, and Quntar 2011, 162). A sample of 33 excavated pieces of obsidian were analysed, revealing that that majority (28/33) were sourced from Nemrut Dağ near Lake Van in Anatolia (Lamya Khalidi and Gratuze 2010, 18). Of the remaining five pieces, two originated from Bingöl B, one from Meydan Dağ, and two from Sarikamiş North (including the one piece analysed from the lowest, pre-LC 1-2 level of the site) (Lamya Khalidi and Gratuze 2010, 18–19). Few of the over 5,000 pieces of obsidian contained cortex, suggesting that this was removed nearer the source (Lamya Khalidi and Gratuze 2010, 19). Furthermore, the lithic assemblage provides evidence that THS25 was producing obsidian blades for local use and was involved in regular, direct exchange with the main source area(s) for the obsidian, currently identified as Nemrut Dağ (Lamya Khalidi and Gratuze 2010, 19–22).

One explanation for how direct exchange between THS25 and Nemrut Dağ could have been maintained, despite the distance, also offers explanation for the large low density area of settlement of the main 31 ha low mound: transhumant mobile pastoralists (Ur, Khalidi, and Quntar 2011, 169; Ur 2010, 147–48; T. J. Wilkinson 2002, 101). Following this hypothesis, settlement at THS25 would have been reduced in the summer as the mobile pastoralist portion of the population took their herds into the highlands near Nemrut Dağ. Before returning to the lowlands for the winter, the mobile pastoralists collected obsidian to bring back to THS25. Without donkeys, they would have needed to either carry the obsidian themselves, along with any personal belongings, or have tried to convince their herds of sheep and goat to carry the items! This is a key critique of the idea that there were transhumant mobile pastoralists at this time: the lack of clear evidence for a domesticated pack animal (Ur 2010, 148). Another argument against a population of transhumant pastoralists are the 'dense and diverse [ceramic surface assemblage], which suggests that households had large pottery inventories that accommodated the full range of sedentary domestic activities, particularly storage of cereal' and 'decayed mud brick, which signifies an architectural investment' (Ur, Khalidi, and Quntar 2011, 169), though Ur (2010, Ur et al. 2011) has not ruled out the possibility.

However, these critiques can be addressed as follows: The total area of soil indicating low density, possibly transhumant, settlement around THS 25 (which is patchy rather than contiguous) is 77 ha. Even if a very low value is used to estimate population, for example 50 people per ha (half the lowest usual estimator of 100 people per ha), there would still have been a population of 3,850 potentially transhumant people living around the core sedentary settlement at THS25. Without a pack animal for weaker members of the population like young children to ride[9], it is possible that women, children, and the elderly remained behind while the men took the animals to summer pasture nearer Nemrut Dağ. This would explain the complete ceramic

[9] See for example early ethnographic footage of the Bakhtiari tribe's transhumant migration from winter to summer pasture in the 1925 documentary film *GRASS: A Nation's Battle for Life* by Merian C. Cooper, Ernest B. Schoedsack, and Marguerite Harrison.

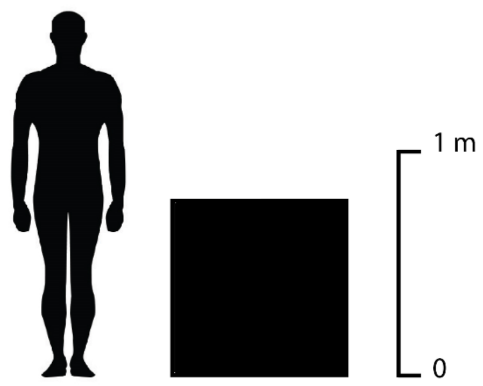

Figure 4.3 A cube of obsidian weighing a metric ton would measure 72.72 cm on each side (image drawn by Ludwig Fuchs).

assemblage observed, since more than half of the total pastoral population would effectively be sedentary.

Applying the above workforce estimates to the very low estimated population of potential pastoralists (3,850), there would have been 2,310 adults, including about 1,155 men. Some of these men would have been too old or unable for other reasons to make the journey, but there still would have been upwards of 1,000 adult men to take the flocks north and carry obsidian back on the return journey. If they all brought back only a single kilogram of obsidian on their return journey to THS25, they would have supplied the site with about a metric ton of obsidian in the autumn of every year. If the men managed to carry more than 1 kg each, then the amount only increases. This would place the sheep and goat herds in the vicinity of Nemrut Dağ at the time of plucking (May/June), providing an easy trade item in exchange for the obsidian.

These estimates and mathematical exercises do not prove that a transhumant population existed, only that it is possible and, given the numbers involved, the task of carrying relatively large volumes of obsidian over a long distance is not as arduous as it might seem at first.

4.2.4 Tell Brak

The economy of Tell Brak during the early fourth millennium B.C. was primarily based on pastoralism of sheep and goat, agriculture, textile production, and large-scale food production for feasts; but also included a range of craft industries including ceramic production and the production of stone tools and ornaments (Pournelle and Algaze 2014, 9–10; Khalidi 2016; Al Quntar and Abu Jayyab 2016; Weber 2016; Ur 2016, 52). Within both the ceramic and stone industries trends have been observed over time.

In the lowest level of LC 2 (level 21), 84% of stone tools were made from obsidian, but the proportion reduced over time such that by the next level of LC 2 (level 20), only 59% of stone tools were produced from obsidian (Khalidi 2016, 70–71). Meanwhile, the proportion of tools produced from chert increased from 16% to 41% (Khalidi 2016, 71). At the same time, there was also a shift away from blade production towards the production of perforators, borers, drills, scrapers, and other tools, which tended to be made from chert (Khalidi 2016, 78). Khalidi (2014, 70) hypothesized that the shift from obsidian to chert seen between levels 21 and 20 may reflect an increased use of hafted tools like sickles and threshing sledges. However, there is another significant observation to be made regarding stone: as obsidian became used less often for practical purposes, it appears to have become appropriated by the elite for prestige items alongside mother-of-pearl, red jasper, and marble (McMahon 2016, 181).

It was in the final early fourth millennium B.C. level (Level 19, LC 2-3) that the famous chalice was found, made from a used obsidian core and a small block of marble bound together by a messy band of bitumen (Khalidi 2016, 84). Khalidi (2014, 84) noted the contrast of a 'regal' vessel made from blade manufacturing waste and highlights that this 'dichotomy exposes the complexity of the relationship between increased specialisation and nascent social stratification'; though the exact nature of that relationship remains unknown.

Finally, it is important to note that not all stone tools found at Tell Brak are believed to have been produced locally. Firstly, there is no local source of obsidian and, secondly, observation of the assemblage shows that obsidian blades made from a distinctive colour of obsidian, which is least frequently found in debris, are also consistently produced using a chaîne opératoire different from the tool forms that can be shown to have been produced at Tell Brak (Khalidi 2016, 74). THS25, however, was not the likely supplier as the colour of these obsidian blades is not consistent with obsidian from Nemrut Dağ, the main supplier of THS25.

At the same time these changes were taking place in the lithic industry, the ceramic industry was undergoing its own shift. From level 21 through level 19 (at the transition between LC 2 and LC 3), chaff-tempered wares and mixed chaff-mineral-tempered wares gradually replaced mineral-tempered wares (Al Quntar and Abu Jayyab 2016, 95). At the same time, and relatedly, there is a shift towards mass produced vessels, most notably the wide flower pot – a mass produced vessel seen across Northern Mesopotamia (Al Quntar and Abu Jayyab 2016, 95).

Evidence for all of these activities, from food production to craft industries, was found in Area TW where a series of workshops was found in the earliest level (21), followed by construction of the Basalt Threshold Building (levels 20-19), the Green Building (level 20), and the Red Building (level 19) (Khalidi 2016; Al Quntar and Abu Jayyab 2016, 89–92).

4.2.4.1 Level 21 Workshops (LC 2, Level 21)

Level 21 of Area TW is described as a complex containing small rectangular rooms, bins, and multiple large ovens for food production (the primary activity), a pottery kiln, and activity areas for stone tool, bead, and ornament production (Al Quntar and Abu Jayyab 2016, 89–90; Khalidi 2016, 71, 75). Debris and ash from these activities was disposed of in a street to the west of the workshop complex and in pits, when it was not used to create a fill layer before construction of a new floor (Khalidi 2016, 71). Within the workshop complex, young children and babies (mostly between 9 months and 2 years old) were buried under floors and ovens, including one exceptional child, 5-6 years old, who wore two mother-of-pearl pendants and was wrapped in a cloth with more than 2,500 stone and shell beads (Khalidi 2016, 71; McMahon et al. 2007, 154). This area also contained the largest and earliest known eye idol on the site (McMahon et al. 2007, 153).

4.2.4.2 The Basalt Threshold Building / Niched Building (LC 2-3, Levels 20 and 19)

The Basalt Threshold Building was described as 'arguably the earliest secular monumental building yet discovered in the Near East' (McMahon et al. 2007, 149). It was a public building that 'was constructed on an 80 cm deep platform of large cobbles and clear red clay' (Emberling and McDonald 2001, 22; Al Quntar and Abu Jayyab 2016, 90). Its name comes from the large basalt threshold (1.85 m x 1.52 m) at the entrance to a wide doorway into the building (Oates and Oates 1997, 288; Emberling et al. 1999, 2–3; Al Quntar and Abu Jayyab 2016, 90; Khalidi 2016, 72). This door was accessed through a large paved (gravel and lime plaster) courtyard leading to an entry way with a plaster floor and timber under-flooring (Emberling and McDonald 2001, 23; Al Quntar and Abu Jayyab 2016; Oates et al. 2007, 90). The walls of the building were 1.85 m thick (Al Quntar and Abu Jayyab 2016, 90; McMahon et al. 2007, 149). Below the northwest corner of the building was a burial with three neonatal skeletons and a small eye idol (McMahon et al. 2007, figs. 153-154). Outside the building there were many ovens and attached directly to the exterior walls of the building were small workshops, which were used to produce ornaments (Emberling and McDonald 2001, 24–25; Emberling and McDonald 2003, 9; Khalidi 2016, 72, 75). Inside the building, the rooms were found completely empty, but it is hypothesized to have been an administrative building for the industrial activities in the courtyard outside and in the neighbouring Green Building (Khalidi 2016, 90–91).

4.2.4.3 The Green Building (LC 2, Level 20)

The Green Building was an industrial building nearly 10 m^2 in size where textiles (evidenced by numerous spindle whorls), beads, stone and shell inlay, stone palettes, ground obsidian discs, bone and stone tools, including obsidian blades were produced (Al Quntar and Abu Jayyab 2016, 90–91, fig. 6.2; Khalidi 2016, 72–73). The entrance of the Green Building leads to a large L-shaped room (McMahon et al. 2007, fig. 4). In the corner of the L, is a large room/courtyard, while to the right (east) of the entrance were a series of three smaller rooms (McMahon et al. 2007, fig. 4). In two of these small eastern rooms 'a number of well-made bone and groundstone tools were found' (McMahon et al. 2007, 153, fig. 4). Ceramics were produced in the courtyard between the Green Building and the Basalt Threshold Building, where there was an updraft kiln (Al Quntar and Abu Jayyab 2016, 91). Children and babies continued to be buried under floors and ovens (Khalidi 2016, 71).

4.2.4.4 The Red Building (LC 2-3, Level 19)

The Red Building (also 'Red Libn Building') was an industrial building constructed in approximately the same location as the Green Building (shifted about 5 m south), but is estimated to have been slightly larger – about 11 m^2 – and built of red mudbricks

(Al Quntar and Abu Jayyab 2016, 91; McMahon et al. 2007, 150, figs. 4,5; Oates et al. 2007, 591). Inside, it had 'four symmetrical rooms of approximately the same size' in which it was described that the same industries represented in the Green Building continued, but 'there appears to be far more organization in the use of space and segregation of activities' (Al Quntar and Abu Jayyab 2016, 90–91). The two rooms (Rooms 1 and 2) on the north side of the building both contained ovens approximately 2.5 m in diameter (McMahon et al. 2007, fig. 5). The obsidian and marble chalice was found inside the southwestern room (Room 4) of the Red Building (McMahon et al. 2007, 151; Oates et al. 2007, 591). Inside the same room were balls of clay, frequently referred to as 'sling bullets', though in this case they have been interpreted as the raw material for sealings; and a sealing depicting a lion (Oates et al. 2007, 592). This lion sealing is significant, because the lion was a symbol of kingship starting in the LC 3 period and continued to be through the first millennium B.C. (McMahon 2009; Weber 2016; Oates et al. 2007, 592).

4.2.5 Trade and Interaction

Looking at the evidence presented above, there is strong evidence for the presence of regional, and even interregional, trade and interaction during the early fourth millennium B.C. It has been observed that some sites are located along long distance routes preserved by hollow way features; and a linear cluster of sites in the North Jazira Survey area appears to indicate a possible additional southwest-northeast route not preserved in the hollow way features.

Beyond the routes there is additional evidence for social, economic, and ideological ties across the region; and for important differences that evidence indirect contact across the region.

Rova (1996) compared ceramic assemblages from LC 2-3 levels across Northern Mesopotamia and concluded that while there was a shared ceramic tradition across the region, there were also distinct ceramic provinces based on form and decoration. Tell Brak was placed in Ceramic Province B, while THS 25 was at the western limits of Ceramic Province C (Rova 1996, 15–16, fig.2).

A more recent study comparing the ceramic manufacturing techniques used at Tell Brak and THS 25 (LC 2)/Tell Hamoukar (LC 3) has found that while the sites manufactured many of the same types, using the many of the same methods,[10] the methods chosen to produce each individual type were different (Al Quntar and Abu Jayyab 2016, 96–97, tables 6.1 and 6.2). For example, both THS25/Tell Hamoukar and Tell Brak produced hole mouth pots, a type of cooking vessel (Al Quntar and Abu Jayyab 2016 tables 6.1 and 6.2). At THS25/Tell Hamoukar, potters sometimes formed this vessel using a slow wheel, while at Tell Brak potters sometimes formed hole mouth jars using coils (Al Quntar and Abu Jayyab 2016 tables 6.1 and 6.2).

It was the same study by Al Quntar and Abu Jayyab (2014), which observed that at both THS25/Tell Hamoukar and Tell Brak during the LC 2 and LC 3 periods there was an increase in chaff wares and mixed chaff-mineral tempers coinciding with a reduction in mineral tempered wares (Al Quntar and Abu Jayyab 2016, 95). Similarly, a study comparing lithic production between Tell Brak and THS25 from LC 1 to LC 3 found a parallel trend in the strong preference for obsidian during the earlier LC 1 and 2 periods giving way to a growing preference for chert (Khalidi 2016). Furthermore, eye idols are present at both Tell Brak and THS 25/Tell Hamoukar, but they tended to be made of stone at the former and bone at the latter (Gibson et al. 2002; Mallowan 1947; McMahon et al. 2007, 153–54). Overall, the evidence suggests regular, but indirect contact across the region.

Returning to the long distance routes, it is too early to establish who the primary travellers would have been along each of the long distance routes. It is tempting to speculate that nomadic or semi-nomadic pastoral groups travelled the routes heading northeast from the limits of rain fed agriculture, through the North Jazira Survey area, towards the Tigris and up towards Nemrut Dağ. The possible transhumant pastoral

[10] The two populations used different kiln technologies. At THS25/Tell Hamoukar, potters made use of pit kilns and at Tell Brak, the potters used updraft kilns (Al Quntar and Abu Jayyab 2016, 98–99, tables 6.1 and 6.2). Both groups of potters sometimes made use of open firing (Al Quntar and Abu Jayyab 2016, 98–99, tables 6.1 and 6.2).

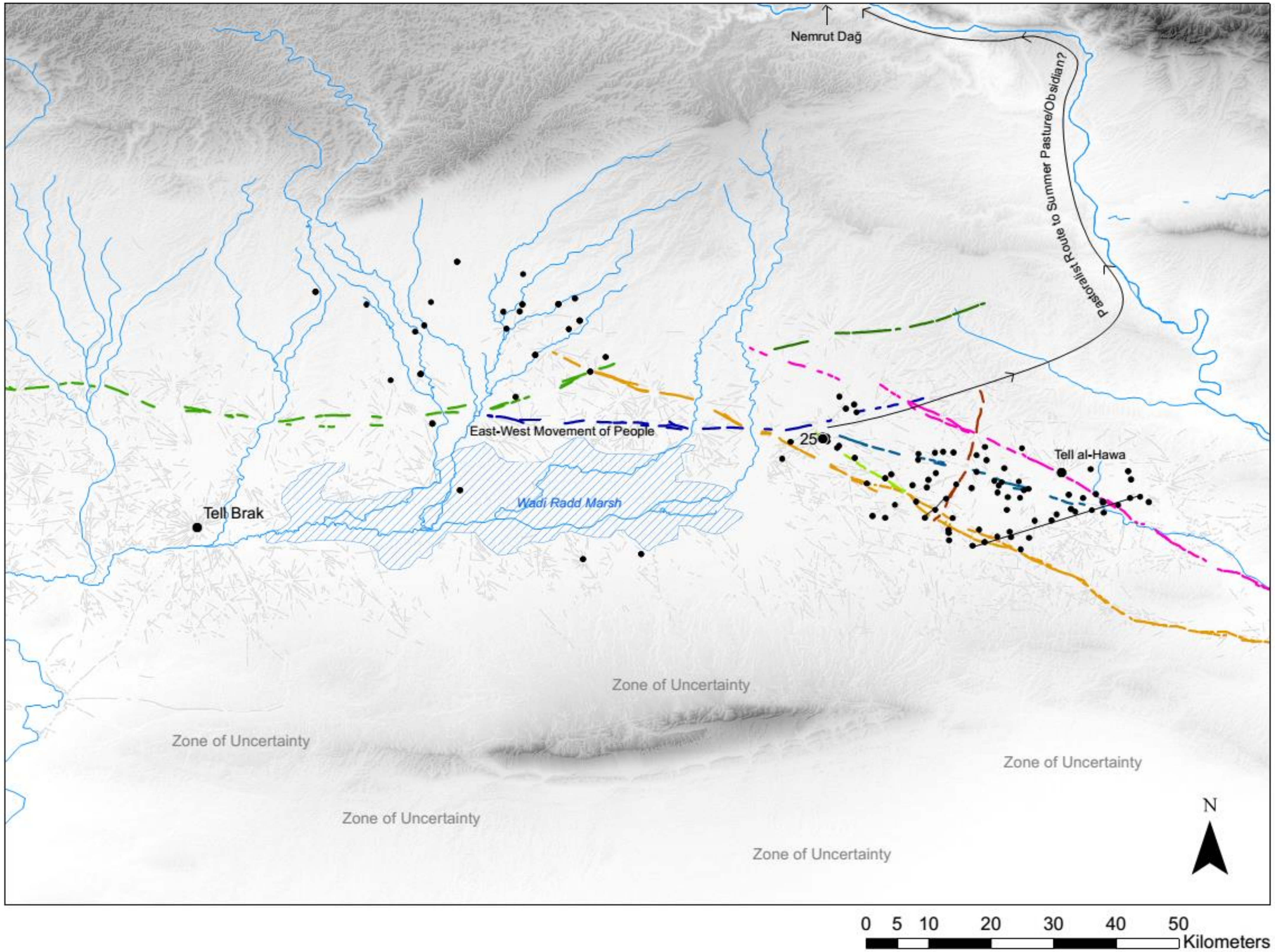

Figure 4.4 A reconstruction of routes used during the early fourth millennium B.C. based on evidence from survey and excavation.

population of THS could be imagined to travel eastward in the spring along the northern east-west route (shown in blue in **figure 4.4**) across the region that runs past THS25 and towards the Tigris, following the river northwards towards upland summer pasture near Lake Van and within relatively easy reach of Nemrut Dağ where they could exchange wool plucked from their animals in May/June for obsidian to bring back to THS25 in the autumn. The fact is, however, this is only speculation and imagination, because at this time there is not enough evidence to decide if there were nomadic or seminomadic pastoral groups in this early time period without pack animals.

Another possible demographic of travellers are the people responsible for the exchange Hole observes (2016) between Ubaid/post-Ubaid/LC1-2 sites in the middle Khabur through the Jazira into Anatolia – especially Kenan Tepe. If the exchange between these sites were direct either via traders or transhumant pastoralists (Hole 2016, 236,238-239), the people engaged in that exchange would have travelled from the middle Khabur sites northwards along the Khabur, then eastwards overland across the North Jazira, quite possibly following the east-west route highlighted in **figure 4.4**, then north along the Tigris, which would lead them to Kenan Tepe.

Finally, it is important to clarify that the potential for transhumant pastoral groups around THS25 does not negate the possibility that some of the sedentary population at THS 25 could have kept herds, which fed on the crops around the site and pastured on the steppe through the dry season. If anything, transhumant pastoralists taking their herds north in the spring towards upland pasture would reduce pressure on the local, steppe compared to the effects that a fully sedentary population with herds at THS 25 would cause from much larger scale grazing.

4.3 The Late Fourth Millennium B.C. (LC 3-5)

This period covers the Uruk Expansion, when two different populations with two different cultures were present simultaneously in the North Jazira: the local inhabitants and an unknown number of people from various polities of Southern Mesopotamia. The result is a palimpsest of two overlying settlement strategies, populations, and cultures. Additionally, two important developments occurred by the start of this period of time in the pastoral and ceramic-production sectors of the economy.

4.3.1 An Important Pastoral Development

Sheep had been increasing in size since the Halaf, but now reached their maximum size in the second half of the fourth millennium B.C. (Vila and Helmer 2014).[11] The same faunal evidence suggests this increase in size was due to selective breeding rather than other factors like improved nutrition (Vila and Helmer 2014). In fact, iconographic evidence indicates that the large late fourth millennium sheep now belonged to one of two breeds: a hairy-coated breed with long spiral/corkscrew horns extending out horizontally, or a coil horned breed (Vila and Helmer 2014, 30-33). Some evidence is also cited for fat-tailed sheep, but the two examples referred to (a stone bowl fragment in Zeuner 1963, fig 85, and a gold filet from the cemetery at Ur in Woolley 1934, pl.139) actually date to the early third millennium (Vila and Helmer 2014, 30-33).

4.3.2 A Note on the Production of Chaff Wares

Chaff gradually replaced mineral temper in ceramic production during the LC 2-3 period (Al Quntar and Abu Jayyab 2016, 95), so that by the LC 3-5 periods most ceramics were chaff tempered (see, for example, Oates 2002, 111; Rothman 2002, 55). This has important implications for ceramic production: chaff is a seasonal product. It is for this reason that Eiland (2003, 345) argued that ceramic production may have been a seasonal activity rather than a full-time profession. He points out that the large quantities of chaff needed to produce the abundance of chaff-tempered wares, including bevel rim bowls, would have been most easily obtained at harvest in May (Eiland 2004). Otherwise, in addition to grain stores, production centres would have needed additional storage space for chaff (Eiland 2004). It is further noted that ceramics would dry much quicker during the dry season that follows harvest, and that the shell temper that sometimes accompanies the chaff

[11] There was an 11.65% increase in sheep size between the Halaf and Uruk, using the dataset presented in Vila and Helmers (2014, table 2.1). The average greatest length of Halaf sheep talus is 28.8 cm vs. 32.2 cm for an Uruk sheep talus. Using the same multiplier applied by Vila and Helmers (2014), this translates to an average withers height of 65 cm for Halaf sheep vs. 73 cm for Uruk sheep.

temper wares would be most easily harvested from mussels living in wadis during the dry season when water levels receded (Eiland 2004).

4.3.3 Settlement Patterning

The number of sites across the region increases greatly between the LC 1-3 and LC 3-5 periods. However, this increase is not uniform across the North Jazira (**figure 4.5**). Rather, while settlement numbers multiplied in the Tell Brak Survey areas and the Hamoukar and North Jazira Survey areas, the number of settlements in the 1995 Tell Leilan Regional Survey decreased.

The inhabitants of the new sites, as seen from the Tell Hamoukar and North Jazira surveys, are varied. In some cases, the inhabitants of these new sites appear to have used exclusively Southern Mesopotamian material culture. Meanwhile, other new sites contained only local material culture. One new site (NJS84) contained a mix of southern and local material culture (**figure 4.6**). There is no apparent spatial patterning to the sites with southern material culture, but it must be kept in mind that collection on the sites was not systematic. Rather the goal during fieldwork was to collect diagnostic sherds in order to provide dates for the sites at a time before the Sante Fe chronological divisions of LC 1-5 (Wilkinson and Tucker 1995, 17). Since then the range of diagnostic wares has increased, particularly with regard to our understanding of local chaff wares, such that the Hamoukar ceramic typology (an updated version of the North Jazira Survey typology) contains 21 new diagnostic types for the Late Chalcolithic, including 12 new types specific to periods LC 3-5 (Ur 2010, 216–17). For this reason, the existing spatial distribution of southern and local sites in the North Jazira Survey is probably a result of survey bias.

Disregarding any patterning to southern or local sites, when the new spatial distribution of sites is examined in relation to the long distance routes, it appears they have shifted to cluster nearer the long distance routes through the region (**figure 4.7**). Around Tell Brak, numerous sites are connected in strings by preserved hollow way segments with a particularly dense string along the east-west route south of Tell Brak and the Wadi Jaghjagh, which would have been a permanent river and may have been navigable at the time (Eidem and Warburton 1996; Riehl and Deckers 2007; Deckers 2011; Wright et al. 2007). In the Hamoukar and North Jazira Survey

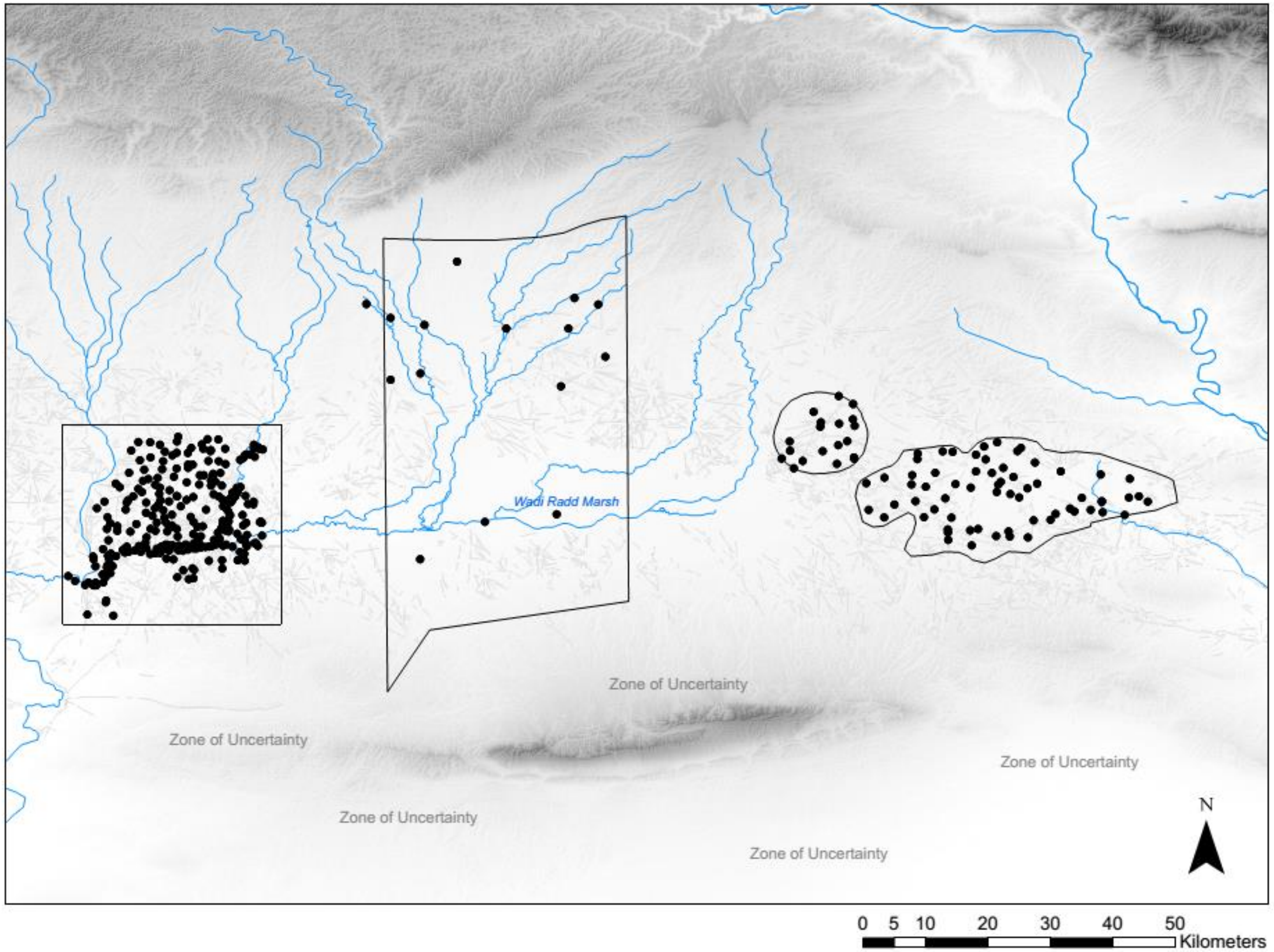

Figure 4.5 Late fourth millennium (LC 3-5) settlement across the North Jazira, including results from the Tell Brak surveys, the re-assessed 1995 results of the Leilan Regional Survey, the Tell Hamoukar Survey, and the re-assessed results of the North Jazira Survey (Eidem and Warburton 1996; Wright et al. 2007; Brustolon and Rova 2007; Jason Ur 2010; Appendix B). The survey boundary around the Tell Brak surveys is estimated based on the locations of sites found.

areas, sites seem to particularly cluster along the northern-most route running northwest-southeast, and a new linear alignment of sites (not associated with preserved hollow ways) appears south of Hamoukar, possibly evidencing an additional route. The exception to this trend is the Tell Leilan Regional Survey area. There, sites that aligned to the northern east-west route across the region during LC 1-3 were abandoned leaving no evidence through association that this route continued to be in use during the LC 3-5. During LC 3-4, three new sites with entirely southern material culture appear south of the Wadi Radd in a roughly linear pattern that loosely appear to be oriented in the same direction as the southern route heading east from the Tell Brak survey areas, but all three were abandoned before the start of the LC 5 period.

While there is stronger evidence through association with sites for use of long distance routes in the other case study areas, in the Leilan Regional Survey area, the disassociation of sites with routes appear to signal the abandonment of east-west routes across the North Jazira during the LC 3-5 (**figure 4.7a**). While this may be very dependent on site recognition, this particular area within the Leilan Regional Survey has been repeatedly surveyed on foot, from vehicles, and with remote sensing (see Chapter 3).

4.3.4 Settlement Hierarchy

In addition to the general (if uneven) increase in the number of sites in the North Jazira during LC 3-5, there were also changes to the settlement hierarchy. The emergence of sites that were neither small villages nor large centres result in a more complex, four-tier settlement hierarchy (compared with the two-tiered hierarchy during LC 1-3). This four- tier settlement hierarchy consisted of small villages under 4 hectares in size, larger villages about 5-6 hectares in size, small centres (Tell Leilan, Tell al-Hawa, Tell Hamoukar, and Tell Hamoukar Survey site 40), and large centres (Tell Brak and al-Andalus in the Leilan Regional Survey) (table 4.2).

4.3.5 Population Demographics and Workforce

Using the same figures as above to estimate the size of the workforce and the number of surplus workers available after agricultural labour is accounted for, the two largest centres had thousands of workers available who could have become specialists (see **table 4.3**).

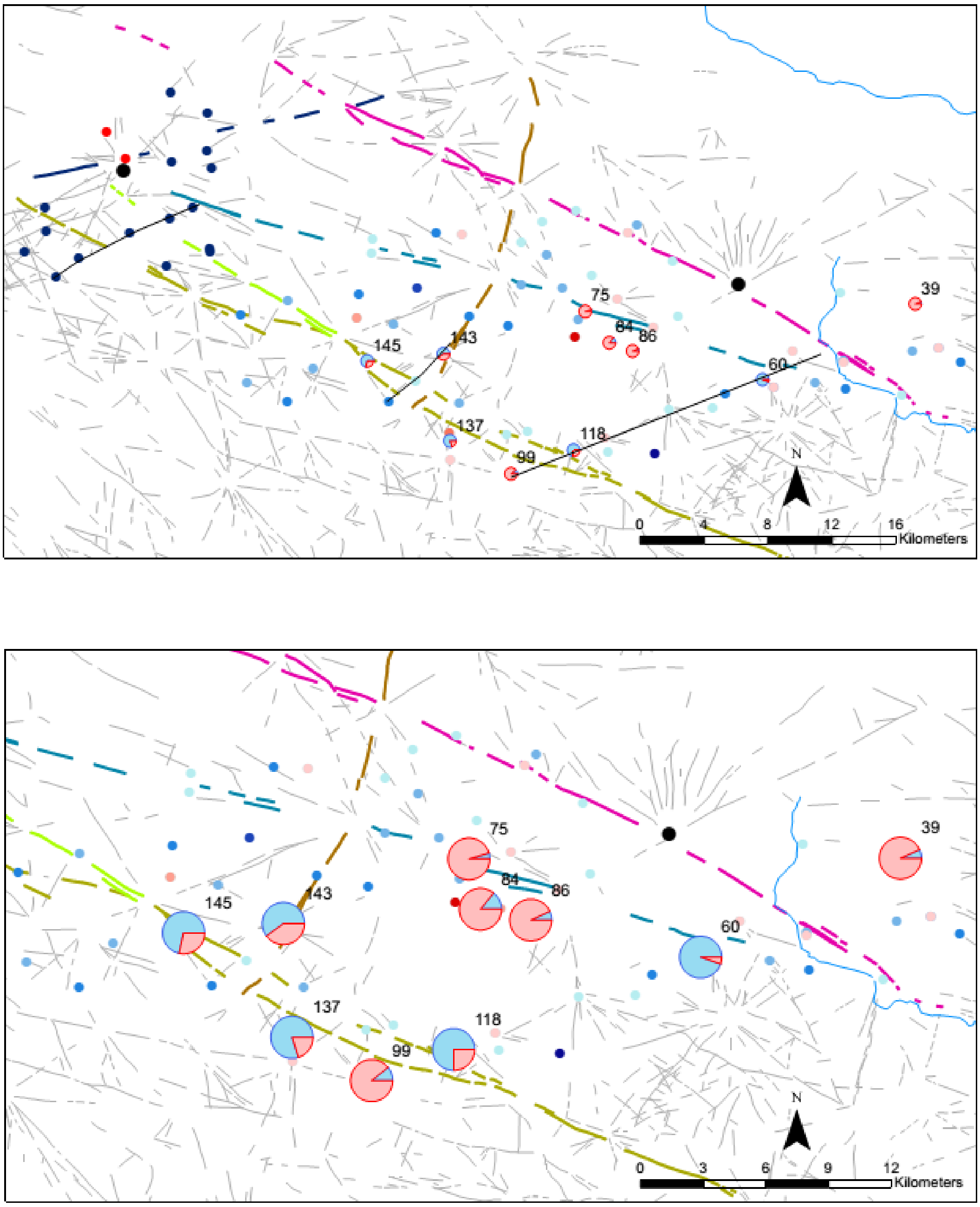

Figure 4.6 Sites with exclusively local ceramics (blue) are differentiated from those containing southern ceramics (red). The darker the colours, the greater the number of sherds collected. Within the North Jazira Survey area, sites with at least five diagnostic sherds and at least one southern ceramic are displayed using pie charts to illustrate the relative proportion of southern (red) ceramics to local (blue) ceramics. Centres are shown in black.

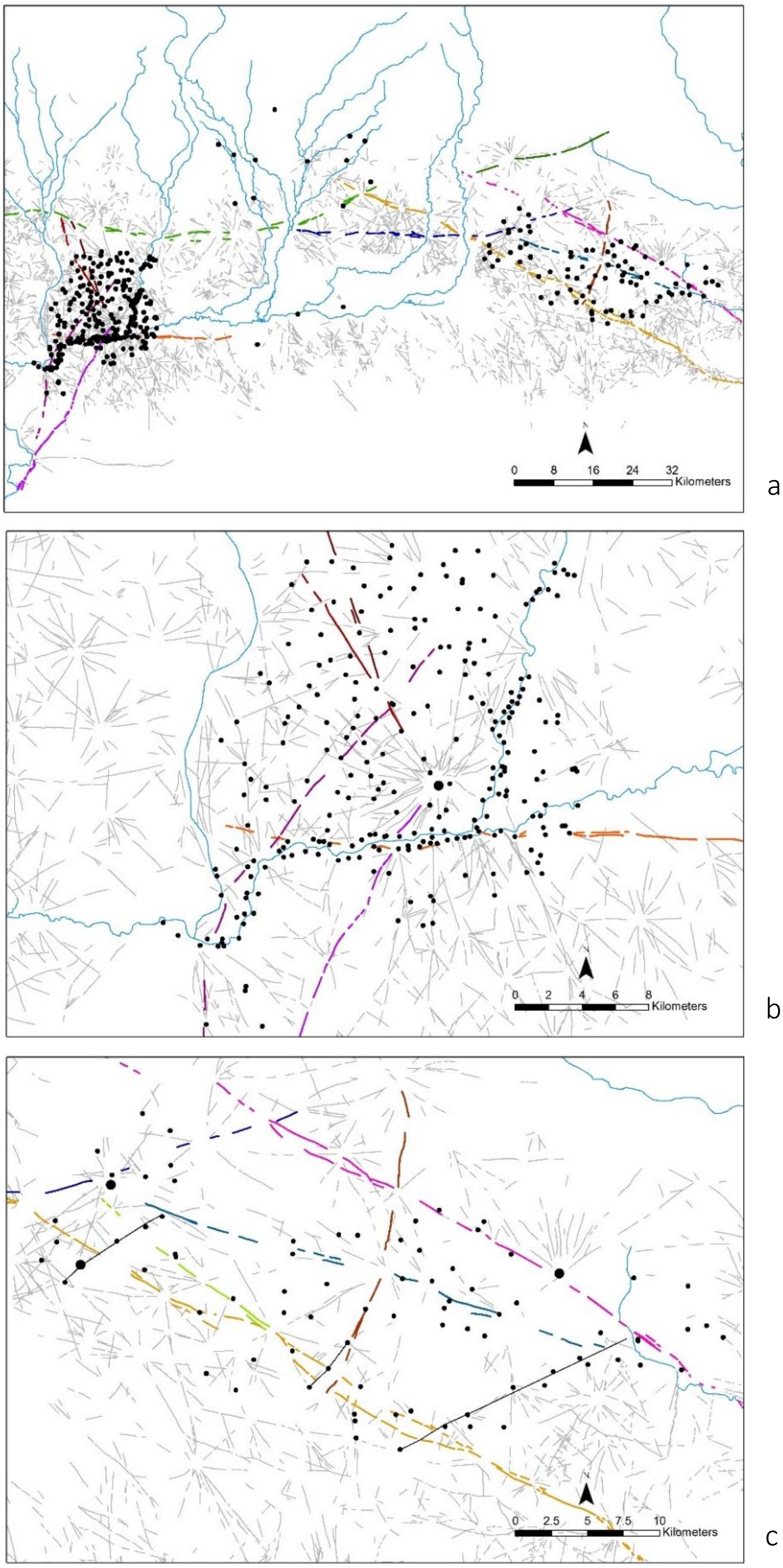

Figure 4.7 (a) Late fourth millennium B.C. sites do not continue to evidence use of the east-west route across the region, however, there is evidence for use of some long distance routes in the area of Tell Brak (b) and in the Tell Hamoukar and North Jazira survey areas (c). Furthermore, (c) there continue to be linear alignments of sites that suggest the presence of routes, which have not been preserved by hollow ways.

The economy of an agricultural village, where everyone was involved in primary agricultural production and some probably also in small-scale household-based production of other goods is relatively easy to imagine. On the contrary, it is much more difficult to imagine the economic structure of the two large centres. Both had thousands of potential specialists and administrators. Tell Brak may have had nearly 6,900.

By comparison, Algaze (2008, 85), using different estimates based on southern Ur III period values, 'conservatively' estimated that Southern Mesopotamian cities during the Uruk Period 'would have employed as many as 5,000 to 6,000 workers. However, the surplus of workers at Tell Brak only increases when it is realized that it was not self-sufficient. Instead it had to rely on a supply for agricultural products from surrounding villages. This will be described more completely below, but it is unlikely that the field area of Tell Brak extended more than 3km beyond the site (equating to 40 ha of fields when the settlement area is considered), less than the required distance/area to support itself. This smaller field radius means there could have been around 9,300 surplus workers[12] at Tell Brak in the LC 3-4 period!

4.3.6 Self-Sufficiency

In addition to the estimates for population density and average consumption, Wilkinson (1990a) has calculated that the maximum field radius for a site is 5km – equivalent to a one hour walk from the edge of settlement. Beyond this distance, small agricultural settlements existed to tend the more distant fields; but their appearance can sometimes be seen to occur as soon as fields reach a radius of 3km (Wilkinson 1990a). By comparing the minimum field radius required by a site with this maximum field radius of 5km, it can be shown that while all centres still had the possibility to be self-sufficient during the Late Chalcolithic; for Tell Brak this was not likely.

[12] The exact maximum estimate is 9,319 surplus workers.

SITE SIZE	NUMBER OF SITES OR NAMES OF SITES	SOURCE
UNKNOWN	Tell Brak Survey: 253 sites 1995 Leilan Regional Survey: 15 sites Tell Hamoukar Survey: 0 sites North Jazira Survey: 12 sites	(Eidem and Warburton 1996; Brustolon and Rova 2007; Ur 2010, Table 6.5; Wilkinson and Tucker 1995, Appendix C; Wright et al. 2007)
SMALL VILLAGES (UNDER 4 HA)	64 Sites	(Ur 2010, Table 6.5; Wilkinson and Tucker 1995, Appendix C)
LARGE VILLAGES (5-6 HA)	5 Sites from the North Jazira Survey (49, 58,60,89, and 91)	(Ur 2010, Table 6.5; Wilkinson and Tucker 1995, Appendix C)
SMALL CENTRES	THS 40 (7.5-8.57 ha) Tell Leilan (15 ha?) Tell Hamoukar (15.31 ha) Tell al-Hawa (20 ha)	(Ur 2010, Table 6.5; Wilkinson and Tucker 1995, Appendix C; Ristvet 2010, 57–58; Lupton 1996, 128)
LARGE CENTRES	al-Andalus (64 ha) Tell Brak (LC3: 130 ha, LC4-5: 55 ha)	(Ur 2010, Table 6.5; Hald 2008; Weiss 2013; Ur, Karsgaard, and Oates 2011)

Table 4.2 Settlement in the North Jazira during the late fourth millennium B.C. had a four-tier hierarchy consisting of small villages, large villages, small centres, and large centres.

Site	Size (ha)	Population	Agricultural Workers Required to Feed the Total Population	Available Workers
Villages	Up to 4 ha	Up to 400-800	Up to 39-108	Up to 121-212
THS40	7.5-8.57	750-1,714	72-232	228-454
Tell Leilan	15?	1,500-3,000	145-405	455-795
Tell Hamoukar	15.31	1,531-3,062	148-414	465-811
Tell al-Hawa	20	2,000-4,000	193-541	607-1,059
Al-Andalus	64	6,400-12,800	618-1,730	1,942-3,390
Tell Brak	130 55	13,000-26,000 5500 – 11,000	1,255-3,514 531-1,486	3,945-6,886 1,669-2,914

Table 4.3 The estimated size, population, and workforce for each of the three centres during the LC 3-5 periods in the North Jazira.

Tell Brak, the largest centre, could only be self-sufficient during LC 3-4 under specific conditions. If population density was 200 people per hectare, then Tell Brak would have required high crop yields for the area (700 kg per hectare per year) in order to maintain average consumption rates with a 5 km radius of fields. A year of lower yields or any failed crops would have been disastrous. In a year of lower crop yields (500 kg per hectare per year), Tell Brak would have only continued to maintain average consumption rates using fields within a 5 km radius if it had a population density of 150 people per hectare or below. These figures, however, ignore the archaeobotanical record. Archaeobotanical macroremains show that while Tell Brak's population certainly enjoyed large quantities of grain (upon which the average consumption value of 250 kg per person per year is based), they also grew or mobilised: lentils, peas, beans, and other foods, as well as flax for textiles (www.ademnes.de; see also Appendix C). Furthermore, an examination of the settlement patterning around Tell Brak reveals smaller settlements occurring at a 3 km radius from Tell Brak (**figure 4.8**). With this limited field radius, Tell Brak could

Centre	Size (ha)	Site Size (sq. km)	Minimum Population (100 people per ha)	Average Consumption (250 kg of grain per person)	Area Required (700 kg of grain per hectare) in Hectares	Area Required (sq. km)	Inner Radius of Ring of Fields (km)	Outer Radius of Ring of Fields (km)	Field Radius (Distance from the edge of settlement to the furthest edge of fields)
THS 40	8	0.08	800	200000	286	2.9	0.16	0.97	0.81
Leilan	15	0.15	1500	375000	536	5.4	0.22	1.32	1.11
Hamoukar	15	0.15	1500	375000	536	5.4	0.22	1.32	1.11
al-Hawa	20	0.20	2000	500000	714	7.1	0.25	1.53	1.28
al-Andalus	64	0.64	6400	1600000	2286	22.9	0.45	2.73	2.28
Brak (LC3)	130	1.30	13000	3250000	4643	46.4	0.64	3.90	3.25
Brak (LC4-5)	55	0.55	5500	1375000	1964	19.6	0.42	2.54	2.12

Table 4.4 The minimum field area and radius required to support the centres in the North Jazira during the late fourth millennium B.C. based on minimum site density, average consumption of grain (and no consumption of other crops), and maximum crop yields from the region. Calculation of field radius us calculated by the radius of a torus (donut) rather than a circle to account for the inner settlement radius. The minimum field radius required to feed Tell Brak exceeds the space available.

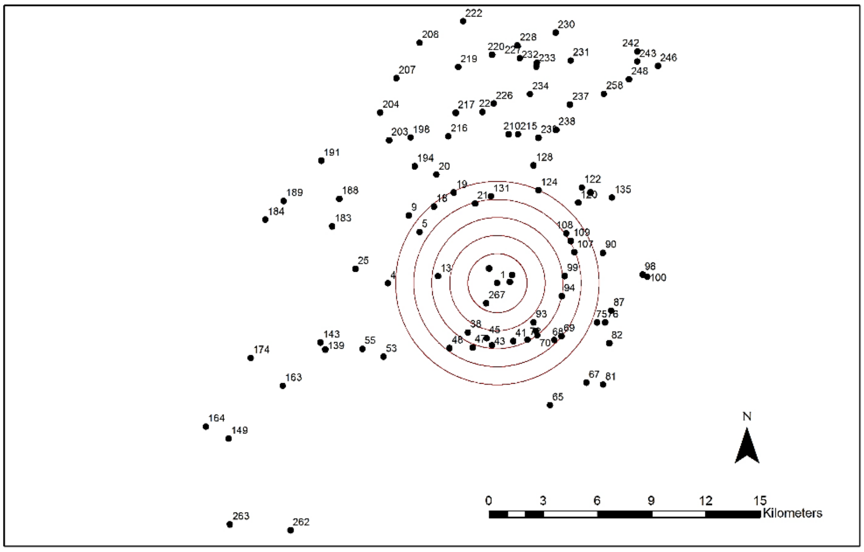

Figure 4.8 When concentric circles spaced 1 km apart are placed around Tell Brak, it becomes clear that smaller sites start to appear at a distance of 3 km from the site. The sites shown within 1 km distance of Tell Brak are the small, related satellite tells like Tell Majnuna (a funerary, feasting, and disposal location).

never have been self-sufficient during LC 3-4, it had to rely on import or tribute from surrounding villages (table 4.4).

Al-Andalus, the next largest centre could have been self-sufficient, if it had maintained a field radius of at least 4.12 km. Unfortunately, insufficient data is available to check the proximity of smaller settlements and, therefore, the potential field area available to al-Andalus.

The impossibility for Tell Brak to maintain self-sufficiency during LC 3-4 indicates that by the late fourth millennium B.C., Tell Brak must have had reliable and consistent influence over surrounding villages or a very low population density well under 62 people per hectare[13] (unlikely). At least one polity, an extended territory controlled by centres, had emerged.

[13] The area of Tell Brak is 1.30 km^2, the area encircled by surrounding sites is 41.62 km^2, therefore the maximum field area (assuming the surrounding sites have no fields facing Tell Brak) is 40.32 km^2 or 4032 ha. In poorer years (resulting in 500 kg of grain per ha), this would yield 2,016,000 kg of grain. Using an average consumption rate of 250 kg per person, this amount of grain would feed 8,064 people. This population across a 130 ha area represents a population density of 62 people per hectare. However, it must be remembered that we know from the archaeobotanical record that additional crops were consumed. If Tell Brak was self-sufficient, grains would have to share the

4.3.7 THS 40 Khirbat Melhem

THS 40, the smallest centre, was a mounded site dominated by southern ceramic types, though it is noted that local ceramic types are also ubiquitous across the site (Ur 2010, 103, 195). The patterning of individual types suggests the site reduced from 8.57 ha to 7.5 ha between LC 4 and LC 5 (Ur 2010, 103). Since the site is only known from survey, nothing further is known.

4.3.8 Tell Leilan

Four levels/strata dated to Period IV (the Uruk Period) were discovered and distinguished from Period V largely on the basis of type ceramics like bevel rim bowls (Schwartz 1988, 51). Excavation of the site predated the Sante Fe chronology and no reworking of the evidence from excavation in light of the new chronological understanding of the period has been published. The most recent publication only mentioned that fourth millennium B.C. levels were reached and that the site is estimated to have been 15 ha at the time (Weiss 2013, 102–3). The presence of southern types like bevel rim bowls raises the possibility that southern Mesopotamian individuals resided on the site. If there was a population of southern Mesopotamian people residing at Tell Leilan (likely given evidence from other sites and the geographic location of Leilan), it is unclear where or how they lived in relation to the local inhabitants. Were they living separate from the local population as at Hacinebi Tepe (Stein 1999a; Pearce 1999) or amongst the local population as they did at Tell Brak (see below)?

4.3.9 Tell Hamoukar

At the end of LC 2 and the start of LC 3, the inhabitants of THS25 are believed to have abandoned the site and formed a new settlement, Tell Hamoukar, less than 2 km north of their former homes (Ur 2010, 148). An absence of evidence also suggests that they abandoned their specialisation in obsidian blade production at the same time, favouring a more mixed economic strategy that did not leave an extreme abundance of a single artefact type for archaeologists to find millennia later.

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limited 4032 ha of available crop land with these crops, lowering the amount of grain, and therefore people that could be supported.

Tell Hamoukar was systematically surveyed (Ur 2002b). The survey found that grit-tempered southern ceramics (excluding bevel rim bowls) cluster in two distinct patches on the east side and south side of the main tell, though the distribution of local ceramic types indicates that the entire mound was densely settled (Ur 2010, 99–103). Only the bevel rim bowl was as ubiquitous as local ceramics across the site (Ur 2010, 102–3). However, due to a mismatch with the results from excavation, which found southern Mesopotamian ceramic types in Area A, there is concern that modern survey results are affected by a history of previous surfaces collections that were biased towards southern types, leading Ur (2010, 103) to suggest 'that the southern Uruk settlement covered the same 15.31 ha area of the high mound as the indigenous settlement' and that 'Hamoukar's significance as a part of the Uruk expansion phenomenon will have to be assessed through excavation' (Ur 2002b, 20). This is undoubtedly true.

Evidence from excavation suggests Tell Hamoukar was 15 ha in size from its foundation (Gibson et al. 2002, 49), making it an instant centre of the region. It is significant that ceramics from the earliest levels of excavation were entirely local, including from the second level of Area A where a large possible city/town wall was discovered on the northern slope of the tell (Gibson et al. 2002, 50). Further evidence for the wall was found in subsequent excavations in Area F placed slightly west of Area A along the northern slope of the tell and Area B on the southern slope of the tell (Gibson 2002, 72; Reichel 2011, 55). However, it is only on the third level of Area A, above the possible city/town wall that southern Mesopotamian ceramic types were found that date to the Late Uruk (Gibson et al. 2002, 50). This indicates the wall pre-dated any Southern Mesopotamian presence. Likewise, while the wall was detected in Area B, it was found associated with earlier LC 3 levels of architecture rather than Level 3 where evidence of southern influence, if not presence, first appeared (Reichel 2011, 55).

In Area B (on the southern slope of the tell) as in Area A, there were houses with entirely local material before the appearance of any southern Mesopotamian material culture (Gibson et al. 2002, 53–58). These houses were described as 'unimpressive' and 'humble' though excavators found associated evidence 'of food preparation on an institutional scale, along with artifacts of administration [stamp seals]' (Gibson et al. 2002, 53). However, as Area B was widened it became clear the houses were more impressive than initially thought. Reichel (2012) distinguished three levels of architecture predated any southern material culture: Level 6 (the earliest), Level 5, and Level 4 (Reichel 2012, 72). Level 6 and Level 4 both contain substantial buildings with large rooms and courtyards, though in Level 4 buildings are separated by narrow 'corridors' (Reichel 2012, 72) – perhaps alley ways? Additionally, while Level 6 has yielded only 2 sealings so far, 'large numbers' of clay sealings have been found in Level 4 – all local Late Chalcolithic stamp seals and all apparently sealing containers (Reichel 2012, 72).

In earlier excavations at Tell Hamoukar, McGuire Gibson (2002, 53) described that 'almost all' of the stamp seals have parallels at Tell Brak' including stamp seals of both bears and lions and this has continued to hold true through subsequent seasons of excavation (Reichel 2004, 85).

Additionally, the early excavations uncovered wells, which were found in both Area A and Area B, as well as ovoid bread ovens shaped 'something like an igloo' (in other words, tannurs) (Gibson and Maktash 2000, 477; Gibson 2000, 8; Gibson et al. 2002, 49–50, 53–58). Three ovens in Area A, one described as 'large' and five ovens found in Area B, each three meters in diameter (Gibson et al. 2002, 50, 53). As Area B was expanded in subsequent excavations, it became clear these ovens belonged to two different tripartite building complexes.

4.3.9.1 Area B Level 3 Mittelsaal/Tripartite Building Complexes (LC 3)

The tripartite building complexes in Area B, level 3, follow a specific layout: a tripartite building is entered from its south wall (facing the edge of the tell) via a courtyard with individual rooms lined around the courtyard walls (Reichel 2004, 85; Reichel 2006, 70–71; Reichel 2011, 54; Reichel 2012, 72, fig. 6). These small rooms contain the large ovens described in earlier excavations (3 m diameter), animal bones, and sometimes grindstones or pots with holes in the bottom (to allow for drainage into a jar or bowl below) embedded into clay benches (Reichel 2006, fig. 71; Reichel 2011, fig. 54). Adjacent to the west side of the tripartite buildings are long narrow rooms which can be accessed from within the tripartite building (tripartite complex A) or through the nearest small room off of the courtyard (tripartite complex B) (Reichel 2007, 63; Reichel 2012, fig. 6). Sealings are found throughout the area, however this long room to the west of tripartite building B contained 'a large dump of sealings' of which 160 came from the same crescent-shaped stamp seal depicting six lions (Reichel 2007, 63–64).

4.3.9.2 Destruction Layer at Area B (LC 3-4, c.3500 B.C.)

The tripartite building complexes of Area B, Level 3, were destroyed in a conflict that led to the entire area being burned down (Reichel 2006, 72; Reichel 2007, 63–65). In this burnt layer filled with ash, over 1,200 sling bullets were recovered just within the initial trench area and more were found as the trench of Area B was extended (Reichel 2006, 72; Reichel 2007, 63). In the level following this destruction, numerous pits were dug and filled 'almost exclusively' with Southern Mesopotamian ceramics (Gibson et al. 2002, 53; Reichel 2006, 74).

4.3.9.3 Area I/THS 2 (probably LC 4)

Area I of Tell Hamoukar, or site THS 2, is a low 1.1 ha satellite mound situated only 200 m north of Tell Hamoukar (Reichel 2009, 83; Ur 2010, 26, fig. 3.8). When surveyed, the site was found to be 'overwhelmingly southern in character but still contained local types' (Ur 2010, 103). Shortly after, the area/site was excavated, yielding a pit containing the same pottery types found on the surface and architectural remains so badly damaged from ploughing, it was impossible to discern any buildings (Reichel 2009, 83). Additionally, evidence of destruction like that found in Area B was uncovered, including sling bullets and two articulated human skeletons that appeared to the excavators to have been left unburied (Reichel 2009, 83). Largely due to the proportion of southern ceramic types found at the site, it is suspected to be the location of a southern enclave, not unlike an Old Assyrian *karum* where foreign traders live in separate settlement near the site of the local population (Ur 2010, 150; Reichel 2009, 83).

4.3.10 Tell al-Hawa

The excavation of Tell al-Hawa took place before development of the Sante Fe chronology and very limited *in situ* finds dated to the fourth millennium mean that very little is known about this site during LC 3-5. Furthermore, what was described is only dated as 'Uruk' rather than separated into local Late Chalcolithic material and southern Uruk (Middle or Late) material. In a trench 400 m east of the main tell (Trench LP), a possible *in situ* layer seems to have been excavated dated between LC 3-5. The excavators wrote that ceramics diagnostic of LC 3-5 like the double mouthed jar were found alongside other objects, including obsidian blades and flakes and a burnt clay sealing in an ashy lens on top of a compacted clay surface (Ball, Tucker, and Wilkinson 1989, 39). At the main mound, 'the Later Uruk material that was found at al-Hawa was restricted largely to the Acropolis. More stratified Later Uruk material was found in the Area D soundings in the Lower Town Area, though little of it was associated with any occupation or architecture' (Ball 1990, 12). Ball (1990, 14) also notes that:

> 'In the 1988 excavations at the Assyrian ziggurat at the top of the Acropolis, a deposit of Later Uruk pottery, consisting of large fragments with many complete profiles, was found. It was the richest and most homogenous corpus of Later Uruk pottery yet found at Tell al-Hawa, that included nearly a hundred bevelled-rim bowl fragments and hundreds of coarse chaff-tempered vessels. This corpus was all concentrated in a single midden heap against and partly on the southwestern edge of the ziggurat, so must have represented a redeposition well after the (Middle Assyrian) construction of the ziggurat…'

Based on current evidence, it seems as though there was settlement on the main mound during the LC 3-5 period, possibly with small satellite locations in the vicinity (like at Tell Brak). This would account for the finds in trench LP east of the main tell and Area D, which is a low mound to the north of the main tell.

Unlike other centres, which were either newly founded in the late fourth millennium B.C. or, otherwise, experienced growth between the early and late fourth millennium B.C., al-Hawa may have shrunk by about a third from 33 ha in the early fourth millennium B.C. to only 20 ha in the late fourth millennium B.C.

4.3.11 Al-Andalus

Al-Andalus, a large centre, was described as having 'a significant Middle Uruk occupation' (Weiss 2013, 103).

4.3.12 Tell Brak

During the LC 3 period, settlement at the central mound of Tell Brak expanded outwards, starting in Level 17, while settlement at the various satellite tells grew inward towards the central mound (Ur 2016, 52). The result was a site with 130 ha of settlement and reduced separation between the central mound and the outlying 'suburb' mounds (Ur 2016, 52; Pournelle and Algaze 2014, 10). Not only did the site dwarf other settlements in the region (see above – Settlement Hierarchy), but Oates (2014, 119) remarks that it was 'the largest settlement attested at Brak at any period.' This expansion was also accompanied by changes in the spatial patterning of the site, which (in area TW) is seen to continue to transform during the LC 3 period (Ur 2016; Oates 2002; Emberling et al. 1999; Emberling and McDonald 2001; Emberling and McDonald 2003; McMahon et al. 2007). The satellite tells appear to have had specialised functions: Tell Majnuna is a midden and location for mass burials and T2 appears to be designated for the firing of ceramics (Ur 2016, 52; Ur, Karsgaard, and Oates 2011, 6–8).

Contemporary to this expansion of Brak, both bears and lions attained symbolic status (Weber 2016; McMahon 2009). Bear statuettes and lion sealings were found within the 'Grey Brick Stratum' underneath the Eye Temple, in Area TW, and lion sealings were discovered at Tell Majnuna (Weber 2016; Mallowan 1947, 41–42; McMahon 2009). Additionally, evidence of bear and lion pelts have only been recovered from store rooms and living spaces within Area TW (levels 18-16, early LC 3) where a feasting hall now stood; unlike the evidence for fox pelts which are more numerous and disposed of like any other object in Area TW and among the midden heaps of Tell Majnuna (Weber 2016, 131; Oates et al. 2007, 594–96). This leads Jill Weber to hypothesize that they were used 'as pelts, trophies, or regalia for the public and communal activities that occurred there' (2014, 131).

The meaning of the bear is difficult to define: the bears appear to behave like humans, sitting and kneeling; and seem to lose their symbolic status by the end of the fourth millennium B.C. (Mallowan 1947, 41–42; Weber 2016, 127–28). By contrast, the early LC 3 depictions of lions in sealings found in Area TW[14] and at Tell Majnuna mark the beginning of a two thousand year glyptic tradition in which the lion was associated with authority – particularly kingship (Weber 2016, 127–28; Mallowan 1947, 41; McMahon 2009). This symbology is also found at Tell Hamoukar where, as mentioned above, the stamp seal assemblage is nearly identical to that found by Mallowan at Tell Brak, including stamp seals in the shape of both bears and many lions (Gibson et al. 2002, 53).

The growth of a settlement from 55 ha to 130 ha in area alone implies changes in political structure and the possibility for increased social stratification to successfully manage and provide for a population that had more than doubled in size to between 130,000-260,000 people. Changes in political structure and increased social stratification is also suggested by the new bear and (especially) lion symbolism and the new use of Area TW as a large feasting hall with enormous ovens able to provide communal meals (Oates et al. 2007, 594–96). Additionally, regular marks labelled vessels (referred to as notational marks) and the first numerical table also appeared in the LC 3 period, attesting to increased administration (Oates 2002, 116–18). While, the mass graves found at Tell Majnuna, dated to LC 3, demonstrate that these developments were met with resistance (McMahon 2016).

4.3.12.1 Mass Graves at Tell Majnuna (LC 3)

Three mass graves have been uncovered at Tell Majnuna, all dated to the LC 3 period (McMahon 2016, 179). The first of the mass graves, located in MTW 1-4, dates to the early LC 3 period and contains at least 50 to 60 disarticulated individuals (McMahon 2016, 178–79). The disarticulation of the individuals is ‘consistent with simultaneous deaths, followed by exposure for at least 10 days to approximately 2 months’ (McMahon 2016, 179). Once their remains were collected and brought to Tell Majnuna, they were buried under piles of ‘rubbish’ (McMahon 2016, 179).

It is believed, based on ‘subtle changes in the associated ceramics and clay sealings’ that the second mass grave was created about 100 years later in the middle of the LC

[14] The earliest lion sealing in Area TW was found in Room 4 of the Red Building in Level 19, LC 2-3 (J. Oates et al. 2007, 592).

3 period (McMahon 2016, 179). Like the first mass grave, the individuals were exposed to the elements for between 10 days and 2 months before their remains were collected and brought to Tell Majnuna where they were dumped and buried under more rubbish (McMahon 2016, 179). The grave continued on three sides of the sounding (EME3), but in the portion of the grave excavated, 'a cluster of 14 skulls and some articulated body elements' were found (McMahon 2016, 179).

The third mass grave (EME1) is estimated to date to the late LC 3 period, about another century later (McMahon 2016, 179). Unlike the first two mass graves, the remains in this mass grave were articulated, but 'some necks were twisted, one skeleton was buried face down and there was one casually intermingled pair' (McMahon 2016, 179). Additionally, the bones associated with the knees and shoulders were weathered in a way that suggests the individuals were buried under only a shallow deposit of rubbish that left parts of their bodies exposed (McMahon 2016, 179).

All three mass graves contained a mix of male and female individuals whose 'ages cluster between 20 and 40' (McMahon 2016, 179).

The combined evidence led McMahon (2014, 181-185) to hypothesize that the individuals represent internal opposition. A foreign army, she argued, would more likely be composed of adult males, rather than a mix of male and females (McMahon 2016, 181). That the dead were buried without care, their body parts mixed together within midden heaps and without grave goods suggests they were enemies (McMahon 2016, 180–81). Furthermore, it is noted that the mass graves should be located near the site of the battle, which suggests a location within or immediately on the outskirts of Tell Brak (McMahon 2016, 179).

McMahon (2016, 181) listed several possibilities for why internal conflict may have arisen during LC 3, including: increased urbanism, increased social complexity, economic asymmetry, and increased social divide.

4.3.12.2 The Grey Brick Stratum (LC 3)

Below the Eye Temple, Mallowan discovered a distinctive grey layer, now dated to the LC 3 period, he named the Grey Brick Stratum and interpreted to contain an early version of the Eye Temple (Mallowan 1947; Ur 2016, 52; Weber 2016). Mallowan described 'the antiquities recovered from these levels consisted principally of stone sculptures, stone amulets, alabaster eye-idols and beads of which there were many hundreds of thousands…even the mud-bricks themselves contained beads within them' (1947, 33). Other finds, included animal-shaped stamp seals, animal and plant models, and pendants (Weber 2016, 128).

Mallowan also described an even earlier Red Eye Temple beneath the Grey Eye Temple (Mallowan 1947, 38), but the date of this first structure is uncertain. Evidence from Area CH, a trench placed directly next to Mallowan's Eye Temple, indicates that the ideology responsible for the temples and eye idols predates the early fourth millennium B.C. The excavator, David Oates (1987, 176) wrote: 'It is significant that there would appear to be no abrupt change from the 'Ubaid [5th millennium B.C.] to Early Uruk levels. The Late 'Ubaid pottery is of special interest, since a conspicuous decorative motif is an unmistakable representation of the human eye, complete with eye lashes, suggesting that whatever cult is represented by the use of this symbol in the Jemdat Nasr [now re-dated to LC 3-4] Eye Temples were already in existence here at the end of the 'Ubaid period [immediately prior to LC 1].'

4.3.12.3 The Eye Temple (LC 3-4)

The Eye Temple, the one simply referred to as the Eye Temple and drawn on many plans of Tell Brak, is now dated to Brak Phase F (LC 3-4) (Ur 2016, 52). While eye idols can be found across the North Jazira, at both Tell Brak and Tell Hamoukar, the Eye Temple (and its predecessors) is a unique cultic building in the region named for 'the thousands of eye images or idols discovered within the precincts and buried within the platform' (Mallowan 1947, 32).

4.3.12.4 Area CH (originally 'Late Uruk/Jemdat Nasr', now LC 3-4)

Adjacent to the Eye Temple along its eastern wall may have been a second temple (D. Oates 1987, 177). David Oates wrote 'In [Area] CH we have also recovered a large quantity of Uruk material, including a new type of painted ware, and exposed part of the façade of a building with shallow rectangular buttresses, one with a central niche, and with Early Uruk pottery on the associated ground level…Such a façade can only be the external wall of a temple and the technique bears a strong resemblance to that of

Uruk temples at Tepe Gawra. Like the temples at Tepe Gawra, but unlike the nearby "Terminal Uruk" (Jemdat Nasr) [actually LC 3-4] Eye Temple at Tell Brak, the newly discovered building stands on the contemporary ground level and not on a raised platform. There appear to have been two different traditions of temple construction in the 4th millennium at Tell Brak' (1987, 177).

Like the Eye Temple, the sequence of levels (9-12) and material found were dated at the time of excavation to the Late Uruk and Jemdat Nasr periods. Since then, a radiocarbon date (BM-2915, c.3500 cal.B.C.) has shown a hearth found near the bottom of Level 9 of Area CH to be contemporary to Level 16 in Area TW (LC 3, BM-2900, c.3500 cal.B.C.) (Oates 1982, 203; Oates and Oates 1994, 168; Oates 2002, 116–17; Oates and Oates 1993, 182). Importantly, a numerical tablet was discovered stratigraphically below this hearth in Area CH (Oates 2002, 116–17), providing very early evidence for writing at the site, prior to the LC 4 period, when Southern Mesopotamians are well attested at the site.

4.3.12.5 A Feasting Hall (LC 3, TW Levels 18-14)

The industrial buildings of the early fourth millennium B.C. were levelled and replaced by a monumental structure built like an oversized tripartite house with niched decoration and interpreted as a feasting hall (Weber 2016, 128–29). In the courtyard enclosed between the feasting hall and a wall, two large tannur ovens were constructed – one 3 m in diameter and the other 4 m in diameter (Oates et al. 2007, fig. 11). Both ovens contained abundant remains from communal cooking and feasting, and numerous mass produced ceramic plates were found with the structure (Weber 2016, 128–29; Oates et al. 2007, figs. 594-596). The courtyard could have been reached through the Feasting Hall building or via a direct entrance from a street along the northwest side of the building (Oates et al. 2007, 594–96).

The feasting hall's location near what was once thought to be the north gate to Tell Brak has led to the interpretation that the feasting hall may have served as a 'traveller's rest', and other interpretations include that it was simply a feasting hall or service building associated with a yet-unexcavated institutional building (Oates et al. 2007, 596; McMahon personal communication). The food capacity of the two ovens, however, was beyond that of a few travellers. For analogy, in 2015 a chef in Xinjuang, China constructed a tandoor (tannur) oven of approximately 4 m in diameter and used it to cook whole, marinated, adult camels, feeding 'hundreds' of people during a festival (You 2015). Similarly, it has been observed that whole carcasses of sheep, goat, and cattle were brought to the large ovens at Tell Brak where they were 'uniformly processed and cooked' (Weber 2016, 128–29).

Such large ovens were not unique to Tell Brak. It has already been described above that there were multiple ovens 3 m in diameter at Tell Hamoukar at this time, and that earlier in the fourth millennium B.C. THS 25 had a 3 m diameter oven (Ur, Khalidi, and Quntar 2011, 155–56).

4.3.12.6 The Level 17 Transformation of TW (LC 3, Level 17)

After Level 18, Area TW is 'levelled with a homogenous red bricky fill' to the top of the now-weathered city wall (Oates and Oates 1997, 289). On this surface, houses were constructed, transforming TW into a residential area and extending the site (Oates and Oates 1997, 289–90; Oates 2002, 119). Under the floors of the houses were burials of infants (mainly) and children, including an adolescent (Oates and Oates 1997, 290, fig. 6; Oates 2002, 119).

4.3.12.7 A Large Tripartite House (LC 3, TW Level 16)

In Level 16, a large tripartite house was constructed adjacent to the Feasting Hall (Levels 18-14), occupying part of the latter's courtyard, which no longer featured large ovens (Emberling and McDonald 2003, fig. 11; Oates and Oates 1993, 174–77, fig. 28). The house is described as 'an elaboration of architecture associated with the ordinary residential plan' (Oates 2002, 116). The largest room of the house, Room 1, was decorated niched walls at either end, while the parallel (and slightly smaller) Room 5 was decorated with a semi-columned façade along its north wall (Oates and Oates 1993, 174). Faunal remains consistent with a lion pelt were recovered from the small room (Room 2) west of Room 1 (Weber 2016, 130). Ostrich shell, many ivory objects, carnelian, and a bead made of 'heavy, rolled gold sheet' were found inside the house (Emberling and McDonald 2003, 8; Oates 2002, 116).

Outside the house, under the shared courtyard with the Feasting Hall, a cache was buried inside a mat or basket containing 350 beads made of gold, silver, lapis lazuli, rock crystal, and ‘other stones’ and two stamp amulets (Emberling and McDonald 2003, 9). Other finds in the area included additional amulets (both kidney-shaped and zoomorphic), similar to those found in the Eye Temple; eye idols, including a bone eye idol more typical of Tell Hamoukar; a seated bear statuette made of alabaster; and a large number of storage jars (some containing carbonized wheat and barley), and stone maceheads *in situ* (Emberling and McDonald 2003, 8–9; Weber 2016, 129). Also in the courtyard was faunal evidence consistent with a bear pelt (Weber 2016, 130).

Eighty of the vessels found in Level 16 had markings or labels that are believed either to indicate the contents of the jars or ownership of the jars (Oates 2002, 117–18).

Level 16 of Area TW was destroyed by a fire, but was rebuilt and continued as it was in Level 16 through Level 14 with ‘an entirely indigenous material culture’ (Emberling and McDonald 2003, 9; Oates 2002, 116).

4.3.12.8 Another Large House (LC 5, TW Levels 12-11)

The earliest buildings dated to the LC 5 period, Level 12, are described as ‘heavily destroyed (perhaps deliberately), creating a large open space’ (Oates 2002, 115). After this destruction, pits were dug and filled with ‘broken mud-brick, literally hundreds of bevelled rim bowls, many so-called “flower pots”, and a great number of clay jar stoppers,’ as well as complex, pierced tokens, and ‘very large quantities of seal impressions’ that had been ‘scrunched up while still moist’ (Oates and Oates 1997, 293–95; Oates 2002, 115).

In Level 11, however, on the north side of Area TW, part of a large house was uncovered containing seventeen complete ceramic vessels, all Southern Mesopotamian types, including: a drooping spout jar, red-slipped nose-lug jar, and some large storage jars (Oates and Oates 1993, 171). One of the jars had a pictographic sign on it (Oates and Oates 1993, 171).

Outside the house and across a courtyard, were a series of small rooms along the courtyard wall with ‘frying pan’ hearths (Oates 2002, 114–15). Flint cores and a 2 kg piece of obsidian alongside Canaanean blades attest to lithic production, while a mould for producing metal axes attests to possible casting activities in the area (Oates 2002, 115). Additionally, and also on the south side of the courtyard, there was a small room with Southern Mesopotamian-type jars set into the floor that contained 'hammer stones, a possible anvil, and large flint cores as well as a variety of baked clay pierced Uruk tokens, a bone awl, spindle whorls, approximately fifty enigmatic large unbaked clay balls and smaller ovoid "sling bullets", a number of bricks made of gypsum plaster (*juss*), and a large number of perforated backed clay cylinders, probably spools for thread' (Emberling and McDonald 2003, 3).

4.2.12.9 Mittelsaal/Tripartite Houses (LC 5, Areas TX and UA)

A Mittelsaal/tripartite house dated to the Late Uruk period or LC 5 was excavated about 30 m northeast of Area TW in Area TX. Pottery inside the house was *in situ* and included a holder for arrowheads made out of unbaked clay, still holding some flint arrowheads. Piled in the southeast corner of the central room of the house was a loose pile of gypsum plaster/*juss* bricks and evidence of food processing (Emberling and McDonald 2003, 11, fig. 20). Outside the house was 'a series of sloping ash deposits' that contained complete bevelled rim bowls and other ceramic vessels, and stamp seal amulets similar to those found at the Eye Temple (Emberling and McDonald 2003, 11). Importantly, the (local) stamp seals were found together with impressions closely paralleled in the south' (Pittman 2003, 19)

On the south side of the mound, partway down the slope of the mound, is located Area UA where another Mittelsaal/tripartite house was found (Emberling and McDonald 2003, 11–12). It was discovered above a series of local LC 3-4 floor levels and a large LC 5 pit containing a mix of Southern Mesopotamian and local ceramic types, as well as seal impressions from both local stamp seals and southern cylinder seals, and bone (Emberling and McDonald 2003, 11–12; Pittman 2003, 19). Inside the house, two stamp seals were found (Pittman 2003, 21).

4.3.13 Trade and Interaction

4.3.13.1 LC 3

During the LC 3 period, before the strong presence of Southern Mesopotamians in the region, there continued to be substantial similarities between Tell Brak and the relocated settlement from THS 25 located at Tell Hamoukar. However, a split had already begun: settlement had started to decrease in the middle of the region (Tell

Leilan Regional Survey) in favour of regions with better access to the river highways that connected Southern Mesopotamia and Anatolia: the Tigris (Hamoukar and North Jazira Survey areas) and the Khabur (Tell Brak Survey), which flows downstream to the Euphrates. The migration of people out of the Tell Leilan Regional Survey area was great enough that by the LC 4 period the whole region was nearly abandoned.

The splitting of the region, however, was only just beginning in the LC 3 and shared ideological beliefs continued across the region. The ideology behind eye idols, for example, continued to be shared across the region with eye idols found in LC 3 contexts from both Tell Brak and Tell Hamoukar (see above - The Eye Temple, Gibson et al. 2002, 57–59, fig. 17; Reichel 2009, 80). Meanwhile, a new ideology involving bears and lions – best attested at Tell Brak – was also present at Tell Hamoukar where lion seals were found in the same elite residential contexts (Area B, level 3, elite residences) as they are found at Tell Brak (Area TW elite residences). Bears seals, but not figurines, have also been found at Tell Hamoukar displaying anthropomorphic behaviour, evidenced by the published example of a seal in the shape of two seated bears 'kissing' (Reichel 2004, fig. 5).

There was also a shared tradition of feasting that may have represented a continuity from earlier time periods. Both Tell Brak in Area TW and Tell Hamoukar (Area B) had large (3-4 m) ovens in the courtyards of elite residences during the LC 3 period that would have been capable of feeding hundreds of individuals. However, large ovens of this size have also been found at the earlier (LC 2) site, THS 25. Similarly, at Tell Brak there was evidence for large scale feasting in the same Area TW in the earlier fourth millennium B.C. (as described above), although the ovens were not as large.

The evidence suggests some continued, but possibly limited, contact during at least the early LC 3 period. The eye idols and feasting could simply represent continued tradition at both Tell Brak and Tell Hamoukar; however, the bear and lion ideology/symbolism is new and cannot be attributed to continuity of tradition. Nonetheless, it is specific to the elite segment of the population, allowing for the possibility that only members of the socio-political and cultic elite interacted with each other in some way.

The exposure at Tell Brak Area TW is relatively limited compared to at Tell Hamoukar Area B where it is clear that there were many tripartite building complexes side-by-side, rather than the unique construction of a large residence that might be expected for a ruler, and the contents strongly suggest the residents were locals. Were the inhabitants of these complexes early members of an elite class of traders/merchants who had begun travelling further distances and gained knowledge of Southern Mesopotamian tripartite residential architecture?

Besides tripartite architecture, the elite of both sites appear to have been interested in other southern practices. At Tell Hamoukar there is evidence for the presence of some cylinder seals, whose impressions can be rolled, based on impressions of cylinder seals on sealings alongside local stamp seal impressions. At Tell Brak they appear more interested in the practice of writing (without necessarily adopting it): a single numerical tablet found in Area CH, contemporary to Level 16 of Area TW, two 'dockets' (one indicating 10 sheep, the other 10 goat), and the regular symbols found inscribed on jars and vessels.

4.3.13.2 LC 4

The LC 4 period is poorly attested from excavation at both Tell Hamoukar and Tell Brak. The levels above Level 3 at Tell Hamoukar, which would date to LC 4, were eroded away leaving only pits dug into Level 3, filled with Southern Mesopotamian ceramics and the architecture of Area I/THS 2 (the possible *karum*) was mostly ploughed away, leaving another pit filled with mainly with southern ceramics (but also the remains of two individuals). At Tell Brak, Level 13 of Area TW only exposed a courtyard.

Nonetheless, survey evidence shows that by the LC 4 period, the region has divided. The southern half of the Tell Leilan Regional Survey Area was almost entirely abandoned. The three sites remaining in the southern part of the survey area were new settlements dominated by southern ceramics south of the Wadi Radd marshes (which will be abandoned by the LC 5 period). For whatever reason, the centre of the North Jazira was not worthwhile for (permanent) settlement. Continued evidence for a Southern Mesopotamian presence comes from the same areas within easier reach of the rivers connecting Anatolia and Southern Mesopotamia that locals had already migrated towards during the LC 3 period: The Tell Brak survey area and the Hamoukar and North Jazira Survey areas. Given the higher density of settlement around Tell Brak and the growth of the site from 55 ha to 130 ha, which lead to the potential for 10,000 specialists (much higher than anywhere else), Tell Brak was probably the larger draw, although, Tell Hamoukar, Tell al-Hawa, and the villages around them almost certainly gained residents from the Tell Leilan region, too.

Rova (1996, 17) wrote that 'the most interesting feature of this phase [LC 4 and LC 5] is the lack of homogeneity between neighbouring sites, which makes the very concept of "ceramic provinces" useless or at least difficult to apply.' Nor is there any evidence from other artefacts types or architecture to support continued connections across the region.

4.3.12.3 LC 5

In the LC 5 period, there is strong evidence both in and around Tell Brak and from the Hamoukar and North Jazira Surveys for Southern Mesopotamians in the region. How the local population lived, what their houses looked like, what objects they used (other than ceramic repertoires), and what activities they engaged in remain almost entirely unknown, so it is impossible to describe what similarities or differences existed across the region, specific to this period.

Nonetheless, the ubiquitous Southern Mesopotamian material culture and architecture found across Tell Brak wherever LC 5 levels are exposed indicates continued, if more targeted, interest in the region by Southern Mesopotamians and continued interaction with the south.

4.3.14 Southern Interest and Presence in the Region

Increased interaction between the North Jazira and Southern Mesopotamia was a gradual process that began during the LC 3 period and eventually led to the settlement of some Southern Mesopotamians in the region starting in LC 4. This contact and interaction with the south coincided with a time of increased social complexity and, undoubtedly, as McMahon (2016, 181) listed: increased economic asymmetry and social division. This was not just a time period of unprecedented interregional interaction; it was a time period of unprecedented social inequality.

Unsurprisingly, there is evidence throughout the LC 3-5 periods for conflict, starting before the arrival of any southerners, but at the same time that local elites began borrowing (tripartite architecture, cylinder seals, tablets) or imitating (regular symbols, but not writing, inscribed on jars) elements of Southern Mesopotamian culture.

This social tension is first evidenced by the three mass graves from three separate local conflicts at Tell Majnuna during LC 3. Also during LC 3 at Tell Brak is the destruction of the tripartite building in Area TW Level 16 by fire (Weber 2016, 129; Oates and Oates 1993, 174; Emberling et al. 1999, 8). Then, there is a clear destruction layer dated to the boundary between the LC 3 and LC 4 periods at Tell Hamoukar, Area B, where elite residences were burned to the ground and the bodies of two individuals were left unburied at the satellite tell Area I/THS 2. Finally, during LC 5 at Tell Brak, Area TW, the tripartite building in Level 12 was 'heavily destroyed (perhaps deliberately)' before large pits were dug on top and filled with pottery and seal impressions (Oates 2002, fig. 115), following the pattern of destruction followed by pits filled with ceramics and sealings found at Tell Hamoukar, Area B.

Contrary to Algaze's (2008, 68) hypothesis based on some of the same data, current evidence does not suggest sites in the North Jazira, not even Tell Brak or Tell Hamoukar, were taken by 'coercive means' by Southern Mesopotamians during the late fourth millennium B.C.

Algaze (1993, 2005) has long argued that the Uruk Expansion was due to a desire by competing Southern Mesopotamian polities to control the import of various commodities by situating people at strategic control points along routes. For Algaze (1993, 2005), the interest by Southern Mesopotamia in the North Jazira and Western Jazira was two-fold: first, to secure access to resources from within the region and, second, to control resources travelling south to Southern Mesopotamia from further north in Anatolia.

From the Syrian-Mesopotamian Plains (Northern Mesopotamia south of Anatolia and West of the Tigris, including the North Jazira), Algaze (2005, table 3) envisions Southern Mesopotamians acquired prisoners of war and/or slaves, alabaster, gypsum,

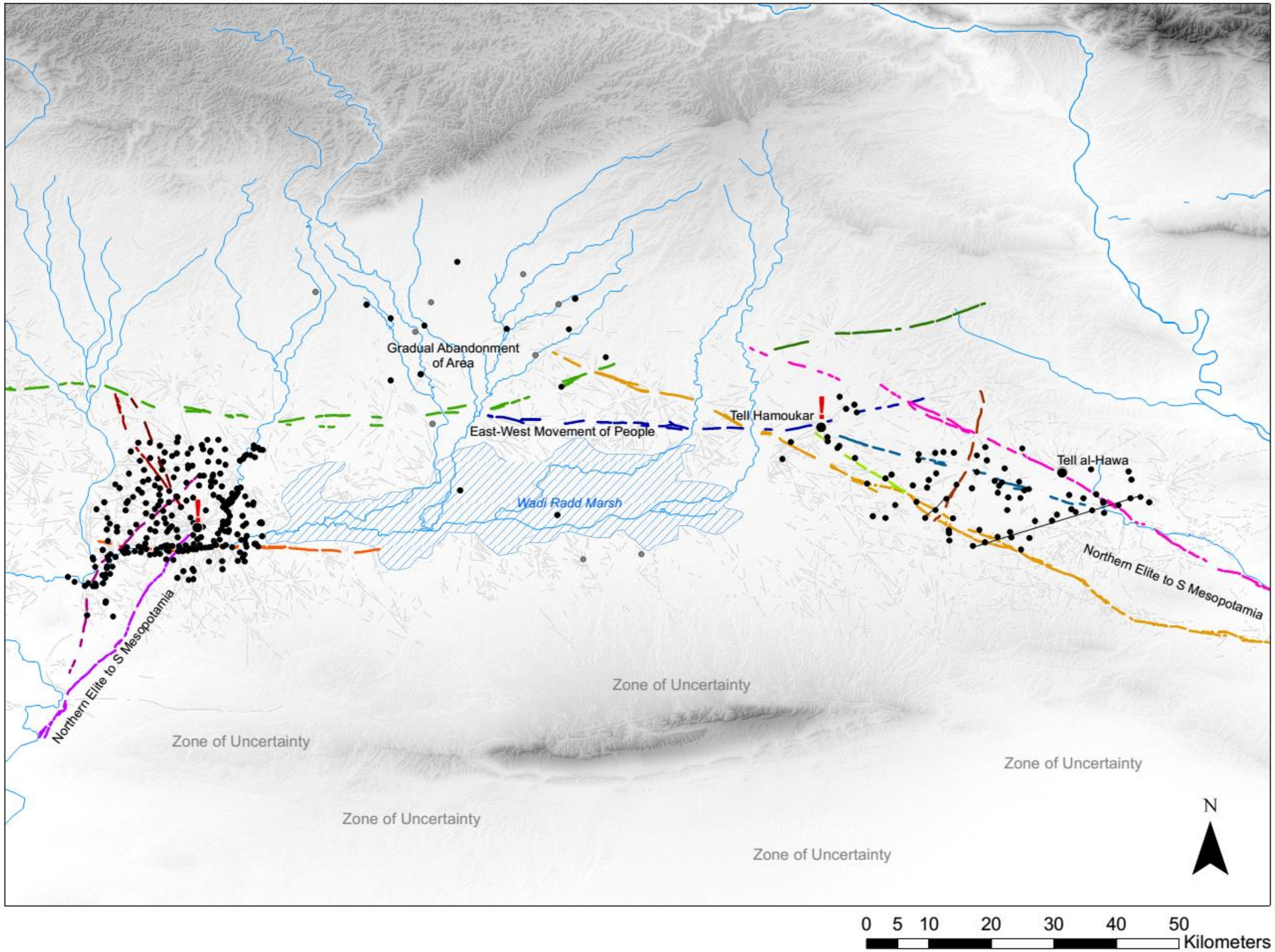


Figure 4.9 The North Jazira during the LC 3 period, sites shown as grey dots (rather than black) were abandoned by the LC 4 period.

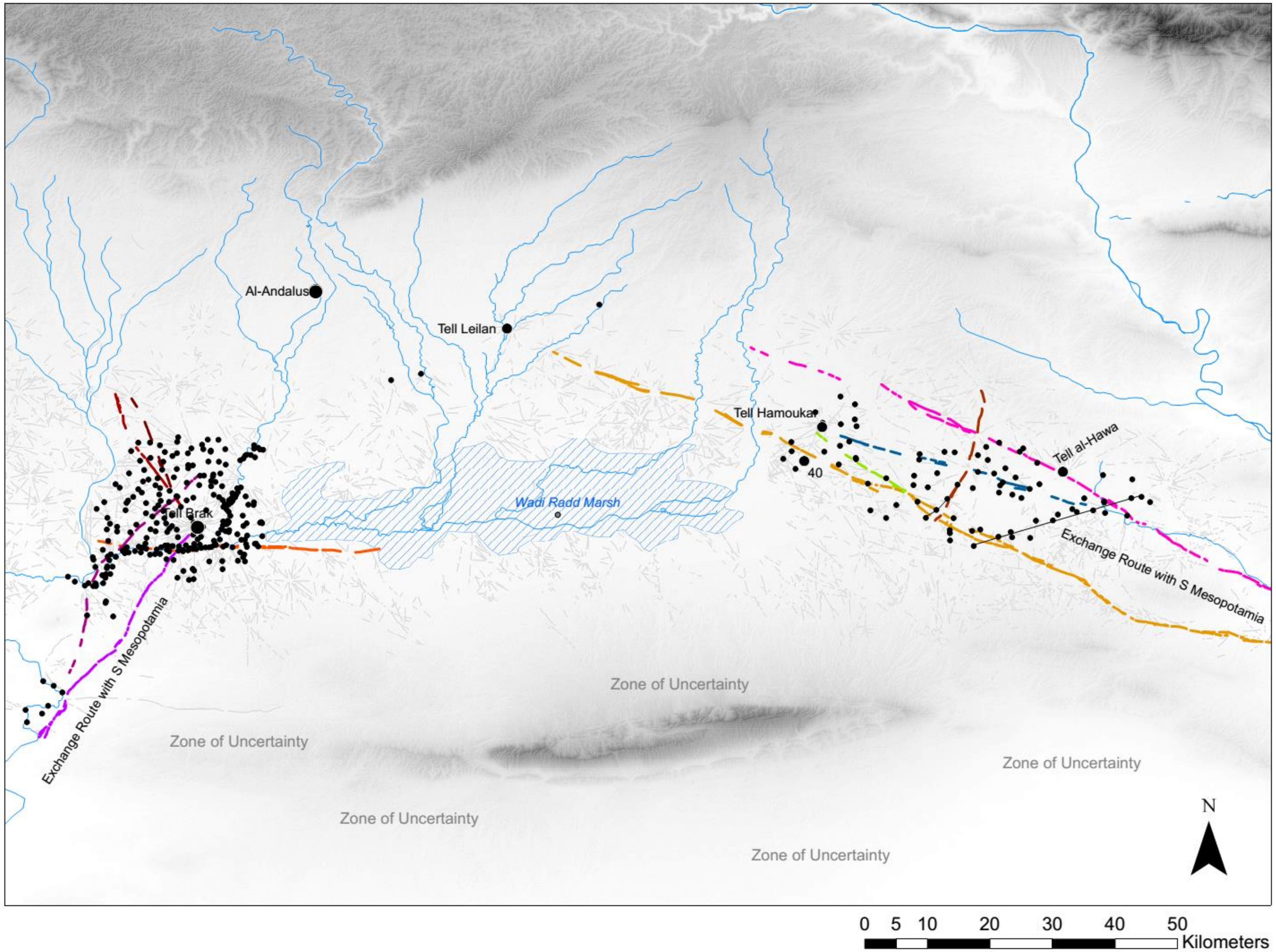


Figure 4.10 The North Jazira during the LC 5 period. Many more sites were abandoned in the Leilan Regional Survey area during the LC 4 period, leaving just a few sites in the centre of the North Jazira. It is uncertain if the grey site located in the southern portion of the survey area, in/near the Wadi Radd Marsh, is still inhabited during LC 5.

bituminous limestone, basalt, limestone, raw flint, flint tools, and bitumen. Within the North Jazira (rather than Western Jazira), it is unclear how many of these resources would have been available. Certainly, the Southern Mesopotamians could have captured local people to use as slaves and procured some of the flint tools manufactured at sites in the region, but no quarries have been located in the area to support the acquisition of stone. Perhaps they were collecting limestone and gypsum rocks from the surface? In the North Jazira there are both calcareous and gypsiferous lithosols (literally, rock soils) whose parent materials would be gypsum and limestone (Buringh 1960; Cherkess 1961). Otherwise, wool or surplus grain might have been exports of the region, but Southern Mesopotamia would have had more local sources of both.

In addition to these local acquisitions, Algaze also argued that some sites acted as strategic points to control trade from further north. Specifically, he describes how '…Brak functioned in effect as a natural gravity-fed collection and bulk-breaking point for metals and other commodities procured from the Anatolian highlands and brought into the Upper Mesopotamian plains, first through overland routes cutting across the Karaca Dağ and the Mazi Dağ mountains of south-eastern Turkey and then shipped downstream the Jaghjagh using boats or rafts. From Brak, in turn, resources could be shipped to markets in southern Iraq via the Khabur and Euphrates rivers or, alternatively be transferred onto porters or donkeys and distributed laterally across northern Mesopotamia' (Algaze 2008, 117-118).

Oates (2002, 121) agreed that 'attempts by the cities of the south to gain access to important resources…remains perhaps the most plausible explanation' for their presence at sites like Tell Brak and other sites outside the North Jazira, but not necessarily that this economic motivation led to political control.

Ur (2010, 150) commented that if THS 2 is a *karum* type settlement, then the Southern Mesopotamian ceramics found on the main mound of Tell Hamoukar should represent trade or emulation. The residents of the Area B, Level 3, tripartite building complexes were local and this would suggest that so were the people who left pits filled with Southern Mesopotamian ceramics and inhabited the eroded level that was once above Level 3.

Overall, the evidence from across the North Jazira at this time suggests that the expansion of Southern Mesopotamian material culture and architectural styles represents a combination of elite emulation (especially in the LC 3 period), possibly exchange, and the presence of Southern Mesopotamians in the region (starting in LC 4), perhaps seeking control of goods flowing into Southern Mesopotamia (particularly in LC 5 when Southern material culture is concentrated in the areas nearest the Khabur and Tigris rivers heading south).

4.4 The Early Third Millennium B.C. (EJZ 0-3a)

At the start of the third millennium B.C., the ties with the south that distinguish the previous period either ceased or were greatly reduced[15] and a new regional material/ceramic culture appeared that extended from the Khabur in the west, across the North Jazira, and south east to the area between the Lower Zab and Diyala Rivers (Rova 2011; Roaf 1990, 80). Originally referred to as the Ninevite V period, after the material culture that appears across the region (affiliated with the fifth level of the Nineveh excavation, labelled Ninevite V), this period is now equated with the Early Jazira 0 through 3a periods (see Chapter 2).

4.4.1 An(other) Important Pastoral Development

Pastoralism continued to be an important part of the regional economy during the early third millennium B.C. with further developments in sheep breeding. After about two millennia of growth, sheep once again became smaller and iconography only depicts coil horn varieties, which, for the first time, had a 'primitive fleece' (Vila and Helmers 2014, figs. 22 and 23, 27-33). This iconographic evidence for a primitive fleece is supported by genetic data: Breniquet (2014, 59) calculated the first genetic shift, which 'amplified the growth of this underwool' occurred during the third millennium B.C. The wool still did not grow year-round; the sheep were merely becoming more woolly and less hairy. Furthermore, the early third millennium B.C. marked the first appearance of fat-tailed sheep (Vila and Helmer 2014, 30–33).

[15] One of the hypotheses for the small agricultural villages with large storage facilities that are found along the Khabur during EJZ 1 and EJZ 2 is that they were for the shipping of grain down the Khabur and Euphrates to Southern Mesopotamia (Pfälzner 2011, 196; Michel Fortin 2000).

The development of the fat-tailed sheep highlights the importance of fat as a commodity; while the development of breeds with a thicker undercoat emphasizes the continued importance of sheep for wool and the textile industry.

4.4.2 Settlement Patterning and Hierarchy

Due to a sharp drop in the number of villages detected in survey (**figure 4.11**), it is hypothesized that the vast majority of people across the region abandoned the countryside in favour of life in urban centres (Wilkinson and Tucker 1995; Eidem and Warburton 1996; Ur and Wilkinson 2008; Ur 2002a). Another explanation for the abandonment of villages seen at the start of the early third millennium B.C. is offered by Weiss (1986, 2003) and Matthews (2003, 124-125, 132), both of whom noticed an overall reduction in total settlement area between the late fourth and early third millennium B.C. and hypothesized it was due to a phase of pastoral nomadism.

While evidence for the presence of semi-nomadic or nomadic pastoralists continues to be enigmatic in the early third millennium B.C., there is some support for this second hypothesis: settlement in the North Jazira Survey area shows the reduction in settlement numbers is largely due to the mass abandonment of the western half of the survey area (**figure 4.11**), which has been linked to the 'reorganisation of settlement and land-use to provide pastureland' (Wilkinson et al. 2014, 64; Wilkinson and Tucker 1995). Importantly, the few sites that remained were all located on or near a route connecting Tell Leilan to the Tigris near Nineveh (**figure 4.12**). Additionally, when the Leilan Regional Survey area was re-settled, sites along the northern east-west route that connected the region were re-inhabited, suggesting the route was once again in use (**figure 4.12**, shown in dark blue and green).

Structurally, settlement in the North Jazira expanded to a five-tier site size hierarchy in the early third millennium B.C. Evidence is limited, but survey data from within the North Jazira Survey area alone contained four tiers of settlement hierarchy: small villages (under 3 ha in size), large villages (4-7 ha), a small centre (10 ha), and a large centre at al-Hawa (42 ha) (de Gruchy and Cunliffe, forthcoming). When the Tell Hamoukar settlement data is added, it fits these categories, with three small villages well under 3 ha in size and Tell Hamoukar either a large village at 3.9 ha or a small centre of 8 ha during EJZ 0-1 (Ur 2010, 105). Adding in other sites from the region during EJZ 0-1, Tell Brak is estimated at 40 ha, fitting well into the hierarchy as a large centre alongside Tell al-Hawa. However, Tell Leilan (26 ha) and Tell Mozan (20 ha) seem to represent a fifth tier of settlement hierarchy – medium centres (see table 4.5). This five-tier site size hierarchy continued into the EJZ 2, although the absolute sizes of each category increased (see **table 4.6**).

This interpretation of settlement hierarchy contrasts with the ARCANE project, which examined a wider area of the Jazira and the entire third millennium B.C. and identified only four tiers of settlement in the Jazira during the third millennium B.C.: '"Rank 1" cities, large settlements of regional importance, "Rank 2" cities of sub-regional importance, "Rank 3" cities of local importance, and villages or specialised settlements' (Lebeau 2011b, 13). While the ARCANE project agree that there are three tiers of centre or city, they lumped all villages together into a single tier. Nonetheless, the (continued) separation of villages into small villages (under 3 ha) and large villages (4-7 ha), is evident when site sizes are plotted into a histogram (see **figure 4.13**) (de Gruchy and Cunliffe, forthcoming.).

Therefore, the growth from a four-tier settlement hierarchy in the late fourth millennium B.C. to a five-tier settlement hierarchy in the early third millennium B.C. is created by the addition of mid-sized centres. Accompanying this increase to a five-tier settlement hierarchy were significant changes to the nature of urbanisation over the course of the early third millennium B.C.

4.4.2.1 EJZ 0-1 Cities

By the beginning of the early third millennium, Tell Brak had shrunk dramatically to only 40 ha, Hamoukar (like Brak) may have also shrunk to about a third of its former spatial extent (see **table 4.5**) (Wright et al. 2007; Ur, Karsgaard, and Oates 2011; Ur 2016; Ur 2010, 105). At the same time, it appears that both Tell Leilan and Tell al-Hawa experienced considerable growth (see **table 4.5**) (Weiss 2013, 102–3; Lupton 1996, 128–29). Additionally, Tell Mozan, an important third millennium B.C. centre in the region located north of Tell Brak, was 20 ha.

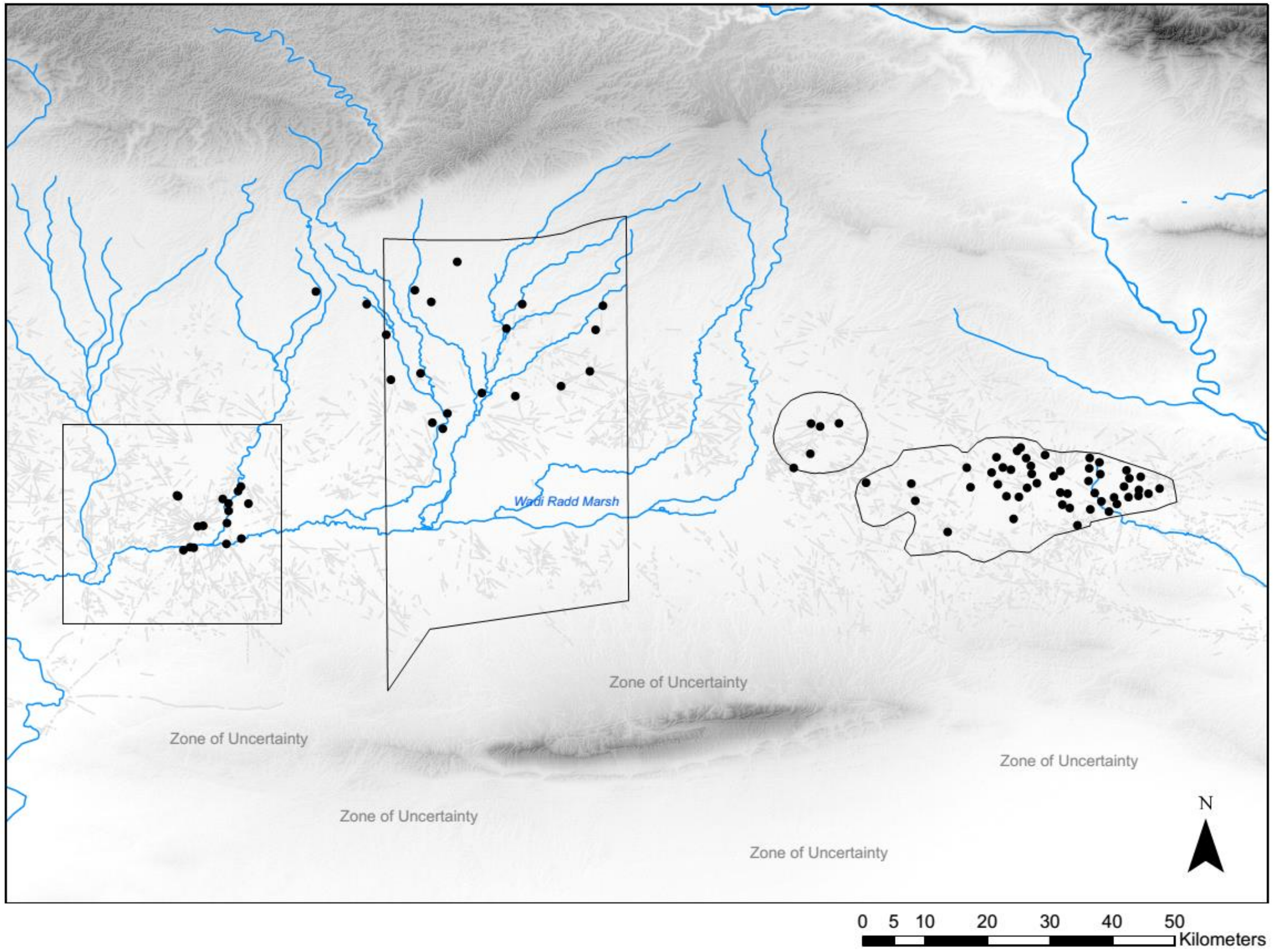
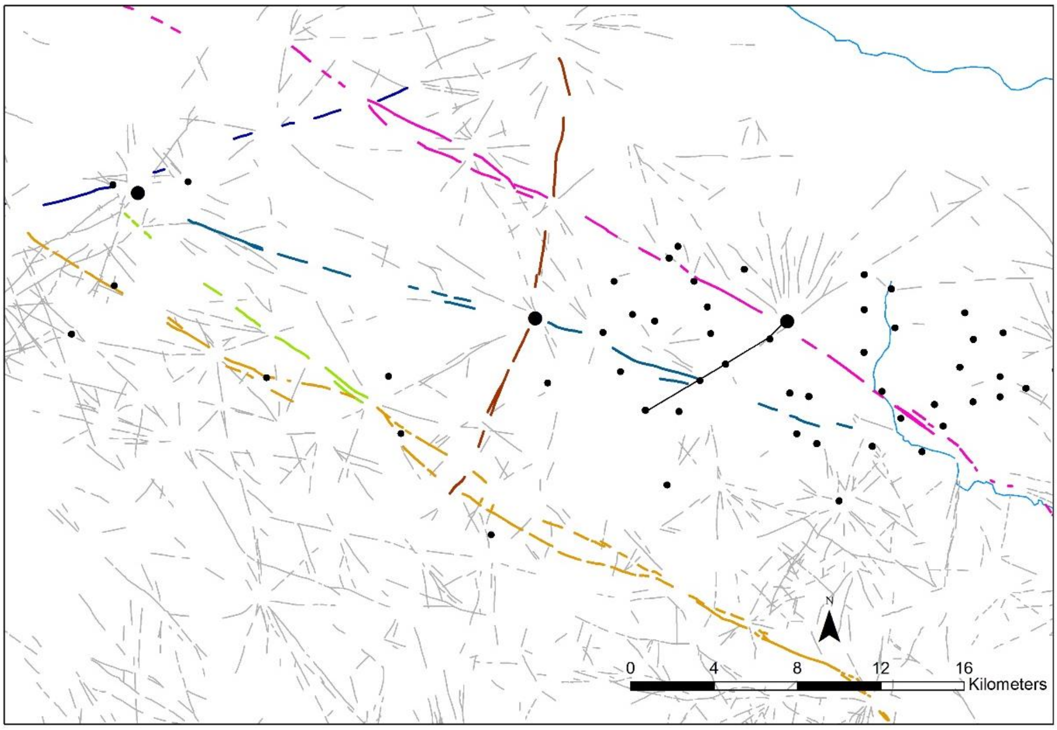
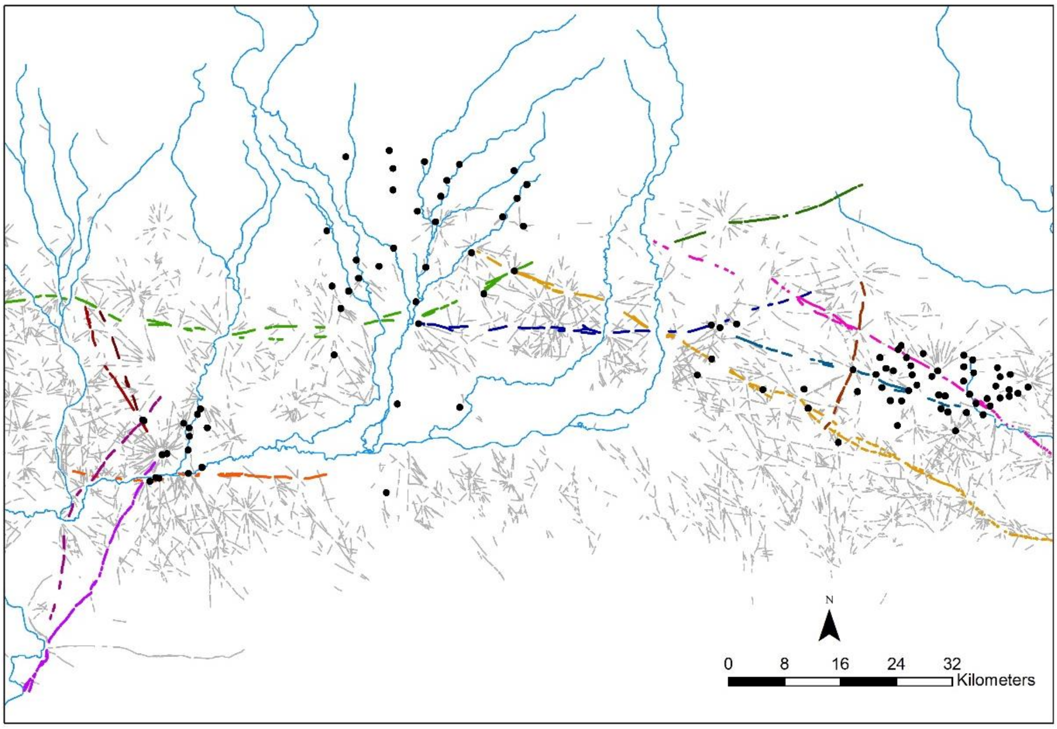


Figure 4.11 Settlement across the region reduces and appears to shift northward, above the Zone of Uncertainty. In particular, settlements are abandoned across the western half of the North Jazira Survey area, with the exception of a few sites located directly along one of the long distance routes (Appendix B). The reassessed 1995 Tell Leilan Regional Survey data appears to show an increase in settlement during the early third millennium B.C. with settlement still mainly occurring in the northern half of the survey region (Arrivabeni 2010).



a



b

Figure 4.12 Generally, settlement across the region recedes away from the Zone of Uncertainty. The western half of the North Jazira Survey area is entirely abandoned except a few sites located directly along a major long distance route (a, b).

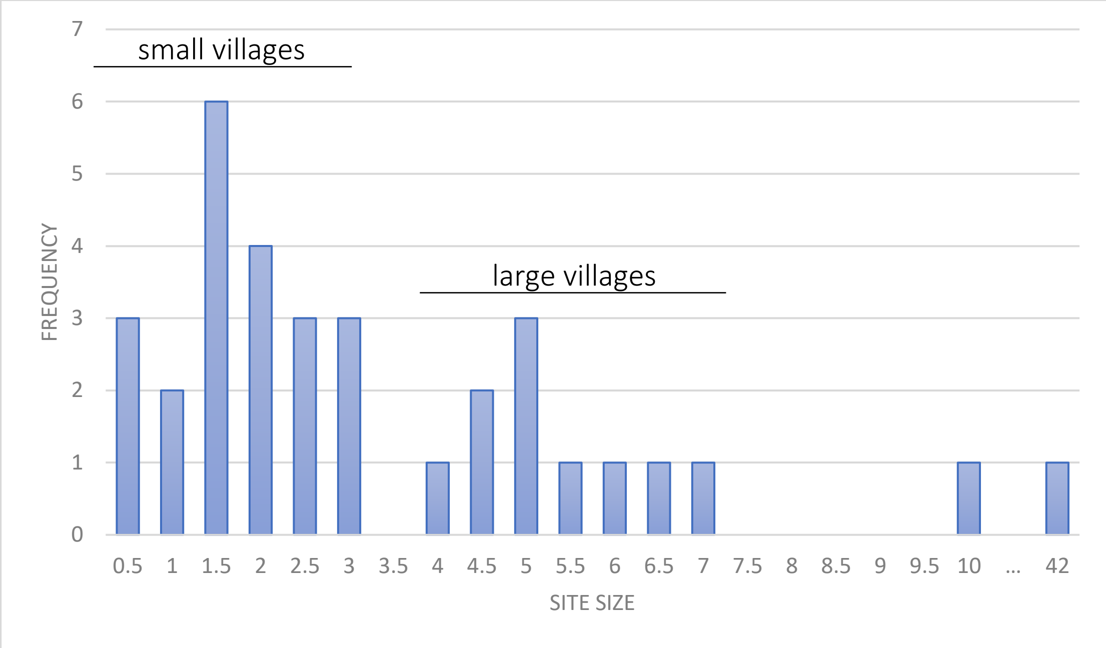


Figure 4.13 Histogram of early third millennium B.C. ('Ninevite V') site sizes from the North Jazira Survey project. Two classes of villages are apparent: small villages under 3 ha and large villages between 4-7 ha in area. While not obvious in the histogram, descriptive statistics suggest that both have a normal distribution: small villages (mean 1.6 ha, median 1.5 ha, mode 1.5 ha), large villages (mean 5.2 ha, median 5.0 ha, mode 5.0 ha).

Unfortunately, very little is known about centres/cities in the EJZ 0-1 periods, partially due to limited excavation, but also to the fact that excavation so far has exposed only houses, storage structures associated with individual houses, and ovens (Pfälzner 2011, 137, 145–46). No public buildings, secular or otherwise have been uncovered to date (Pfälzner 2011).

4.4.2.2 EJZ 2 Cities

In this next period of the early third millennium B.C., cities across the North Jazira and, indeed, the wide Jazira region experienced considerable growth (see **table 4.6**) (Meyer 2011, 135). Leilan, which already grew in size between the Late Chalcolithic and EJZ 0-1 periods, more than tripled in spatial extent (Meyer 2011, 135). Meanwhile, Tell Mozan more than quintupled from 20 ha to 125 ha; but it is Tell Hamoukar that (conservatively) grew 1225-percent between EJZ 1 and EJZ 2 (Ur 2010, 105–6)!

Tier/Site	Size (ha) LC 3-5	Size (ha) EJZ 0-1	Percent Change
Small Villages	Up to 4 ha	Up to 3 ha	75%
Large Villages	5-6 ha	4-7 ha	80-117%
Tell Hamoukar	15	3.9 or 8	26% or 53%
Small Centres			
NJS 93		10	
Medium Centres			
Tell Mozan	N/A	20	N/A
Tell Leilan	15	26	173%
Large Centres			
Tell al-Hawa	20	42	210%
Tell Brak	130	40	31%

Table 4.5 Changes in the size of settlements dated to the early third millennium B.C. in the North Jazira between the LC 3-5 periods and the EJZ 0-1 periods.

Tier/Site	Size (ha) EJZ 0-1	Size (ha) EJZ 2	Percent Change
Small Villages	Up to 3 ha	Up to 3 ha	
Large Villages	4-7 ha	4-7 ha	
Small Centres			
NJS 93	10	N/A	
Medium Centres			
Tell al-Hawa	42	N/A	N/A
Tell Brak	40	65 or 70	163% or 175%
Large Centres			
Tell Leilan	26	90	346%
Tell Hamoukar	3.9 or 8	98	1225% or 2513%
Tell Mozan	20	125	625%

Table 4.6 Changes in the size of settlements dated to the early third millennium B.C. in the North Jazira between the EJZ 0-1 periods and the EJZ 2 period.

The cause of this growth in spatial area differed from site to site. At Tell Mozan, expansion was driven by the creation and settlement of a lower town (Meyer 2011, 132). The straight roads radiating out from the gates of the upper town through the lower town even suggests some degree of planning (Meyer 2011, 132). At both Hamoukar and Leilan, the growth appears to be due in part to the creation of acropolis for public buildings in addition to expansion due to population growth (Meyer 2011, 133; Ur 2010, 105–6).

Both Tell Leilan and Tell Mozan feature inner and outer city walls in EJZ 2 and at Tell Leilan there is further evidence for a rampart or earthwork associated with the outer city wall (Quenet 2011, 35; Meyer 2011, 132, 135; Pfälzner 2011, 140–43).

A final development of EJZ 2 period cities was the appearance of large temples and palatial (or at least combined storage and administrative) buildings at Tell Brak, Tell Leilan, and Tell Mozan (Quenet 2011, 31, 35; Meyer 2011, 132, 135; Pfälzner 2011, 170, 179–80). At Tell Mozan, the earliest Temple Oval dates to the EJZ 2 period with the construction of a raised terrace for a temple with a monumental staircase connecting the palace to the top of the terrace (Pfälzner 2011, 179–80; Meyer 2011, 132).

4.4.2.3 EJZ 3a Cities

No separate size estimates are available for sites during the EJZ 3a period, instead continuity from EJZ 2 is assumed. Nonetheless, the cities continued to develop. Tell Brak gains its own monumental oval building, referred to in literature as the Oval, in Area TC, which functioned as a bakery (Emberling et al. 1999, 9–15; Emberling and McDonald 2001, 31–40; Emberling and McDonald 2003, 37–51; Quenet 2011, 31). Tell Leilan built the monumental Cultic Platform at this time on its Acropolis (Harvey Weiss et al. 2002; Quenet 2011, 35). Meanwhile, the Temple Oval at Tell Mozan grew with the construction of a 9 m high rectangular, mud brick terrace constructed on the site (Pfälzner 2011, 179–80).

There were also major changes in domestic architecture. Beginning in the EJZ 3a period, standardized house plots with standardized houses, 'allotment houses', are observed across the Jazira, including at Tell Leilan (Pfälzner 2011, 152). As described by Pfälzner (2011, 152), 'plots are usually 6 m, 7.5 m, 9 m, 12 m, or 15 m in width' and the smallest two sizes are observed most frequently.

4.4.2.4 Settlement Beyond the Urban Centres

Outside the urban centres, settlement numbers appear to be reduced throughout EJZ 0-3a. The western half of the North Jazira Survey area was almost entirely abandoned except for a few sites located directly on one of the long distance routes through the region and there are few recorded sites for the Hamoukar Survey area to the north (see **figure 4.11**).

The only published early third millennium B.C. sites from the Tell Brak area are from the more restricted area of the Eidem and Warburton (1996) survey, which found a lower density of sites for the late fourth millennium B.C. compared to the later survey by Wright et al. (2007). Therefore, it is impossible at this point to determine whether the apparent reduced settlement at the Tell Brak area is real or only reflective of the available published data.

On the contrary, results from the 1995 Leilan Region Survey actually show an increase in settlement numbers during the early third millennium B.C. (Arrivabeni 2010).

4.4.3 Self-Sufficiency

All the centres in the North Jazira could have been self-sufficient during EJZ 0-1, but this does not mean they necessarily were (**table 4.7**). Tell Brak, in particular, would have had to rely on imports starting in the late fourth millennium B.C. and would have had an established structure in place for procuring those imports. In the EJZ 2 period, Tell Hamoukar, Tell Leilan, and Tell Mozan all required more than a 3 km radius of fields to feed their populations (and nearly 4 km in years of lower yield – 500 kg of grain per ha). Either way, the presence of only 2 or 3 very small villages within this zone suggests both Tell Hamoukar and Tell Leilan could have been self-sufficient. (There is not enough data currently to evaluate Tell Mozan.[16]) One of the small villages around Tell Hamoukar may not have even been a normal settlement. THS 51's position near hollow ways leading to Hamoukar's (later) western gate leads Ur (2010,

[16] A settlement survey is required in the region of Tell Mozan before it is possible to assess whether or not it was possible for Tell Mozan to be self-sufficient.

204) to suggest that (in the later third millennium B.C.) the site 'may have had a specialized function related to the movement of goods and people in and out of the city.' It is possible the site may have had this specialist function earlier in the third millennium B.C., too.

The conclusion is that sites during the early third millennium B.C. did not *have to* rely on surrounding sites, but this does not mean they did not *choose to* mobilise crops from surrounding villages to gain access to other crops besides grain, like vegetables or flax for linen. In fact, archaeobotanical evidence from Tell Brak, Tell Leilan, and Tell Mozan prove that all three sites grew or imported a wide variety of crops besides grain, including: lentils, peas, chickpeas, vetch, alfalfa, and flax (Wetterstrom 2003, www.ademnes.de). This, again, raises the possibility for nascent polities in the region.

4.4.3.1 Small Settlements with Large Grain Storage Facilities on the Khabur

South of the surveyed area around Tell Brak, along the Khabur River between the Jebel abd al-Aziz and Jebel Sinjar were a series of villages with large storage facilities (Meyer 2011, 133–35; Pfälzner 2011, 193–97). Three of these villages are believed to have been planned settlements: Melebiya, Khazne, and Raqa'i (Meyer 2011, 133–35).

The earliest of these sites, date to the EJZ 1 period: Atij, Ziyade, Raqa'i, and Kneidij (Pfälzner 2011, 138, 193–94). All of the sites featured a combination of domestic houses and an abundance of grain storage facilities; but Atij and Kneidij also had perimeter or fortification walls (Pfälzner 2011, 138, 193–94; M. Fortin 1998).

In EJZ 2, more settlements of a similar nature (domestic houses, plenty of grain storage facilities) appear in the area: Melebiya and Bderi (Meyer 2011, 133; M. Fortin 1998, 234). Like Atij and Kneidij, Bderi was a walled settlement (Meyer 2011, 133–35). At the same time, Raqa'i constructed a large grain storage building, the Round Building, while Atij added silos along three sections of its fortification wall (Pfälzner 2011, 194–95; Fortin and Schwartz 2003; Schwartz and Klucas 1998).

There are different hypotheses regarding the purpose(s) of these sites, these are: that the settlements represent centralized storage for redistribution out of the Jazira, downstream towards Mari and the Euphrates River; the settlements stored grain for seasonally mobile populations; and that they were simply for communal use by the

Centre	Size (ha)	Site Size (sq. km)	Minimum Population (100 people per ha)	Average Consumption (250 kg of grain per person)	Area Required (700 kg of grain per hectare) in Hectares	Area Required (sq. km)	Inner Radius of Ring of Fields (km)	Outer Radius of Ring of Fields (km)	Field Radius (Distance from the edge of settlement to the furthest edge of fields)
Hamoukar	3.9-8	0.04-0.08	390-800	97,500 -200,000	139-286	1.4-2.9	0.11-0.16	0.68-0.97	0.56-0.81
NJS 93	10	0.10	1,000	250,000	357	3.6	0.18	1.08	0.90
Mozan	20	0.20	2,000	500,000	714	7.1	0.25	1.53	1.28
Leilan	26	0.26	2,600	650,000	929	9.3	0.29	1.74	1.46
Tell Brak	40	0.40	4,000	1,000,000	1,429	14.3	0.36	2.16	1.81
al-Hawa	42	0.42	4,200	1,050,000	1,500	15.0	0.37	2.22	1.85

Table 4.7 The minimum field area and radius required to support the centres in the North Jazira during EJZ 0-1 based on minimum site density, average consumption of grain (and no consumption of other crops), and maximum crop yields for the region. Calculation of field radius is calculated by the radius of a torus (donut) rather than a circle to account for inner settlement radius.

sedentary inhabitants of the settlements themselves (Pfälzner 2011, 196; Hole 1999, 274–78; Fortin 1998). All three hypotheses are plausible.

4.4.3.1.1 Hypothesis 1: Centralised Storage for Redistribution

During the early third millennium B.C., these small settlements with large storage facilities all clustered along the Khabur – a navigable river that could have provided a link between sites in the Khabur Triangle[17], like Tell Brak and Southern Mesopotamia. If these sites were centralised storage facilities for the shipment of grain to South Mesopotamia, the boats used to make these shipments down the Khabur and Euphrates to Southern Mesopotamia would have been reed boats sealed with bitumen, not unlike those used by modern Marsh Arabs in southern Iraq (Schwartz and Hollander 2006, 327; Algaze 2008, 51). These boats would have provided an easy means of transporting bulk goods compared to the best overland alternative: donkeys (see Chapter 5).

If exchange with the south had not ceased in the early third millennium B.C., then perhaps these villages could have acted as drop off points, from which grain would be loaded onto boats heading further south to Southern Mesopotamia. An argument against this is that if the goal was shipment of grain from the Jazira down the Khabur to the Euphrates, then it would be expected that any central storage facilities would be located further north on the Khabur, not within the Zone of Uncertainty (Hole 1999, 277).

4.4.3.1.2 Hypothesis 2: Grain Storage for Mobile Populations (Pastoralists)

The location of these small settlements with large storage facilities within the Zone of Uncertainty raises the possibility that the large storage facilities stored grain for exchange with pastoralists, or perhaps the pastoralists spent part of the year living at the Khabur settlements and part of the year away. The argument for this is partially based on the location of the sites (within the Zone of Uncertainty, but along a river in the flood plain), and the growing economic importance of sheep and goat as reflected by their proportions within faunal assemblages (Hole 1999, 277). This hypothesis envisions that the system of pastoral and agricultural symbiosis described by Barfield

[17] A term that refers to a series of parallel wadis that eventually combine to form the Khabur River.

(1993, 93-130) as the traditional economic model for pastoral nomadism in Southwest Asia was already in place. The large grain stores supply the residences within the settlement and the pastoralist segment of the population that resides in tents (Hole 1999, 277). The argument against this model is that the evidence for the existence of nomadic or semi-nomadic pastoralists at this time is circumstantial, reliant on the abandonment of pasture land in the North Jazira Survey, traditional models for sheep/goat herding, and the growing importance of sheep/goat to the economy.

4.4.3.1.3 Hypothesis 3: Local Use within the Villages

The last model is supported by the fact that in the EJZ 0-1 at Raqa'i and Atij, storage facilities tend to be paired with houses, suggesting ownership, though houses shared courtyards and tannur ovens (Pfälzner 2011, 145–46, 193–94). In EJZ 2, the model of storage shifted to communal silos and storage facilities located near village walls (Pfälzner 2011, 194–97). Inside these large communal storage facilities at Raqa'i, Atij, Kneidij, and Khazne, space was divided into compartments or rooms (Pfälzner 2011, 194–97). It is unknown if the total volume of storage space available at each site changed between EJZ 0-1 and EJZ 2. It is possible that these communal storage facilities simply represent a switch to centrally organized storage and that, as suggested for the EJZ 0-1 period, the storage serves only the residents of the villages. The argument against this is the possibility, even if the evidence is mostly through circumstantial evidence, for nomadic or semi-nomadic pastoralists. If they did exist, it would be expected that there would be exchange between them, the sheep/goat specialists, and surrounding agricultural communities, especially the small villages conveniently located in the Zone of Uncertainty with large grain storage facilities.

4.4.3.1.4 A Mathematical Evaluation of the Three Hypotheses

The three hypotheses, all have arguments for and against. All are possible, and perhaps, to some extent, they are all true: the villages stored grain for themselves, shipped some downstream, and exchanged more for sheep/goat products like cheese, milk, wool, and meat.

Tell Raqa'i is an ideal site for testing if this possibility, because excavation fully exposed the plan of the EJZ 2 communal storage facility (the Round Building).

Assuming the communal storage building at Tell Raqa'i was only a single-story building (perhaps 2 m high), it is possible to use geometry to determine that it could have held about 200,000 litres of grain[18]. Converting this to kilograms to make it comparable with the food requirements of the population: 200,000 litres of grain weighs 140,000 kg[19]. By comparison, the oval-shaped tell measures 100 m x 50 m at its base (Curvers and Schwartz 1990, 6), which equates to 0.4 ha. Ignoring the fact that about a fourth of the site is taken up by the storage building and applying a high estimate of 200 people per hectare to present a very high estimate of grain consumption, the site would require between 10,000 and 20,000 kg of grain a year to feed its population. Realistically, the actual grain requirements probably would have been much lower since about a fourth of the site is taken up by a large non-residential building. Together, the figures for storage capacity and grain consumption by the residents demonstrate that the site has built storage facilities for holding at least seven times the amount of grain that the local community would consume in a year. Perhaps some of the storage was intended for chaff to use in pottery production, but even so the surplus seems excessive – and of course it only gets more excessive if the Round Building had a second story, or the population of the site was lower (very likely).

The grain storage situation gets even clearer when it is realised that Tell Raqa'i could not have grown that much grain in a year. It is located 1.5 km downstream of Kerma and 1 km upstream of Gudeda – both are agricultural villages like Tell Raqa'i (see Lebeau 2011b, fig. 3). Furthermore, the flood plain is only 500-750 m wide around Tell Raqa'i (Lebeau 2011b, fig. 3). This means that the total agricultural area available to Tell Raqa'i would have extended about 750 m north and 500 m south for a total length of 1250 m with a width of about 600 m, yielding an area of about 75 ha. A field area of 75 ha would produce between 37,500 and 52,500 kg of grain a year – 188% to 525% more grain than was required to feed the population and about a third of the available storage capacity of the site.

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[18] Given radius 1 = 6 m, radius 2 = 5.75 meters, and estimated height = 2 m, the total volume is 217 m^3 or 216,770 litres, ignoring the internal walls. This has been rounded down in the text to 200,000 litres.
[19] Continuing to use the conversion provided in Algaze (2008, 58) that a litre of barley weighs 0.7 kg.

It was not possible that Tell Raqa'i filled its communal storage with grain on its own. Even if they kept surplus from one year to the next, it would take them at least three, possibly six, years to fill the building – would three-year-old grain even be edible? The storage capacity was well beyond the needs of the community.

Together, the evidence strongly supports that possibility that all three hypotheses could be correct: Tell Raqa'i and the other agricultural communities along the Khabur probably received imports of grain from further north, but not to feed themselves (hypothesis 1). They could provide for themselves from their own crops, which undoubtedly were also stored in the communal storage building(s) (hypothesis 3). The surplus grain kept in these settlements could have been exchanged for sheep/goat products (wool, cheese, milk, meat, leather) from any surrounding pastoralist communities and/or shipped downstream towards the Euphrates and sites in Southern Mesopotamia (hypotheses 1 and 2).

4.4.3.2 Self-Sufficiency: Possible, but not Probable

The conclusion of this examination of self-sufficiency during the early third millennium B.C. is that even the largest centres during the early third millennium B.C. *could* have been self-sufficient, but also that it is unlikely. Yes, the centres had enough agricultural areas to enable their populations to consume average quantities of grain, but this does not represent a full diet. The people in these centres enjoyed other foods, too, like lentils, chickpeas, and peas. They even grew products like alfalfa for animal fodder and flax for linen. These crops were either grown locally at the large centres (at the expense of grain) or were imported. Regardless, food was being imported into the centres. Furthermore, large quantities of grain were being shipped down the Khabur to agricultural villages with large storage facilities along the Khabur, probably from the Jazira, and most likely from the Khabur Triangle where Tell Brak is situated.

4.4.4 Population Demographics and Workforce

Looking at the population demographics and potential workforce figures during the early third millennium B.C., individual sites experienced large losses and gains in specialist/administrator capacity, but the scale of population and workforce within each tier of settlement hierarchy was comparable to that of the late fourth millennium B.C. The site that experienced the most dramatic changes was Tell Hamoukar, which went from having hundreds of potential specialists and administrators in the late fourth millennium B.C. to only perhaps one or two hundred in the EJZ 0-1 period (**table 4.8**), only to explode in size and have thousands of potential specialists and administrators in the EJZ 2 period (**table 4.9**).

Using the same figures as before to estimate population and workforce sizes in the early third millennium B.C., the increased settlement hierarchy and urbanism was accompanied, initially, by a reduction in available specialists and administrators in the region. This reduction of potential specialists and administrators in the EJZ 0-1 period was mainly due to the smaller size of the largest centres in the region. Otherwise, the sites included in all the other hierarchical tiers were broadly comparable to the sites included in the same tiers in the late fourth millennium B.C.: the villages (small or large) continue to have dozens of potential specialists and administrators, and small and medium centres continue to have hundreds. It is the largest centres that were reduced from having thousands to merely hundreds of potential specialists and administrators.

In the EJZ 2 period, figures for villages and small centres remain stable due to a lack of separate size estimates for the sites included in those categories; but the sizes of medium and large centres have increased. The large centres of EJZ 2 grow and return to be similar in scale to the larger centres in the late fourth millennium B.C. with thousands of potential specialists and administrators. Meanwhile, the medium centres represent an intermediate class not present in the late fourth millennium B.C. with many hundreds, perhaps a few thousand potential specialists and administrators.

4.4.5 NJS 93

The name of this site is Tell al-Samir, but nothing further is known. A site referred to as Tell al-Samir 5 has been excavated, but it is NJS 94 located 3.5 km south of NJS 93 (Wilkinson and Tucker 1995, 130; Altaweel 2006, 197).

Site	Size (ha)	Population	Agricultural Workers Required	Available Workers
Small Villages	Up to 3 ha	Up to 300-600	Up to 29-81	Up to 91-159
Large Villages	4-7	400-1,400	39-189	121-371
Tell Hamoukar	3.9 or 8	390-780 or 800-1,600	38-105 or 77-216	118-207 or 243-424
NJS 93	10	1,000-2,000	97-270	303-530
Tell Mozan	20	2,000-4,000	193-541	607-1,059
Tell Leilan	26	2,600-5,200	251-703	789-1,377
Tell Brak	40	4,000-8,000	386-1,081	1,214-2,119
Tell al-Hawa	42	4,200-8,400	405-1,135	1,275-2,225

Table 4.8 The estimated size, population, and workforce for each of the three centres during the EJZ 0-1 periods in the North Jazira.

Site	Size (ha)	Population	Agricultural Workers Required	Available Workers
Small Villages	Up to 3 ha	Up to 300-600	Up to 29-81	Up to 91-159
Large Villages	4-7	400-1,400	39-189	121-371
NJS 93	See above	See above	See above	See above
Tell al-Hawa	See above	See above	See above	See above
Tell Brak	65 or 70	6,500-14,000	627-1,892	1,973-3,708
Tell Leilan	90	9,000-18,000	869-2,432	2,731-4,768
Tell Hamoukar	98	9,800-19,600	946-2,649	2,974-5,191
Tell Mozan	125	12,500-25,000	1,207-3,378	3,378-6,622

Table 4.9 The estimated size, population, and workforce for each of the three centres during the EJZ 2 period in the North Jazira. Separate figures for EJZ 2 are unavailable for NJS 93 and Tell al-Hawa.

4.4.6 Tell al-Hawa

Beyond site size, the only thing known about settlement at Tell al-Hawa is that it appears from ceramic sherd densities on the surface that settlement shifted off of the Acropolis/main mound to the lower town area south of the Acropolis/main mound (Ball, Tucker, and Wilkinson 1989, 93–95; Ball 1990, 14). Three soundings on the Acropolis/main mound reach late fourth millennium B.C. deposits through about a meter of stratified levels, but there is no mention of any Ninevite V (EJZ 0-3a) finds (Ball 1990, 14).

4.4.7 Tell Brak

Unfortunately, while pottery from the early third millennium B.C. has been found in many locations across Tell Brak (Areas CH, DH, ER, FS, HF, HL, HP/SS2, HS, SS, ST, TC, TW) the Ninevite 5 (EJZ 0-3a) architecture is poorly preserved, revealing mainly scattered and, often, unconnected walls with occasional surfaces (Matthews 1995; Matthews 1996; Oates and Oates 1991; Pfälzner 2011, 137, 145–46, 179; Quenet 2011, 30–31; Meyer 2011, 132). As a result, reconstructing the history of the site is difficult. It is possible that there is a practice of tallying/counting items, evidenced by pieces of clay with impressed dots and lines (Oates 1985, 191, pl. XVc; Matthews 1995, 88, fig. 3). Other examples of this kind of tallying on clay have been found at two of the small agricultural villages: Tell Raqa'i 2 (EJZ 3a) from within a fill context and Tell Atij 'in association with the storage architecture' (Subartu IX, 222-223, fig. 11, fig. 19).

4.4.7.1 EJZ 0

EJZ 0 corresponds to Phase H at Tell Brak, when it is estimated that settlement was 30 or 40 ha (Quenet 2011, 30). Pfälzner noted the presence of domestic architecture and installations dated to EJZ 0 in Area TW, Levels 1-6 (Pfälzner 2011, 145–46). These residential buildings were described as rectangular mudbrick buildings often with orange/red plastered walls and floors (Oates and Oates 1991, 138). In Level 6, the earliest level, a round building with grill-plan walls for under-floor ventilation and interpreted by the excavators as perhaps a kitchen or perhaps an industrial space (Oates and Oates 1991, 138) is reminiscent of the storage facilities at the small agricultural villages downstream along the Khabur River with their grill-plan walls in the EJZ 1 period and the round storage building at Tell Raqa'i in EJZ 2. The photograph of the structure is at an angle, but it appears that this round building, probably for grain storage, is about 3 m in diameter, making it comparable in scale to the EJZ 1 storage facilities that accompany single room houses at Atij (Pfälzner 2011, 146–47, fig. 11).

4.4.7.2 EJZ 1

EJZ 1 is equivalent to part of Phase J at Tell Brak (Quenet 2011, 30). Only domestic architecture has been excavated, but it is unclear what a typical EJZ 1 house plan would look like at Tell Brak due to poor preservation of architecture (Matthews 1995, 88–98; Quenet 2011, 30).

4.4.2.3 EJZ 2

EJZ 2 is roughly the later portion of Phase J and Phase K at Tell Brak (Quenet 2011, 30–31). The settlement grew to between 65 and 70 ha by the EJZ 2 (Meyer 2011, 135), a growth of about 150% percent from its previous extent of 30 or 40 ha in EJZ 0. Poor preservation of architecture continues to pose a problem, but two changes can be observed to date to this period: a retaining wall on the northeast side of the site in Area ST and temples in the northwest in Area HS.

The retaining wall in Area ST on the northeast side of Tell Brak was attributed by David Oates (1982, 194) to the early Agade Period, but is considered by Quenet (2011, 31) to date to terracing activities in the EJZ 2 period. This retaining wall contained architecture (Oates 1982, 194), rather than vineyards or gardens. At the time of excavation, the 'vestiges of houses' containing both late fourth and early third millennia B.C. ceramic sherds found in the trench at Area ST were described as 'below this wall'.

In Area HS, the eighth (lowest) level dated to EJZ 2 contained a large room with multiple layers of fine plaster flooring, the last of which was burnt (Matthews 1995, 71; Quenet 2011, 31). Inside the room were steps and 'complex interior fittings', which together with the way the room was carefully packed with bricks upon abandonment (rather than fill/rubble), has led to the interpretation that it served 'some special function for the building' in which it was situated (Matthews 1995, 71).

Above this special room, in the fifth level of trench HS4 in Area HS, a one-room building about 4.5 m wide and 8 m long with an altar on its north side was found that has been interpreted as a small temple or shrine (Quenet 2011, 31; Pfälzner 2011, 179; Matthews 1995, 71–75, fig. 10). In front of the altar, a section of the floor steps down slightly and was lined with bitumen (Matthews 1995, 71–74). Pfälzner (2011, 179) interpreted this area in front of the altar as a hearth, while Roger Matthews (1995, 71-74) interpreted the bitumen lining as an indication for the presence of a small pool of liquid. Around and inside the altar, were 'several hundred clay sealings with cylinder seal impressions', a 'large' flint blade, and a model chariot wheel (Matthews 1995, 71–73). Under the floor, under the altar, was a clay wedge-shaped object with a non-functional handle that may have been formed around balls of organic material (Matthews 1995, 73). Outside this temple/shrine, was a courtyard with post holes that may have been used for tethering animals (Quenet 2011, 31; Matthews 1995, 71).

4.4.2.4 EJZ 3a

EJZ 3a corresponds to the earlier portion of Phase L (Quenet 2011, 31). The main feature dated to this time period was the enormous oval building found in Area TC on the east side of the site, which continued in use into the late third millennium B.C. (Quenet 2011, 31). Only a small portion of the building dated to this earliest phase has been uncovered, including a courtyard area surrounded by a series of rooms, each of which measure about 6 m by 3 m (Room 1, Room 2, and Room 3) (Emberling et al. 1999, 9, fig. 12; Emberling and McDonald 2003, 39). Room 1 contained a row of bins along its back wall and sloping plaster surfaces leading to storage jars, but it is unclear what these would have been used for (Emberling et al. 1999, 9, figs. 12, 14, 15, 16). Analogy to houses excavated at Tell Raqa'i and another site, Selenkahiye, led the excavators to suggest perhaps Room 1 was for grinding flour and producing dough (Emberling et al. 1999, 9, 12). Room 2 contained seven tannur ovens and stairs that led down from a second story (Emberling et al. 1999, 12, figs. 12, 18). Both rooms appear to have had their entrances from the central courtyard blocked and were instead accessed via stairs from a second story (Emberling et al. 1999, 12, fig. 12). To the south of this large oval building was a cobbled surface believed to be a possible street on which was found a shell pendant and a model wagon (Emberling et al. 1999, 13).

4.4.8 Tell Leilan

While multiple strata have been excavated dated to EJZ 1, EJZ 2, and EJZ 3a, they are mainly characterised by small exposures of fragmentary architecture that occasionally contains or includes other features.

4.4.8.1 EJZ 1

The EJZ 1 period is represented by strata 40/39 to 37, which was exposed in Operation 1 on the north west side of the Acropolis (Mayo and Weiss 2003, 26–28; Quenet 2011, 35). Like the architecture at Tell Brak during EJZ 0, interior surfaces (especially floors) of the two earliest strata were plastered in a thick orange-red clay (Mayo and Weiss 2003, 26). In earlier levels of stratum 39 a one-metre diameter oven was discovered, which was incorporated into a platform by the later levels of the same stratum (39) (Mayo and Weiss 2003, 26–27). In stratum 38, the excavators found pits, fire pits, and burial pits (Mayo and Weiss 2003, 27). One of these burial pits contained an adult, flexed, and without grave goods (Mayo and Weiss 2003, 27).The final stratum of EJZ 1 contained evidence of burning: a thick layer of ash, burnt grain, and many ceramic sherds (Mayo and Weiss 2003, 27)

4.4.8.2 EJZ 2

Strata 36-15 correspond to EJZ 2, with strata 18-15 equating to the Late EJZ 2 period (Quenet 2011, 35). Stratum 36 contained another burial, this time a flex adult with a single burial good: a black burnished incised jar (Mayo and Weiss 2003, 28). In stratum 35, part of a room with an orange plastered floor was found in the western half of the trench (Mayo and Weiss 2003, 28). Additionally, a 60 cm deep pit was dug during stratum 35 and filled with ‘bones, ceramics, organic material, and earth’, before further walls and an orange plastered floor was constructed on top of the pit (Mayo and Weiss 2003, 28). On this floor, red and grey bricks were used to construct a platform (Mayo and Weiss 2003, 28). Surfaces ‘north of the platform were not plastered and were covered with ashes, bones, organic material and ceramics…similar to the material in the pit below’ (Mayo and Weiss 2003, 28)

Later stratum revealed two buildings which were continuously rebuilt/maintained between strata 17-15. Inside the buildings were Ninevite 5 incised ceramics and sealings. In the past these buildings were interpreted as a palace, but this has since been modified to 'large houses engaged in the storage of produce and the processing and/or preparation of food stuffs' (Calderone and Weiss 2003, 194). Another interpretation of the buildings is that the rooms, (which were small, a maximum of 2.6 m by 2.3 m) were storage rooms and the buildings are communal storage facilities like those seen elsewhere in the Jazira during this time (Pfälzner 2011, 170).

It is during the Late EJZ 2, when these large household were constructed on the acropolis that the city expands from 15 ha to 90 ha and, in fact, when it is believed that the acropolis was formed as a mound and the lower city wall was constructed (Meyer 2011, 133, 135, Pfälzner 2011, 141, Quenet 2011, 35). The wall surrounding the acropolis was built at the very end of EJZ 2, in stratum 15 (Pfälzner 2011, 141, Weiss Late Nin V 2003, 196, 198).

During this final stratum of EJZ 2 both the large houses/communal storage facilities undergo massive renovation, but keeping their form with small internal rooms (Calderone and Weiss 2003, 197).

4.4.8.3 EJZ 3

EJZ 3a and EJZ 3b are represented in strata 14-13 at Tell Leilan (Quenet 2011, 35). The buildings constructed and renovated through EJZ 2 continue in use (Quenet 2011, 35; Calderone and Weiss 2003, 198). Likewise, the acropolis walls and lower city wall remained in use, though the lower city wall was altered (Pfälzner 2011, 143). There has been no excavation to EJZ 0-3 levels beyond Operation 1 where the two buildings were found, however, based on an aerial photograph, Pfälzner (2001, 156-157) suspects that domestic architecture followed the allotment house plan seen at other sites in the region.

4.4.9 Tell Hamoukar

Three trenches (Areas K, E, and H) revealed Ninevite V (EJZ 0-3a) levels in the last seasons before excavation halted due to the present conflict in Syria (Reichel 2009, 2011). The architecture in Area K was poorly preserved, but three large buildings with ‘several ovens and large storage jars’ were found in Area H (Reichel 2009, 2011). These have been preliminarily interpreted as areas for food storage and processing (Reichel 2011).

4.4.10 Tell Mozan

Excavation at Tell Mozan has uncovered EJZ 3 levels in both the lower town (Area C) and the palatial area (Area B). Additionally, EJZ 2 levels have been excavated in Area B. EJZ 1 has not yet been reached (Pfälzner 2010, table 1). Area B, from the earliest EJZ 2 levels excavated thus far shows evidence a palace complex with a central plaza that, in the EJZ 3 period, connected the palace to a temple on a brick platform via a monumental staircase (Meyer 2011, 132; Pfälzner 2011, 179). In the EJZ 2 period, the platform was present, but no evidence has yet been found for a temple building on top of it before EJZ 3 (Pfälzner 2011, 179).

Further evidence of planning is seen in the lower town, established during either EJZ 2 or EJZ 3, where straight roads can be seen to radiate outwards from the inner city gates and an additional lower town fortification wall was constructed (Meyer 2011, 132; Pfälzner 2011, 143). The foundation of the lower town and the shift of settlement off of the mound marks the point when Tell Mozan grows from 20 ha to cover 125 ha (Meyer 2011, 132; Pfälzner 2010, 4).

4.4.11 Trade and Interaction

The re-settlement of sites that evidence use of the northern route connecting the region east-west, suggests re-use of this route in the early third millennium B.C. after hundreds of years of disuse. Along with reconnection, the region experienced some reunification. Rova (1996) placed the entire North Jazira within a single ceramic province. Nonetheless, the landscape had changed and the region was no longer as culturally unified as it was before the Uruk Expansion. This might be explained partially by the growing strength of independent polities across the region.

During EJZ 0-2, the spatial distribution of sites, their sizes, and food requirements, combined with archaeobotanical evidence for crops other than grain, including crops like alfalfa and flax which were probably not for human consumption, indicate that (as with Tell Brak in the late fourth millennium B.C.) the largest sites were not self-sufficient. Instead, they relied on the regular import of food from their surrounding hinterlands, which suggests the possibility for polities. By the EJZ 3 period, it is possible that independent city states had developed in the North Jazira.

Beyond the regular movement of goods (and people) between hinterland and centre, Tell Brak and other sites in the Central Khabur Province (which includes the many wadis that come together to form the Khabur River, as well as Tell Leilan) would have been in a prime location to export surplus grain (grown or collected from their hinterlands) to the cluster of agricultural villages downstream. However, it is unlikely that Tell Hamoukar or Tell al-Hawa would have shipped any surplus grain to these sites, since the Tigris River would have been much closer, if either site did export grain. Nonetheless, some movement between the Tigris River near Nineveh to Tell Leilan is evidenced by a series of sites along this long distance route (shown in light brown) through an area that otherwise experienced total abandonment (**figure 4.14**). This route leading towards Tell Leilan ran parallel to a Y-shaped route (shown in bright pink and a lighter blue) linking both Tell al-Hawa and Tell Hamoukar to the same point on the Tigris.

There is no obvious reason why this more southerly route through what is hypothesized to have been pasture land would have been preferable. Was there a reason to avoid passing through NJS 93 (a small centre) and Tell Hamoukar (a medium centre) on the way to Tell Leilan (the lighter blue route)?

4.5 Summary

This chapter has described the evidence for movement across the region and for exchange networks (trade) and interaction before, during, and after the Uruk Expansion. It has been possible to discern the use and disuse of long distance routes over time through the association of hollow ways with settlements. Meanwhile, calculations of the necessary field areas required to feed the centres has revealed

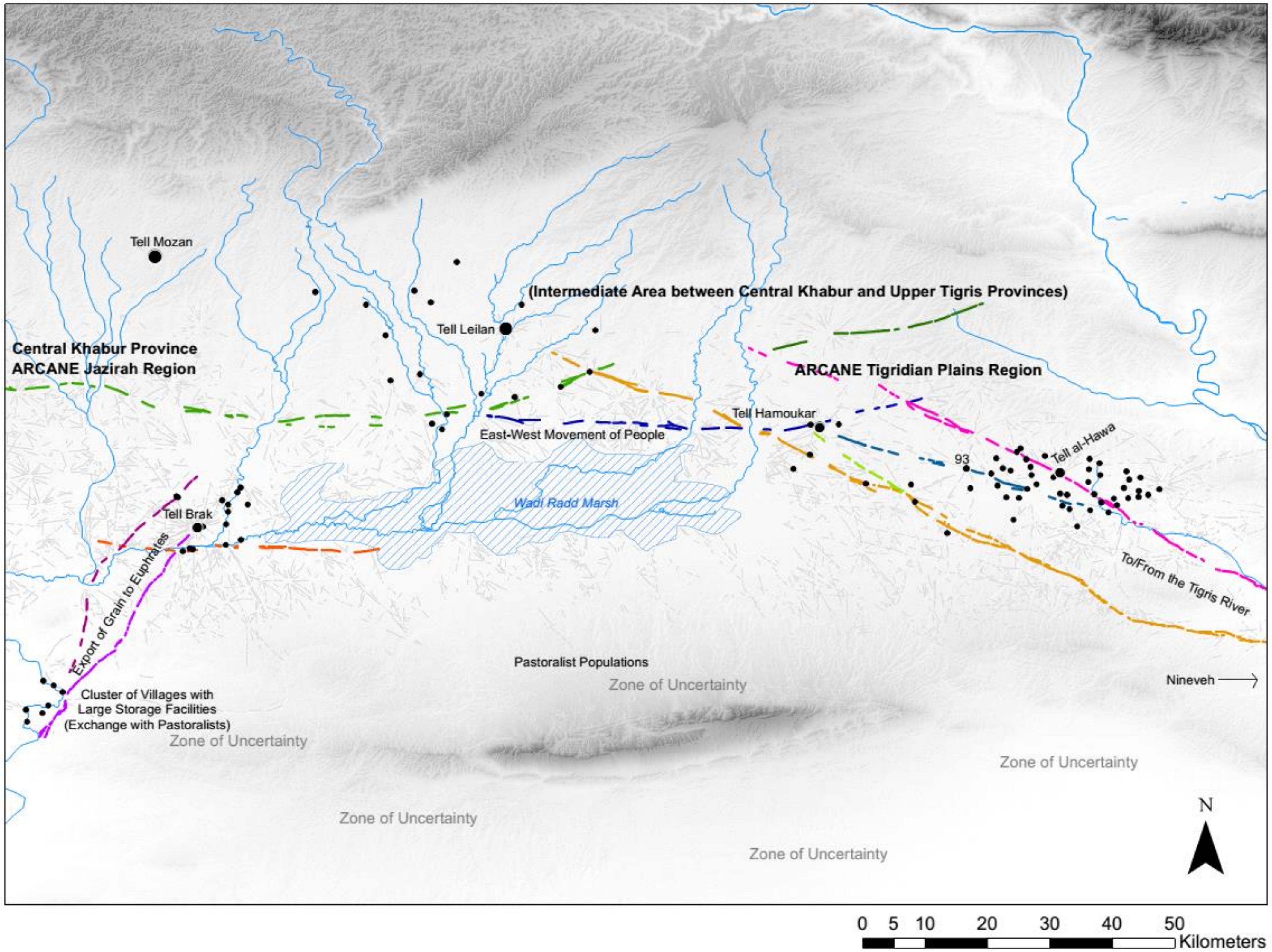

Figure 4.14 A reconstruction of the routes used during the early third millennium B.C. (EJZ 0-3a).

that nascent polities may have begun to form in the region as soon as the late fourth millennium (LC 3-5), but possibly earlier than the physical presence of Southern Mesopotamians in the region (LC 4-5). Territorial control by a centre could affect movement across the landscape, for example: by providing an area of passage safe from thieves, banning certain groups from traversing within the territory, or imposing tribute payments or taxes on those travelling through the territory.

Furthermore, it was only by examining the archaeological evidence from excavation in detail that it was possible to discern that evidence for conflict and burning at Tell Brak (from the mass graves at the satellite Tell Majnuna, but also later in Area TW) and Tell Hamoukar pre-dates evidence for Southern Mesopotamians residing in the region: these layers do not support violent take-overs by Southern Mesopotamians forcibly colonizing the region (Reichel 2006, 74; Reichel 2007, 65; Algaze 2008, 69–70) (Reichel, 2006, 74; Reichel 2007, 65; Algaze, 2008, 69–70), but rather local revolts likely against growing social inequality, as argued previously by McMahon (2016, 181), for the mass-graves at Tell Majnuna. The people journeying the routes connecting the North Jazira to Southern Mesopotamia were likely merchants and other travellers, not invading armies and their shape will reflect their route.

The same careful examination of evidence from excavation also suggests the possible presence of pastoralists on the outskirts of THS 25 during the early fourth millennium B.C. who may have travelled a segment of the northern east-west route across the region to reach the Tigris River, which they could take northwards to Nemrut Dağ (the source of obsidian at THS 25). The shape of this route (and possibly the parallel route shown in dark green) may, therefore, reflect the route choice decisions of pastoralists bringing flocks of sheep and goat to summer pasture.

Similarly, archaeological evidence from the early third millennium B.C. points strongly to the export of grain downstream from locations like Tell Brak to small agricultural villages with large storage facilities where it could be exchanged for pastoral products with an pastoral populations in the Zone of Uncertainty and/or shipped downstream to the Euphrates where it could have continued downstream to Southern Mesopotamia – a possibility that cautions against assuming a complete disconnect between the North Jazira and Southern Mesopotamia following the Uruk Expansion, even if the south no longer had any influence in the North Jazira.

It is only by thinking of who might have been travelling and why they would have been travelling that the results of any quantitative analysis evaluating route choice variables has any meaning. Otherwise, what would it mean that people were or were not travelling fastest routes (or any other type of route)? This not all, though. It is also important when modelling and assessing route choice variables to consider how people would have travelled. Did they walk? Did they ride animals? If they did ride animals, the model must reflect how those animals would cope with different slopes and conditions. The following chapter explores precisely this issue.

Chapter 5: Transportation

From the evidence in the previous chapter, it has become clear that *who* travelled during the fourth and early third millennia B.C. would have included pastoralists and members of the elite classes – in particular, merchants. This chapter now addresses *how* people might have travelled given the transport technology available: boats and donkeys.

5.1 Boats of the Fourth and Early Third Millennium B.C.

5.1.1 Reed Boats

Many of the boats used to travel along the Tigris and Euphrates rivers during the fourth and early third millennia B.C. would have been similar in form to the many types of reed boats still used during the 20th century A.D. by the Marsh Arabs of southern Iraq (Algaze 2008, 51; Rajab 2003, 82–83). These reed boats are/were constructed by tying together bundles of reeds and sealing the boats with bitumen, and would have been propelled either by rowing or punting (Schwartz and Hollander 2006, 327; Potts 1997, 122–25, notice the round paddles depicted on the bottom of some of the punting poles in figs.v.1.3 and v.2).

At Hacinebi Tepe, on the upper Euphrates river, fragments of bitumen that once sealed reed boats has been found and sourced using stable carbon and stable hydrogen isotopes (M. Schwartz and Hollander 2006). The results demonstrated that the bitumen used to seal boats used by the local population differed from that used to seal boats used by the Southern Mesopotamians at the site (Stein 1999a; Schwartz and Hollander 2006, 325–26). Furthermore, the bitumen used by the Southerners at the site was sourced from the same location as bitumen found at Kish in Southern Mesopotamia (Schwartz and Hollander 2006, 326, Fig.1).

5.1.2 Wooden Boats

In addition to reed boats, it is debated that wooden plank boats ‘were probably used in prehistoric Mesopotamia,’ based on the height and smoothness of the sides of clay boat models from the Ubaid period and Ur III period texts (Potts 1997, 125–26). It is also possible that these model boats represented reed boats that had been coated both internally and externally with bitumen (Schwartz and Hollander 2006, 327).

5.1.3 The Capacity and Speed of Boats

Using figures from the Ur III period, Algaze (2008, 57-60) calculated that shipments of grain ranged from 1 *gur* (300 litres, 210 kg) to 3,581 *gur* (1,074,300 litres, 752 tons), averaging 474 *gur* (142,200 litres, 100 tons).[20, 21] The boats carrying these Ur III period shipments fell into a series of size classes from 10 *gur* (3,000 litre capacity) to 300 *gur* (90,000 litre capacity) (Algaze 2008, 58–59), meaning that the average 50 ton shipment of grain[22] could have been sent in two boats. In other contexts, one *gur* of grain is equivalent to 300 litres; however this might not apply in the context of boats and (based on Ur III texts) likely underestimates the maximum carrying capacity of the boats (Algaze 2008, 58; Potts 1997, 129). Perhaps *gur* referred to the internal volume of the boat?

Ur III texts also describe travel speeds, which range between 7.1 km per day and 16 km per day, regardless of whether the journey is entirely upstream or includes both upstream and downstream segments of travel (Algaze 2008, 60–61). Despite the slow pace, the volume of cargo the boats could hold meant that water travel was a much more efficient means of transporting goods than overland (Algaze 2008, 61).

5.2 Reconstruction of a Fourth Millennium B.C. Donkey Caravan

The increasing evidence, both direct and indirect, for the domestication of donkeys or at least the use of captive asses for traction raises the possibility of donkey caravans as early as the mid-fourth millennium B.C. It is an important point to explore, because essential to modelling a route system is an understanding of the mode of travel. There is a growing body of iconographic evidence for the use of donkeys or asses from the area of Egypt to Iran during or before the fourth millennium B.C. (Potts

[20] 1 GUR = 300 litres = 210 kg of grain (Algaze 2008, 57–58).

[21] The conversions presented on pages 57-58 do not yield the values presented on p. 59, for example that an average shipment of 474 GUR equates to 50 tons (metric or U.S.). The modern equivalent volumes and weights presented are, therefore, recalculated using the figures presented by Algaze (2008) on pages 57-58.

[22] Algaze (2008, 59) calculates this value based on shipment amounts listed in 52 texts from Girsu and dated to the Ur III period (Algaze 2008, 58-59).

2011; Epstein 1985). The limited morphological and physiological evidence available suggests domestication of the donkey was a long, gradual process with morphological changes appearing in ass skeletons as early as the 7th millennium B.C. in Egypt and the emergence of domestic donkeys around the beginning of the fourth millennium B.C. (Marshall and Weissbrod 2011; Shackelford, Marshall, and Peters 2013; Rossel et al. 2008). As the first pack animal, the impact of donkeys on society must have been profound. Specifically, a recent ethnographic study has found that the primary social impact of adopting donkeys for labour is the freeing of women from the time-consuming task of collecting water (Goulder 2016).

5.2.1 Indirect Evidence for Donkeys: Workshops filled with Women

Contemporary seals and sealings feature various groups of people engaging in different industries and professions (Amiet 1980, pl. 12, 16, 17, 19-21 bis, 123, 135) (see also **figure 5.1**). While other industries were important, the textile workshops filled with pig-tailed women (who look much more like they are sporting pony tails) are most significant here due its all-female workforce. Of particular relevance is the origin of the women working inside these weaving workshops.

Evidence from later texts, mainly from the Ur III period of Southern Mesopotamia, suggest that these women could have been foreign slaves brought from military operations (less likely in the fourth millennium B.C.) and/or dependent workers (Steinkeller 2015, 7, 23). Dependent workers may have been widows, orphans, or from poorer or landless households (Steinkeller 2015, 23–24; Wright 2013, 411; McCorriston 1997, 526–27). Specifically, and again based largely on Southern Mesopotamian texts from the Ur III period, McCorriston (1997) has connected the emergence of weaving workshops to changes in production associated with the adoption of wool textiles. Specifically, McCorriston (1997) argued that with changes in land ownership and the transition from kin-based social stratification to formalized classes over the late fourth and third millennia B.C., some men and women lost tenure of their land as it was gradually incorporated into larger households (McCorriston 1997).

Simultaneously, as larger households gained control of more land, they built weaving workshops which employed the poorer, landless women (McCorriston 1997). In fact,

Figure 5.1 Men and women working in a variety of industries and professions, including weaving in the lower six images (all images from Amiet 1980).

it is believed that by the mid-third millennium B.C. in Southern Mesopotamia, the palace (the house of the ruler) and large households may have supplanted the temples (the houses of the gods) as the primary locations of employment and production, weaving or otherwise (Collins 2013, 353–55; Wright 2013, 407–11).

In Northern Mesopotamia, evidence for weaving workshops first appears in the fourth millennium B.C., starting in the LC 2 period, exemplified by both the Green Building (LC 2) at Tell Brak and the Red Libn Building (LC 2-3) that replaced it (Oates et al. 2007; see also Chapter 4, this volume). However, the LC 2 period residents of Northern Mesopotamia would not have been subject to the same socio-political and economic dynamics around land ownership and tenure as the inhabitants of late third millennium Southern Mesopotamia, described by McCorriston (1997).

Kinship ties and the household as social structures of organisation did likely exist during the LC 2 period in Northern Mesopotamia (Ur 2014; Walther Sallaberger and Pruß 2015), but with important differences. Combining textual and archaeological evidence, Sallaberger and Pruß (2015) demonstrate that in the mid-late third millennium B.C. (EJZ 3b period), workers were employed in communal workshops – not by larger house complexes owned by wealthier families, as described by McCorriston (1997). Likewise, early LC 2 and LC 3 evidence for weaving workshops in Northern Mesopotamia comes from public buildings, the Green Building and Red Libn Building at Tell Brak, not large house complexes.[23] It is unlikely, then, that the weaving workshops in Northern Mesopotamia reflected structural changes in society that resulted in poor, landless women seeking employment in larger households. Instead, another intriguing possibility may explain the sudden appearance in the LC 2 period of the fourth millennium B.C. of these weaving workshops filled with women – donkeys (Goulder 2016), or at least the widespread use of captive asses for traction.

Donkeys are intelligent animals who are able to learn routes and travel them unaccompanied. In the modern world, this is a nuisance for law enforcement who

[23] Although in the Late Uruk period, the successive public buildings are replaced by a large, Southern-style tripartite house (see Chapter 4, this volume).

find unaccompanied donkeys dutifully smuggling goods across borders[24], but this skill also means they are useful for gathering water. The donkeys learn the routes to the water sources and only a child is required to accompany the donkey in order to collect the water and re-load the donkey. A job that took women hours could now be delegated to a donkey and a child, and women could engage in more skilled labour – like weaving (Goulder 2016).

5.2.2 Indirect Evidence for Donkeys: The Uruk Phenomenon

Another source of indirect evidence is the unexplainable occurrence of the Uruk Phenomenon. Regardless of the debate around exactly what it represented (colonization, trade diasporas, and so on), there is no question that the mid-fourth millennium is a time of unprecedented interaction on a scale never seen before. Furthermore, it is recognized that a primary motivation behind the Uruk Expansion was the procurement of resources unavailable within the Southern Alluvium, including various stones, metals, and wood (Algaze 1993; Algaze 2005; Algaze 2008; Stein 1999b; Rothman 2001b; Minc and Emberling 2016). The question remains: why then?

Algaze (2008) has indirectly addressed this question by examining the origins of urbanism in Southern Mesopotamia. Urbanism in Southern Mesopotamia developed during a climatic phase with higher precipitation, in a fluvial landscape with many channels flowing into an expanded marsh area, and out to a higher Persian Gulf due to increased global sea levels (Algaze 2008, 42–46; Kennett and Kennett 2006). There is some climatic data for an arid 5.4 KYA event (c.3600 B.C.); which, as Algaze (2008, 42-43) observed, would have affected Southern Mesopotamia 'at about the transition from the Middle to Late Uruk periods' – the time of the Uruk Expansion. The same

[24] 'Regime forces and allied militias launched an assault on the city of Zabadani just east of the Lebanese border this past July in an effort to retake it from rebels who have held it since 2012. The city is the gateway into the Qalamoun Mountains, which overlap into Lebanon. Hezbollah, and Iran by extension, are deeply invested in maintaining access to the mountain range, home to hundreds of foot paths, some so narrow as to only have room for one donkey to walk through, that are used for smuggling in and out of Lebanon.' (Syria Direct, 27 Aug 2015).
'…local smugglers decided the journey to Iraq was too dangerous. To their relief, however, they found their mules were smart enough to make the 24 km (15-mile) trip to the border by themselves. All the keepers needed to do was set them off down the right track with empty saddlebags, and they would come back loaded with contraband. The illicit trade continued.' (Shahdi Alkashif, BBC News, 3 May 2015)

marshlands and fluvial environment was favourable for the development of a transport network between settlements based on boats from at least the sixth millennium B.C., which could be easily used to transport bulk goods at a time before pack animals and encouraged centres to develop means for exporting their local products (Algaze 2008, 50–52, 66). According to Algaze (2008, 64-65), this setting enabled the development of urbanism during the late fifth and early fourth millennium B.C. such that in the mid-fourth millennium B.C. a 'second stage' of urbanism took place 'marked by an emerging elite awareness of the social implications of intraregional trade patterns in place until that point in time.' This led to 'competitive emulation' first between centres in Southern Mesopotamia, as they adopted each other's technologies and products; but, ultimately, this desire for the new and different led to an expansion outward to neighbouring regions (Algaze 2008, 65–66). This, as argued by Algaze (2008, 66), led to the Uruk Expansion, which was enabled by the development of export industries in Southern Mesopotamian centres and *the domestication of the donkey*, the first pack animal, in the mid-fourth millennium B.C. This suggestion that the domestication of the donkey enabled the Uruk Expansion is not new, and has been argued before by Joan Oates (1993, 417).

The adoption of the first pack animal is a simple explanation for the timing of this sudden, intense regional interaction. The adoption of the donkey or captive ass as a pack animal would represent the first time in the history of the region that people would be able to trade goods without the limits of what a person or group of people could hold. It would be unsurprising if this caused people to venture further afield than they had in previous time periods, spurring new regional interactions on an unprecedented scale as is seen with the Uruk Phenomenon.

5.2.3 Indirect Evidence for Donkeys: Texts, Iconography, and Figurines

The first texts that mention ANŠE – donkeys – date to the late fourth millennium, (Nissen, Damerow, and Englund 1993, 89–92; Klein and Gan 2004; "Schøyen Archaic Nn, CDLI No. P006077," n.d.[25]). In the archaic texts (ShM 1-6) found at Uruk dated to the Jemdat Nasr period, the symbol for donkey (ANŠE) is shown with a series of

[25] The Schøyen and Moussaieff collections were illegally excavated.

parallel lines extending from the back of the donkey's neck (Klein and Gan 2004), an addition to the sign that is also added to the sign for pig to distinguish wild pigs from domestic ones (see Nissen et.al. 1993, 92) (see **figure 5.2**), perhaps indicating that the animals were wild animals rather than domesticates. Additionally, while breeding is recorded for other animals (cattle, pigs), Nissen et al. (1993, 90, 92) have stated that 'there seems to be no written evidence from the archaic script phases Uruk IV and III concerning the practice of ass breeding. Such texts are well known, however, beginning with the later Fara period.' Nonetheless, the series of archaic (ShM) texts describe the use of these animals for ploughing (ShM 1 and 4, transliterated in Klein and Gan 2004, 162, 167) and the need to provision them with fodder (ShM 6, transliterated in Klein and Gan 2004, 171), so it is clear that regardless of their status as domesticates or not, they are being kept and used like donkeys.

In art, equids are depicted on the walls of Çatal Höyük and on sherds of ceramic from time periods well before the fourth or third millennium B.C. (for a review see Zarins 2014, 97-105). Most of these images are devoid of people and in no image are any of the equids depicted as employed in any labour. It is starting in the fourth millennium, or perhaps in the millennium before, that the first donkeys used as pack animals are illustrated or formed (Potts 2011; Epstein 1985; Zarins 2014, 105–7).

Two donkey figurines carrying vessels (baskets or water jugs?) on either side were found in ossuary caves, one each at Giv'atayim and Azor in modern day Israel (**figure 5.3**, Epstein 1985, figs. 57-59). A third fragment of just the head of a figurine has been found at 'a site near the Yarmuk River' that clearly shows harnessing (**figure 5.4** Epstein 1985, fig. 11). An early chariot scene from Susa in Iran dated to the late fourth millennium B.C., however, shows a bovid animal pulling the vehicle (Zarins 2014, 107, 2.28), suggesting donkeys/asses were not always used for traction. Finally, there is a ceramic fragment from level A18 at Tol-e Nurabad in Iran dated to 4940-4680 cal.B.C. that appears to show an equid with a saddle blanket (Potts et al. 2005, 90).

Overall the textual evidence shows that donkeys/asses at the end of the fourth millennium B.C. may not have been fully domesticated, as they are denoted in protocuneiform texts with the same series of lines that distinguish wild pigs from domestic pigs, but the texts, figures, and imagery all indicate these animals were

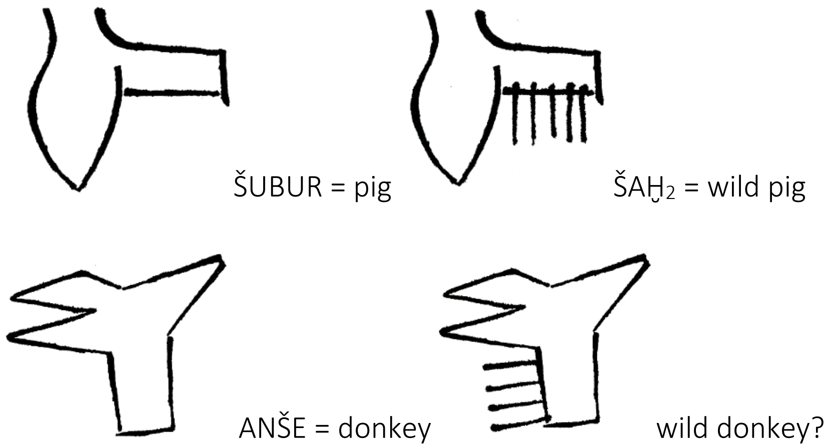

Figure 5.2 Textual evidence for donkeys or asses in archaic script from six tablets recently re-discovered from Uruk during the Jemdat Nasr period, compared to the signs for one-year-old pig and one year old wild pig (tablet images from Klein and Gan 2004, cuneiform symbols for ŠUBUR, ŠAḪ$_2$, and ANŠE redrawn from Nissen et al. 1993, 89).

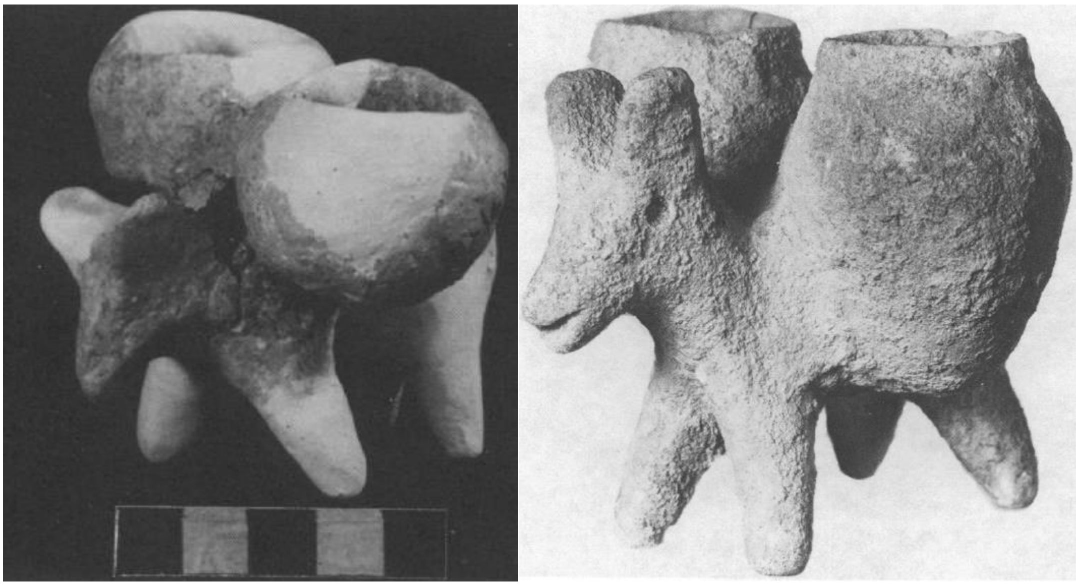

Figure 5.3 The donkey figurines from Giv'atayim and Azor (reproduced from Epstein 1985, figs. 9 and 10).

being kept by people, provided with fodder, and used to help in the fields and for carrying goods or water.

5.2.4 Direct Evidence for Donkeys: The Donkeys

Genetic analysis of donkey domestication based on mitochondrial DNA (mDNA), indicates that donkeys were potentially domesticated twice due to the presence of two haplogroups. One of these groups developed from Nubian wild asses and the other group originates from an extinct subspecies of wild ass that is genetically similar to the Somali wild ass (Kimura et al. 2013).

A morphological study, examining the rate of change in domestication of the donkeys, argues that the appearance of phenotypical or morphological traits in donkeys (when an ass starts to look like a donkey) took hundreds of years or more with even early third millennium skeletons showing only very small differences from wild asses (Marshall and Weissbrod 2011; Shackelford, Marshall, and Peters 2013). This slow rate of change, first observed in the ankle bones, is attributed to the use of donkeys for transport (Shackelford, Marshall, and Peters 2013), and underlines the point that asses were used for transport for perhaps centuries before their skeletons changed significantly enough to be diagnostics of domestication.

At Tell Nebi Mend, analysis of 'the domestic mammals from secure contexts' yielded 16 bones identified specifically as donkeys from phases 6-12 in trench VIII dated to the LC 2 period (Grigson 2015, 5, 13–15, Table 1, Fig. 9).[26] Early fifth or fourth millennia B.C. discoveries of donkeys occur in Egypt at Maadi, El Omari, Heirakanopolis, Abusir where three complete skeletons were found dated to around 3000 B.C., and Abydos where ten donkey skeletons were found in mortuary contexts also dated to around 3000 B.C. (Rossel et al. 2008, 3716; Kimura et al. 2013, 86). The paleopathology of the Abydos donkeys, however, indicates that they were more similar to Nubian and Somali asses than domesticated donkeys and may have been captive asses (Rossel et al. 2008). Nonetheless, all showed palaeopathological signs in their long bones and vertebral columns consistent with carrying heavy loads on their backs as pack animals used for transport (Rossel et al. 2008).

5.2.5 A Summary of the Evidence

Skeletons identifiable morphologically as donkeys may occur as early as the first half of the fourth millennium B.C. (Tell Nebi Mend), but certainly by some point during the third millennium. The mid-third millennium is when texts explicitly mention the breeding of ANŠE (donkeys/asses), but ANŠE with the same extra denotation used to distinguish wild from domestic in pigs are mentioned earlier in a series of protocuneiform texts from the site of Uruk dated to the end of the fourth millennium B.C. in the context of being used to plough fields and fed fodder. It is also in the fourth millennium B.C. that two figurines from two different sites in Israel depict these animals carrying baskets or perhaps water jugs (**figure 5.2**). The ability of donkeys to learn routes and make journeys can free women from the time consuming task of gathering water every day as they can be sent to gather the water with a child old enough to fill the jars with water and place the jars back on the donkey. Therefore, the use of captive asses for this purpose may have begun as early as the LC 2 period, contemporary to the emergence of weaving workshops, and the date of the faunal remains identified as donkeys at Nebi Mend.

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[26] Recall, this is the same period as the appearance of weaving workshops in the Green Building (LC 2) and Red Libn Building (LC 2-3) at Tell Brak.

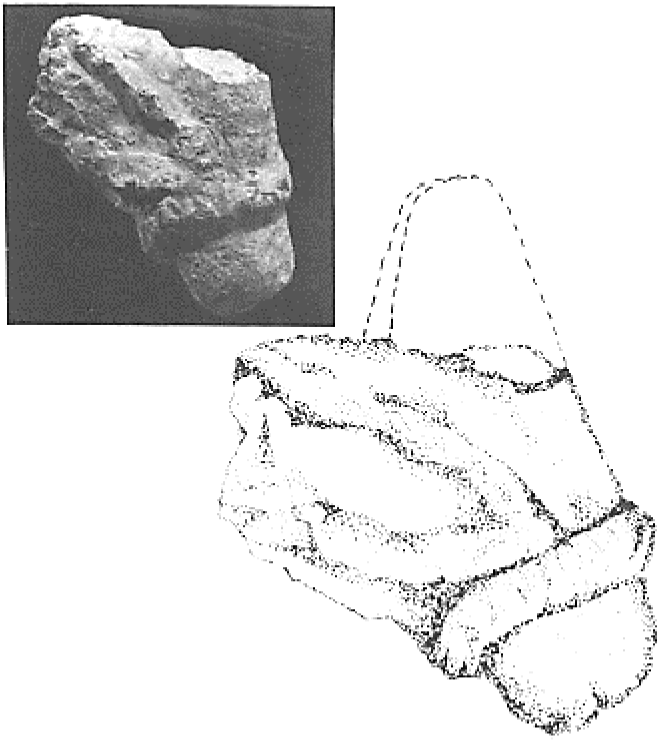

Figure 5.4 The harnessed donkey/ass found near the Yarmuk River (image reproduced from Epstein 1985, fig. 11 a, b).

By the LC 3 period, there is the first evidence for contact with the south and the Uruk Expansion begins, and a logical explanation for this and the Uruk Expansion which quickly follows (besides the motivation for exotic goods – Algaze 1993, 2005) could be the use of captive asses for transport. Therefore, the potential for captive asses being used as donkeys (even if they not yet sufficiently distinct genetically to be classified as domesticated donkeys) is enormous and evidence continues to build. Given the distinct possibility that donkey/ass caravans existed by the second half of the fourth millennium when the Uruk Phenomenon begins, a new question follows: what would such a caravan look like?

5.2.6 The Care and Administration of Captive Asses

The negative evidence from archaic texts for breeding could indicate that any kept wild ass was either first caught in the wild or else born in captivity without the human intervention of selective breeding. Once in captivity, the animals were fed fodder as described above.

Captive asses were probably kept in limited numbers. The ShM series of archaic texts from Uruk only list large numbers of donkeys in the two texts concerned with ploughing (ShM 1 – 35 ANŠE and ShM 4 – 18 ANŠE). ShM 2 (12 ANŠE) and ShM 5 (possibly a single ANŠE) are both difficult to understand. The text, ShM 6 believed to describe allocation of fodder mentions only 4 ANŠE, but ShM 3 describes the yoking of 9 ANŠE. Furthermore, ANŠE are excluded from a type of contemporary archaic text that lists herds and the corresponding names of the responsible herdsman/shepherd (Nissen, Damerow, and Englund 1993, 92).

By contrast, in the second half of the third millennium, records from Tell Beydar and Umma categorize donkeys by age group and sex (a practice already applied to sheep, goats, cattle, and pigs in the fourth millennium, see Nissen et.al. 1993, 92); and distinguish between at least five different types of donkey, ass, and mule. Specific donkey keepers (SIPA ANŠE) or herders of donkeys (NA-GADA ANŠE) are mentioned (Stępień 1996, 30–31; Ismail et al. 1996, 114), but it seems donkeys were often kept with cattle and fed barley and bran fodder (Stępień 1996, 33–34, 58–63). This trend is fitting when it is considered that both oxen and donkeys were used for ploughing and draft labour (Ismail et al. 1996, 114–17). A few centuries later and the care and keeping of Old Assyrian donkeys is separated from cattle through institutionalized paddock organisations: the *gigamlum* and *nabrītum* (see Dercksen 2004, 259–60, 267–70).

5.2.7 The Equipment of a Captive Ass

The two ass figurines dated to the Late Chalcolithic and found in modern Israel are probably carrying baskets on either side of their bodies, while all of the donkeys in the Old Assyrian texts translated by Larsen (1967) carry goods between Assur and Kültepe wrapped in cloths with no mention of baskets or other carrying containers. Whether a fourth millennium Mesopotamian ANŠE would have carried goods wrapped in cloths and strapped to their sides like Mesopotamian donkeys two millennia later or placed in baskets at their sides like contemporary asses in the Levant is impossible to know without further evidence. Current evidence indicates that wagons are an early third millennium B.C. invention (Wissing 2009; Pruß 2011).

Evidence of harnessing in the fourth millennium B.C. is limited to the single figurine fragment found near the Yarmuk River (see **figure 5.4**), which may in fact date to the Early Bronze Age I (Epstein 1985, 60) and possibly the sign for ANŠE in ShM 4 (**figure 5.2**), which appears to have an additional line around the nose of the pictogram symbol.

5.2.8 The Morphology of a Caravan

Old Assyrian texts have very specific formats for different types of texts (see Larsen 1967 for discussion), and in the texts from one merchant to another describing the goods that are being carried to them and by whom, donkeys are listed and enumerated among the people and goods (Larsen 1967). From these texts of caravans between Assur and Kültepe, as well as texts describing caravans travelling to and from Mari, a picture of the typical late second millennium caravan emerges (Larsen 1967; Dercksen 2004, 284). The vast majority of these caravans consisted of a single agent/driver leading one or two donkeys.

In 32 caravan texts translated by Larsen (1967) explicitly enumerating donkeys, the following is observed: a typical donkey caravan travelling between Assur and Kültepe consisted of 1 or 2 donkeys (25/32 texts) and 1 agent (30/32 texts). Occasionally, more donkeys were employed (7/32), up to a maximum of 14 donkey (1/32), and sometimes in these cases harnessers were employed (3/7). Harnessers were on rare occasion hired for smaller caravans as well (1/25), and temporary assistants (*sāridum*) could also be employed to help with a particularly difficult segment of a route (2/32). Other travellers, not engaged in caravan trade, sometimes chose to follow along (2/32).

The Mari texts at first seem to describe much larger caravans. A particularly large text states that "300 Assyrians and 300 donkeys with them have left Ekallatum for Karana" (translation in Dercksen 2004, 284), however this still represents a ratio of 1 Assyrian to 1 donkey. The text later states that 30 Assyrians split from the larger group of 300 and continued onward from Karana to Andarig with 60 donkeys; a ratio of 1 Assyrian to 2 donkeys (Dercksen 2004, 284). Rather than describe an exceptionally long individual caravan, it seems likely this text is providing an example of the practice sometimes adopted by individual agents in the Old Assyrian period to wait for others leaving in the same direction in order to travel together (Dercksen 2004, 255). The individual caravans within this group once again illustrate that a single agent with one or two donkeys seems to be common practice; though sometimes larger caravans with 6 or 9 donkeys were employed (Dercksen 2004, 262–63).

It is likely that two millennia earlier an ass caravan would also consist of a single person with one or two asses.

5.2.9 Abilities and Limitations of a Caravan

The strength of a fourth millennium captive donkey/ass remains unknown, however suggestion can be gained from later breeds. The British Donkey Breed Society (2009) does not recommend a person over 50 kg ride a donkey, although working donkeys in modern tourist locations routinely carry 100 kg and suffer as a result (Judge 2017). Texts indicate that Old Assyrian black donkeys of the 2nd millennium B.C. carried 'donkey-loads' measuring 75 kg (Dercksen 2004, 278).

While asses, as the first pack animals, undoubtedly opened up new possibilities for trade and interaction they also had their limitations. A pair of donkeys needs about 2 to 5 gallons of water per day depending on the heat and how much they are grazing in addition to eating fodder[27] (about a third the amount of water horses would require) (personal communication, British Donkey Breed Society, 2011). Donkeys can, however, go 2 to 3 days without water when working (10 days if not working) and can rehydrate, making up for lost days of water consumption, very quickly (Tisserand and Pearson 2003, 66; King 1983, 69). Donkeys walk at speeds between 3 and 4 km per hour, switching to a trot at 6 km per hour (King 1983, table 39; Tisserand and Pearson 2003, 64; Dijkman 1992; Maloiy, Rugangazi, and Rowe 2009, 250), this means a pack donkey loaded with goods could easily walk 50 km between watering sites if necessary. Donkeys also require relatively little feed, eating only about 2.5 to 3 kg of fodder per day (Tisserand and Pearson 2003, table 4).

At first, it may seem that the rainy season would be a preferable time for travel since there would be plenty of water and green pasture. However, donkeys are not well

[27] Donkeys grazing on grass drink less water than those eating dry fodder such as hay (British Donkey Breed Society).

suited to long durations on wet ground. Their fur does not naturally wick away the moisture, rather allowing it to build up and cause health problems in their lower legs (British Donkey Breed Society 2009). The dry season, however, comes with its own problems as Old Assyrian texts warn against travelling when it is too warm. Rather, travel at night, when temperatures are cooler, was sometimes preferred, particularly during summer (Dercksen 2004, 255).

As will be shown in Chapter 8, the climate and land cover was different in the Late Chalcolithic period, but travellers with asses would still want to avoid extended stretches of muddy or swampy ground and extreme heat.

5.2.10 Description of a Fourth Millennium Donkey Caravan

A fourth millennium donkey caravan was likely a small operation consisting of a single person in charge of the transport and only a few animals travelling at a speed of 3 to 4 km per hour. The animals would have likely been captive asses whose morphology was gradually becoming more donkey-like, rather than fully domestic donkeys. The animals would have been loaded with up to 75 kg of goods in baskets on either side or with the goods wrapped in cloths.

Like in the Old Assyrian period, it is possible that assistants were hired either for the duration of the journey if an especially large caravan was travelling or temporarily for a particularly difficult segment of the route. The route would need to mainly be on dry ground. Water would only be needed every 2 to 3 days, while fodder for three days' travel could easily be carried, allowing the caravan to travel at least 50 km before needing to resupply – a distance far greater than the typical distance between administrative centres at the time.

5.3 Transportation and Travel in and around the North Jazira

Algaze (2008, 61) calculated that travel by boat 'could be about 170 times more efficient than the average donkey caravan,' based on an average caravan size of two donkeys. Nonetheless, the only way to cross the North Jazira would have been overland. This implies that trade between Southern Mesopotamia and Anatolia occurring along the Tigris or down the Wadi Jaghjagh, past Tell Brak, to the Khabur and the Euphrates would have been many times more efficient in transporting cargo than any trade across the North Jazira. This difference in the cost of trade may explain why the North Jazira becomes disconnected and polarised in the late fourth millennium B.C. during the Uruk Expansion (see Chapter 4).

Within the North Jazira, using the figures presented above as guidance and considering that people travelled by foot (with or without a donkey) along the long-distance routes and the Wadi Jaghjagh, figures can be generated that estimates the distances and approximate travel times between centres (table 5.1). The closest centres, Tell Hamoukar/THS 25 and Tell al-Hawa were about one day's journey apart. Meanwhile, travelling between Tell Hamoukar/THS 25 and Tell Brak, which in Chapter 4 have been demonstrated to share many similarities throughout the LC 1-3 periods, would have taken 2-3 days, assuming 8 hours of travel per day.

How people travelled, when they travelled, how long it took to get to places, the socio-political and economic conditions people lived in and all the culturally-specific information presented both in this chapter and Chapter 4 are what will (in Chapter 10) provide meaning to and contextualise the route model analysis presented in Chapter 9. First, however, it is necessary in the following section (Part 3) to describe the theory and methods behind route modelling and the quantitative route analysis employed.

	Tell Brak	Tell Leilan	Tell Hamoukar/ THS 25	Tell al-Hawa
Tell Brak	-	59 km 1 day *2 days*	91 km 2 ½ days *3 days*	124 km 3 days *4 days*
Tell Leilan	59 km 1 day *2 days*	-	44 km 1 day *1 ½ days*	79 km 2 days *2 ½ days*
Tell Hamoukar/ THS25	91 km 2 ½ days *3 days*	44 km 1 day *1 ½ days*	-	33 km 1 day *1 day*
Tell al-Hawa	124 km 3 days *4 days*	79 km 2 days *2 ½ days*	33 km 1 day *1 day*	-

Table 5.1 The distance between centres and the time it would have taken in days walking and (in italics) walking with a donkey.

Routes of the Uruk Expansion

Volume 2 of 3

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Ph.D. Thesis
Archaeology Department
Durham University
2017

Table of Contents

PART 3: Analysing Routes and Reconstructing Land Cover

Chapter 6: Human Navigation and Wayfinding

The premise of this thesis is that travel and route choice is a cultural practice and that, therefore, the shapes of routes hold information about past cultures. This chapter explains why it can be expected that routes will accurately reflect the travel and route choice preferences of a culture. It is shown that:

- people have the biological capacity to perfectly travel a route of their choice (the fastest route, the shortest route, etc.), and
- there are tools (besides maps in the Western sense) that enable people to know where they are going, even if they are travelling to a new location they have never personally travelled to before, aided by the fact that
- people navigate through two landscapes: one physical and one cultural that are interlinked and intertwined.

Then, it is argued that people optimize their travel according to the variable(s) that are important to them. Finally, a theoretical framework on human travel is presented that supports the methodology presented in Chapter 7.

6.1 Lessons from Sociobiology and Neurology

The parts of the human brain responsible for wayfinding and navigation are some of the most primitive (Burgess, Maguire, and O'Keefe 2002, 625). There are numerous models regarding specifically how the brain processes wayfinding and navigation, including the cognitive map model, but all centre on the hippocampus (Bird and Burgess 2008). The most recent model is the Byrne, Becker and Burgess (BBB) Model that also associates wayfinding and navigation to the hippocampus, but attributes the use of landmarks for wayfinding and navigation to the dorsal (back of the) striatum located immediately underneath the hippocampus (Bird and Burgess 2008, 185–87).

Specifically, the four types of cells discovered so far that are responsible for both human and animal abilities to wayfind and navigate are nicknamed: 'place cells', 'direction cells', 'border cells' and 'grid cells' (Maguire et al. 1998; Burgess 2006; Bird and Burgess 2008; Burgess and O'Keefe 2011). The place and direction cells provide an egocentric (where am I?) knowledge of location, while the border and grid cells help build an allocentric or geocentric (where locations are relative to each other independent of the self) picture of the world (Wang and Spelke 2002; Burgess 2006)[28]. Evidence suggests how we access this spatial knowledge may not be as a continuous imaginary map, but through a hierarchical organization (Wiener and Mallot 2003). This biology is responsible for some shared wayfinding and navigational skills across species.

It has been demonstrated that many animals, including insects, are capable of dead-reckoning (Shettleworth 2010, 267; Müller and Wehner 1988), going in a straight line route to their target (or the shortest optimal route), due to a special part of their brain that acts as a compass. Humans, however, can also easily travel in straight lines, provided there are visual cues. A study by Souman et al. (2009) asked participants to walk in a straight line through a forest in Germany, and asked another set of participants to walk in a straight line in the Sahara Desert. When the first four people walked through the forest, the sun was behind clouds and none of the participants walked in straight lines. When the last two people walked through the forest, the sun was out and both managed to walk in perfect, straight lines. In the desert, the first two participants also walked in straight lines, but the third walked at night and did not. It is with mammals like rats and chimpanzees that we share our additional ability to also use landmarks for wayfinding and navigation (Normand 2010; Normand, Ban, and Boesch 2009; Burgess and O'Keefe 2011; Burgess 2008; Burgess 2006). This is due to the evolution of the limbic system, also called the mammalian brain, that includes the hippocampus (Burgess and O'Keefe 2011; Burgess 2008; Bird and Burgess 2008; Burgess, Maguire, and O'Keefe 2002). Our unique ability as humans, according to current research, is our ability to 'go beyond these basic processes by using natural language[29] to combine each with the other, as well as by using artefacts such as symbolic maps' (Burgess 2006, 551).

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[28] Interestingly, it has been shown that the place and grid cells fire in regular patterns with the grid cells mapping space in a triangular grid pattern (Burgess and O'Keefe 2011).

[29] '…a natural language is one that has not been specially constructed, whether for general or specific purposes, and is acquired by its users without special instruction as a normal part of the process of maturation and socialization' (Lyons 1991, 1).

This is not to say that all human cultures use the same types of symbolic maps: these can vary from paper or digital maps of various types to narrative stories, itineraries, and even songs (Lewis 1976; Miller 1986; Darling 2009)[30]. These cultural devices for wayfinding and navigation make route choice a conscious and culturally-specific process.

6.2 Lessons from Ethnography and History

6.2.1 Linking Physical Landscape to Economy (Resources)

During the 1990s, and in a follow-on study a decade later, Widlok (1997, 2008) investigated the orientation, wayfinding, and navigation skills of the Hai//om Bushmen of Namibia. The group was selected in part because of the legendary orientation skills they have displayed historically as a population alongside other Bushmen cultural groups (Widlok 1997, 317). The purpose of the first study was to learn more about the nature of these skills and how they develop (Widlok 1997). The results demonstrated that the entire population's wayfinding and navigation skills were remarkable, though women were better than men, and younger people better than older people – suggesting experience from big game hunting is not the underlying reasons for these skills, which would predict that the best group would be older men (actually the worst group!).

Instead, it was revealed that among the Hai//om, 'topographical gossip and the indexicality of environmental knowledge emerge as forming a socio-cultural system independent of a latitude-longitude grid and inconsistent with attributing orientation to the individual mind alone' (Widlok 1997, 317).

Topographical gossip is a term that refers to the social sharing of topographical information. In the Hai//om this involves habitual pointing in the directions of people and places when they are mentioned in conversation (Widlok 1997, 321). The 'indexicality of environmental knowledge' connects surrounding regions and populations to easily identifiable topographic features and economic resources – for example, the //Goaikhoe translates as 'The people of the fine sand where the !no fruit

[30] The first maps in Mesopotamia were drawn much later than the first writing (for example, object ME92687 at the British Museum).

Figure 6.1 An illustration of the indexical naming practices of the Hai//om (from Widlok 1997, fig. 1).

grows' (Widlok 1997, 321). Instead of fixed terms for North and South, the words change depending on an individual's location and refer to the next population group in that direction (Widlok 1997, 323–24).

For the Hai//om, topographical gossip enables them to accurately point to distant locations and clarify precisely the direction they mean, for example "between those two trees over there" even in dense bush with limited visibility and from unusual starting points away from their home (Widlok 1997, 318–20). Topographical gossip and the cultural practice of indexing environmental knowledge into place names and population group names allows members of the Hai//om, as well as other groups, including Khoekhoe- and Bantu-speaking groups to successfully wayfind and navigate to new locations they have never personally travelled to before (Widlok 1997, 318–24; Widlok 2008, 367–69).

The follow-on research by Widlok (2008) focused on the nature of this indexation of environmental knowledge. One finding was that the language of the Hai//om people, ≠Akhoe Hai//om, does not have separate linguistic systems for place names and general landscape terms (Widlok 2008, 368–69). An example of this that Widlok (2008, 369) provides is the word !ab, which is both the name of the largest river and the word for river, but this pattern continues throughout the language. Another observation is that the language updates with changes in the landscape. The example provided is the construction of a fenced farm in formerly open Hai//om land. The Owambo owner named the farm Daidams, which he understood to be the Bushman name for the location, but in ≠Akhoe Hai//om the area of the farm is now called //As, which translates as 'satisfied hunger' (Widlok 2008, 371).

Undoubtedly, these flexible and adaptive linguistic characters of the ≠Akhoe Hai//om language play a role in the success of topographical gossip and indexical environmental knowledge as navigational tools for the Hai//om.

6.2.2 Linking Physical Landscape to Ideology/Belief Systems

Aboriginal Australian cultures also make use of topographical gossip to share topographical and directional information. Their use of the practice, however, varies from that of the Hai//om. As they discuss directions of locations they point not in the direction of the location from their present point, but in the direction of the locations from important Dreamtime locations (Lewis 1976, 255–256). Similarly, Aboriginal art has been found to contain geographical information, not entirely unlike a western map, and directional information, decipherable to those who know the corresponding stories (Lewis 1976, 267–71).

Lewis (1976) conducted an important ethnographic study on wayfinding and navigation with Aboriginal men primarily from the Pintupi, with individuals from other groups including the Anmatjara and Loritja. From the first field season in 1972, travelling with the men to various set destinations picked by Lewis, the profound importance of Dreamtime stories, art (including rock art), and Dreaming Tracks in navigation and wayfinding among the various Aboriginal groups was obvious. The specific ways Dreamtime stories, art, and Dreaming Tracks informed wayfinding and navigation, as well as their relative magnitude of importance against other methods like using the sun or stars was examined through further travels and tests in subsequent years (Lewis 1976).

Unlike the Hai//om, all the Aboriginal men involved in the study by Lewis, regardless of their specific culture, made use of cardinal directions in conjunction with references to Dreamtime (Lewis 1976, 255). Their ability to point in the direction of a set of locations dictated by Lewis varied depending on the type of location, with consistently accurate performance when pointing in the directions of sacred places and cardinal directions, but more varied performance when pointing in the direction of other, secular locations (Lewis 1976, Graphs 1 and 2).[31]

An important observation Lewis (1976) made during his field seasons travelling with the men was the constant reciting of Dreamtime stories as they travelled:

‘The Pintupi sang the Dreamings of every rock outcrop, creek-bed or plain, hour after hour, all day as we drove through their “country”. The major Dreamings were sung by the campfires until everyone fell asleep, the *Malu Tjukurpa* taking two evenings to

[31] An interesting future study would be to compare the ability to point in the directions of locations across sex and age groups, since the later study by Widlok (1996) with the Hai||om demonstrated the worst performing group, older men, were precisely the population group that Lewis focused on with only a couple of younger men described as being aged in their mid-thirties (Lewis 1996).

sing…Constant reference was made, in every conceivable context, to the network of Dreaming tracks that criss-crossed the land…' (Lewis 1976, 276).

By comparison, Lewis' study revealed use of the sun in only one individual and use of stars in two individuals despite extensive and repeated questioning and enquiry into the subject (Lewis 1976).

Furthermore, he observed the profound interest in making and sharing detailed observations about topographical features:

'…I failed fully to understand the deep satisfaction elicited in my Aboriginal friends by monotonous driving from dawn to dusk day after day, across a landscape that was vivified in sacred myth. Every terrestrial feature, plant or track of an animal was meticulously noted and aroused very lively discussion. Highly coloured subsequent accounts of the features of the country traversed, such as the height of the sandhills, the colour of the rocks, the profusion of honey flowers, were given to envious friends back at the settlement' (Lewis 1976, 252).

The constant connections made between Dreamtime and topography and the sharing of detailed information about the topography and landscape by those who return from travelling, are at the centre of Aboriginal peoples' ability to wayfind and navigate. In the dark when the topographic features become difficult or impossible to see the Aboriginal men in the study became disoriented and their ability to navigate across the landscape was completely lost (Lewis 1976, 273).

6.2.3 Linking Physical Landscape to Political Control

A third method of wayfinding and navigation is exemplified by medieval Arabic texts and maps for those travelling across Northern Mesopotamia, including the Jazira (see Miller 1986, 81–86). While contemporary geographers would write descriptive narratives based on their own travels, accounts of previous geographers, and conversations with local people, there seems to be no connection between these geographers and the people who travelled habitually, including Bedhouin merchants, and those running the postal system (see translated examples in Bevens 1988). Instead, it appears that merchants and postal workers created and used a completely parallel system of itineraries: a series of named destinations, across specific borders, and passed certain landmarks (Bevens 1988). The names are not indexical, they do not encode topographical information, but provide sequential lists of places to guide people over vast distances both in the real world and in stories (Clarke 2012; Miller 1986; Lopez and Raymond 2001; Meri and Bacharach 2006). Medieval Arab travellers could orient themselves as they followed these itinerary routes by the stars, and by the 12th century A.D. through use of a compass (Shihab 2013), and some itineraries provide distances between stops (Meri and Bacharach 2006, 378; Lopez and Raymond 2001, 31–32). In this way, the journey was broken into a series of smaller trips that enabled the person to travel vast distances.

6.3 Mesopotamian Navigation and Wayfinding

It is not known how any Mesopotamian cultures would have navigated prior to historic time periods. Most information is Late Babylonian (1st millennium B.C.), such as from the famous Babylonian Map of the World tablet and tablet BagM Beih 2 no 98, which shows a diagram of the four winds, sunrise, and sunset; as well as other tablets from later, historic periods containing stories of kingship, conquest, and gods, written in both Akkadian and Sumerian (Horowitz 1998). This cosmology and the evidence it contains for navigation and wayfinding can only be traced back to the mid-third millennium B.C. (Horowitz 1998, xiii). For these later Mesopotamians, directions were connected to topographic features and winds, while the sunrise, sunset, and stars played additional roles in orientation (Horowitz 1998; Wyatt 2001, 45–46; Tinney, Sjöberg, and Leichty 2006).

Directional Words in Akkadian and Sumerian

In both Akkadian and Sumerian, north can refer to upstream or the north wind, and the words used in both languages can also be translated as storm (Horowitz 1998; Wyatt 2001, 45–46; Tinney, Sjöberg, and Leichty 2006). In Sumerian, it is associated with the words for anger, being angry, a mythical snake, and snake-like weapons (Tinney, Sjöberg, and Leichty 2006). Likewise, in both languages, south is downstream or south wind, and in both languages the words for south can also refer to a demon (Horowitz 1998; Wyatt 2001, 45–46; Tinney, Sjöberg, and Leichty 2006). East, in both languages, refers to the sunrise, east wind and mountains, as well as countryside, land, steppe, and the underworld (Horowitz 1998; Wyatt 2001, 45–46; Tinney, Sjöberg, and Leichty 2006). In Sumerian east is also associated with the verbs to light up or to burn, while in Akkadian it is also associated with the ground, earth, and dirt (Tinney, Sjöberg, and Leichty 2006). West, in both languages, refers to sunset (Horowitz 1998; Wyatt 2001, 45–46; Tinney, Sjöberg, and Leichty 2006). The word for west also either comes from the Amorites or the Amorites' name refers to them being from the west, but in both languages the word for west (*amurru* and *mar.tu*) and the name for the Amorites are related (Horowitz 1998; Wyatt 2001, 45–46; Tinney, Sjöberg, and Leichty 2006).

Nonetheless, given the context from which these directional words are embedded in the tablets, it is unlikely that they apply to time periods earlier than the mid-third millennium B.C., before there were kings or militaries, much less military conquests. This is particularly the case for Northern Mesopotamia, which is represented only as a small circle (an 'other' to the great Babylonia) in the 6th century A.D. Babylonian Map of the World, one of the primary sources for our current understanding of Mesopotamian systems of orientation and geography (Horowitz 1998; Horowitz 1988).

Navigation and Wayfinding c.2000-500 B.C

Starting in the late second millennium B.C. there is an abundance of texts on travel: who is going where with whom, with how many animals or boats, the items they were carrying, if they should travel straight away or wait for someone/something, as well as travel itineraries (Barjamovic 2011; Barjamovic 2008; Larsen 1967; Hallo 1964; Goetze 1953). These texts have already informed the reconstruction of what a fourth millennium B.C. donkey caravan would have looked like (Chapter 5), but offer little information about how people oriented themselves and found their way through the landscape as they travelled between points in their itineraries. However, Unger (1935) conducted an important comparative study of maps and plans that does begin to evidence how second and early first millennium B.C. Mesopotamians may have oriented themselves, using:

- the Babylonian Map of the World (BM 92687),
- the Nippur City Map (HS 197),

- two fragments of a map of Babylon (BM 35385),
- a fragmentary map of Lagash dated to the Akkadian period,
- a map of showing the location of Sippar in relation to the Euphrates and the Tabbishtum canal,
- various estate and field plans attributed from the Akkadian period to the first millennium B.C.,
- various ground plans of buildings, and
- various 'sketch-maps of camps' from Assyrian reliefs.

Unger found that all the maps and plans are oriented with the northwest at the top – a point indirectly contested later by Hallo who described the same maps and plans from Mesopotamia as 'characterized by indifference by angles, variables scales, mixture of elevations and birds-eye views, inconsistent orientation, and limited areal coverage (Unger 1935, 318; Hallo 1964, 61). Unger found this orientation to the northwest corresponded to his idea that people oriented themselves, at least in part, to the prevailing winds; his study of 150 years of meteorological records revealed these blow northwest, northeast, southeast, and southwest (Unger 1935, 320). Additionally, the sun, mountains, desert storms, clouds (from the southeast wind originating in the Persian Gulf), and stars are also argued to have played a role in navigation (Unger 1935, 320–22). This is an area of research that deserves further attention.

6.4 Two Landscapes, Not One

A clear point from even a brief examination of ethnographic and historical strategies in wayfinding and navigation is the presence of a dual landscape: one physical (mountains, rivers, trees, etc.) and one cultural. The concept of a cultural landscape separate from the physical landscape is not new, first appearing in the 1920s in geographical literature where the cultural landscape is described as the structures and alterations made by people (Barrows 1923). Even the concept of a cultural landscape that is more ideological in nature and that could be overlaid on top a natural landscape was recognized by 1980 (Rowntree and Conkey 1980). This is an important phenomenon to consciously consider in a study about route choice, because it has implications for *how* people navigate, the route choice variables that may be important, and ultimately why routes are shaped the way they are.

Within anthropology, recognition of this dual landscape is universal with research on routes dominated by phenomenology and focusing on societies whose wayfinding and navigation strategies are connected to their ideology, similar to the Aboriginal Australian example above. This may be due to the prevalence of researchers working in the southwest, western, and mid-western United States who are interested in wayfinding and navigation, and the tendency for the native cultures in these adjacent regions to share a connection between ideology and the physical landscape, as already exemplified in the introduction through the Hopi who are located in the American southwest (Whorf 1950; Ferguson, Berlin, and Darling 2009; Snead 2009; Darling 2009; Zedeño, Hollenback, and Grinnell 2009). The focus on phenomenological approaches to walking along routes extends, however, to European ethnographers, perhaps because senses and physical experience tend to play a large role cross-culturally in wayfinding and navigation (Tuck-Po 2008; Legat 2008; Olwig 2008; Edensor 2008).
Phenomenological approaches, alongside ethnography and ethnographic analogy to earlier time periods, are used to try understand the cultural landscape and, therefore, movement. Strongly related to phenomenology is the concept of contextual experience: 'Gaining understanding of a place cannot come exclusively from "being there," but also requires constructing a perspective analogous to those for whom the place had significance. Contextual experience is a landscape archaeology of cultural traditions, an ethnogeography of the past' (Snead 2009, 44). Within anthropology this notion that 'physical or geographic space has both etic [outsider] and emic [insider] properties' (Darling 2009, 73) is generally accepted, as is the impact this has for how this influences route formation.

In a cross-cultural comparative approach to 'construct a working typology and cultural evolutionary model' of routes (Earle 2009, 253), Earle identifies categories of etic and emic properties that influence route formation: 'topography and hydrology'; 'subsistence intensity, mobility and [transport] technology'; and whether a societal organisation is based on ideology, military, or economic power (Earle 2009, 260–68).

Given the nature of how routes are etched into the landscape, it is perhaps not surprising that another theoretical approach applied to routes is habitus. 'As a result of intentional activities of everyday life, repetitive movement creates physical structure over time. Once established, this highly patterned structure often determines later activities through features that facilitate and impede movement. Because of this recursive relationship, trails, paths, and roads can be models of and for society or Bourdieu's habitus' (Erickson 2009, 207). This link between habitus and movement has also been recognized by Ingold (2008), who highlights the different cultural 'rules' of walking.

Ingold (1993, 2007, 2009, 2015) would probably object to the comparative typology developed by Snead (2009). Instead, he argued that it is the type of movement along a route that is significant, not the technological form of the route or vehicles used (Ingold 2009, 29–44; Ingold 2007, 72–103). He contrasted two types of movement he calls wayfaring and transport (Ingold 2007, 75–81). In wayfaring, stops are rests or for resupply and life occurs on the journey, as with mariners who spend their life at sea (Ingold 2007, 75–77). In transport, stops are destinations and life occurs at the destination (Ingold 2007, 77–81). Airplane or train passengers can be thought of as examples of this (Ingold 2007, 77–81).

Ingold would also object to the division of the dual landscape, at least within the context of studying human culture and behaviour, only because for him the physical world is never without cultural overlay (Ingold 1993). This may be true, but it is still useful to examine the physical world independently, if only to better understand the relative importance of the cultural landscape.

All of these approaches can be used, more or less, within archaeology; they all highlight the important role of culture in human wayfinding and navigation through the landscape. For archaeologists, using these approaches can create hypotheses that can then be tested.

Important to the idea of testing is the degree to which people would successfully wayfind and navigate according to a chosen variable, or if they would be expected to deviate from this variable. For example, if a society values time (like modern, western society), would that population actually follow the fastest routes or would slightly slower but good enough routes suffice?

6.5 Do Humans Satisfice or Optimize?

6.5.1 Herbert Simon

It is within the context of *Administrative Behavior* that Herbert Simon first defined the word satisficing as both '[looking] for a course of action that is satisfactory or "good enough"' and making 'choices without first examining all possible behaviour alternatives and without ascertaining that these *are* in fact all the alternatives' (1965, xxv-xxvi). It is a term that defines a proposed behavioural strategy that results from our human nature as boundedly rational beings (Simon 1945; Simon 1957; Simon 1976; Simon 1997). The logic behind this argument is that it is a monumental, time-consuming, and potentially impossible task to consider every single possible option or even realize what every single possible option and outcome is of what may be infinite options and resulting outcomes when making decisions. An example is given of a British politician deciding whether or not to support legislation on marriage tax bonuses. Would they think of the impact their decision could have on the clover crops and bee population (Simon 1957, 82)? Apparently in England there is a strong correlation between older, single women and the size of clover crops due to the habit (at least in the mid-20th century) of older, single British women keeping cats and the cats eating mice, and this impacting the bee population, leading to a significant change in the size of clover crops in areas with many single, older British women (Simon 1957, 82). Of course, this assumes a connection between marriage tax bonuses and the number of single women, which could very well not be there.

The result of this inability to consider all possible options and resulting outcomes when making a decision is that the human mind practices satisficing – choosing the good enough option (Simon 1957; Simon 1976; Simon 1997).

In *Administrative Behavior,* humans are only boundedly rational and as boundedly rational beings we can only satisfice (Simon 1945; Simon 1957; Simon 1976; Simon 1997):

> 'In one sentence, the thesis of Chapters IV and V is this: The central concern of administrative theory is with the boundary between the rational and the non-rational aspects of human social behaviour. Administrative theory is peculiarly the theory of intended and bounded rationality – of the behaviour of human beings who satisfice because they have not the wits to maximize' (Simon 1957, 118).

The full theory of bounded rationality, out of which the term satisficing originates, takes a full book to describe and cannot be over simplified as simply 'good enough' behaviour. For example, Simon (1957, 41) considered acting in one's own interest over the interest of the organization to be non-rational behaviour – a point that could definitely be contested!

Intuitively, it may be tempting to automatically accept and apply this theory on human nature to route studies (for example, see Branting 2012). Certainly, Simon's ideas remain an important part of business studies as reprinting of the latest edition of *Administrative Behavior* continues. Nonetheless, a group of politicians making a legislative decision on marriage bonuses is not entirely analogous to the gradual formation of hollow ways through the repeated decision by people to travel a single path across the landscape, despite their increasing knowledge of the landscape both from personal experience and shared experience. People have the potential to learn from experience and, over time, to optimize.

6.5.2 Human Experiments

Evidence from experiments within the field of route studies suggest that over time people optimize their travel as knowledge of their landscape increases (Kneidl and Borrmann 2011). Kneidl and Borrman (2011, 3) were able to distinguish between three types of pedestrian in their study on human wayfinding and navigation:

- 'Pedestrians who are familiar with the location and know the best way to their destination
- Pedestrians who are not familiar with the location, but try to keep as close as possible to the airline [beeline/straight line] to their destination

- Pedestrians who are not familiar with the location and make their decisions based on local criteria.’

The study asked students to travel to a well-known (and undisclosed) landmark from one of four corners of the Munich Technical University campus in groups of two to four without a map. The subjects were also instructed to record each street along their journey (Kneidl and Borrmann 2011, 3). Upon returning to campus, the students drew their route on a map, filled in a survey that inquired about their familiarity with the city centre and whether or not they felt they had taken the fastest route (Kneidl and Borrmann 2011, 3, 5). The majority (89.54 percent) thought they had, but only about half (51.44 percent) indicated they were familiar, quite familiar, or very familiar with the area. Unfortunately, the success rates are not published. Rather the routes are plotted together on a single map, but it is clear that about half took the fastest optimal route indicated by a computer algorithm (Kneidl and Borrmann 2011 figs. 4 and 5). What is most fascinating about this experiment and its results is that, if the methodology described is complete, the researchers assumed that the subjects would (or would try to) take the fastest route and 89.54% of the subjects believed they had succeeded in doing so, despite no specific instruction to take the fastest route (or any other optimal route).

In a very different experiment run by psychologists, 20 subjects from Lancaster, UK were asked to solve a type of travelling salesperson problem: create a circuit tour of 10 locations, not visiting a single location more than once (Chronicle, MacGregor, and Ormerod 2006). In a follow on study by the same researchers, 112 subjects from the Introduction to Psychology course at the University of Hawaii at Manoa were asked to solve the same problem with 15 location points. In both cases, subjects were asked to generate optimal shortest routes and pessimizing longest routes. Among the initial 20 subjects, each of whom solved five variations of the problem, 31 of the 100 shortest tours were optimal, but none of the subjects managed to pessimize the longest possible solution to the problem (Chronicle, MacGregor, and Ormerod 2006, 77). In the follow on study, the subjects were also significantly better at generating the shortest solutions than the longest solutions (Chronicle, MacGregor, and Ormerod 2006, 79–80).

6.5.3 Archaeology

Archaeological evidence for (or against) optimal behaviour in wayfinding and navigation has, until recently (de Gruchy 2016), been limited by an inability to quantitatively assess an optimal route model against a preserved route. However, the debate on whether people optimize or not has a much longer history in the subsistence patterns of archaeological hunter-gatherers, where optimal (energy) behaviour has traditionally been assumed in optimal foraging theory. With its origins in biology (MacArthur and Pianka 1966), the theory was borrowed by archaeology quickly and used to make interpretations about subsistence strategies and settlement patterns of anthropological and archaeological hunter-gatherer populations (Lee 1969; Yellen and Harpending 1972; Bayham 1979; see also Smith 1979). The theory encompasses several models including: diet breadth, patch choice, central place foraging models, and margin value theorem (Kelly 2013, 46–70), and there is no reason why other models based on additional evidence could not be constructed within the framework of optimal foraging theory.

Like optimal route models, optimal foraging models assume that the subject people are knowledgeable about their landscape and able to make informed decisions. Interestingly, there may be a practice analogous to topographical gossip for optimal foraging in which 'men and women note the presence of plants, animal tracks, spoor, water sources burrows, and nests and later share this information with other' (Kelly 2013, 63). So, while humans may not have 'perfect information about their environment' (Kelly 2013, 70) shared experience ensures 'what should be obvious: foragers know what is going on in their environment' (Kelly 2013, 63). It is no surprise, then, that optimal foraging theory has been found to successfully model the actual behaviour of hunter-gatherers in ethnographic examples and to fit well with archaeological data (Broughton 1997; Stiner, Munro, and Surovell 2000; see also Smith et al. 1983; Zeder 2012; Kelly 2013, 40–76).

Optimal foraging theory is not perfect and, for some, it is believed that in some cases an alternative paradigm, niche construction theory, can provide a better approach (Smith 2014, Zeder 2012). Niche construction theory differs from optimal foraging theory because it is based on the recognition that people 'modify their environment to increase the relative abundance and predictability of plant and animal researches within their research catchment areas' (Zeder 2012, 257). Others think a fusion of optimal foraging theory and niche construction theory could provide a useful framework, at least for the question of the origin of agriculture (Gremillion, Barton, and Piperno 2014a; Gremillion, Barton, and Piperno 2014b). The fusion proposed by Gremillion et al. (2014a) is possible, because niche construction theory does not inherently contradict optimal behaviour. Nonetheless, it should be noted that the issue of whether or not people tend to behave optimally is debated in the field of foraging strategies (Zeder 2012, 255–56).

Overall, optimal foraging models are really quite analogous to optimal route models in that 'Foraging models…claim to model reality at some level of specificity *if* hunter-gatherers [people] are behaving according to a model's set of goals and conditions. Optimization models are heuristics, they do not provide a priori answers and explanations. By predicting which resources a forager will take if resource are ranked only in terms of their search costs and post encounter return rates, for example, the data collected to test optimal-foraging models can flag those resources that are taken or ignored for reasons other than energetics' (Kelly 2013, 76). Likewise, optimal route models based on physical variables can highlight routes or route segments where cultural variables are responsible for directing the nature of travel. Used this way, optimal foraging models do not expect people to behave optimally, but it is assumed that they have the ability to do so. The same sentiment was expressed already in the early 1980s by Eric Alden Smith et al. (1983, 626):

> 'optimization assumptions should be viewed as potentially useful starting points for building models rather than as Panglossian conclusions about the operations of the real world…Like any optimization analysis, an optimal foraging model must specify a currency (such as energy), a goal (such as maximizing foraging efficiency), a set of constraints (factors that limit the range of options…), and a set of options (choices left open to the actor).'

6.6 A Theoretical Framework on Human Travel

Archaeological route studies has a large body of literature from the broader field of route studies to draw upon when developing its own body of theory appropriate to the types of evidence archaeologists encounter and the research questions that arise as a result. From neuroscience and biology, it is clear humans should have the cognitive ability to optimize. From ethnography and history, it becomes clear that humans not only make use of our biological capacity to develop a mental picture or understanding of our surrounding landscape, but also cultural tools like topographical gossip, maps, and indexical names to enable us to know how to get to locations, even ones we have never personally travelled to before. The addition of these cultural tools means that humans live and move through a dual landscape.

This dual landscape, in turn, has implications for archaeologists, best highlighted in the work by anthropologists of connecting habitus to movement and cultural rules of movement that shape the routes formed by a society, which then serve to shape movement. For the archaeologist, the challenge is to discover these rules of movement, the variables that were important to movement and, therefore, to route formation. Some will be physical, but not all. This dual landscape humans reside in and move through means that focus on physical variables (fastest, easiest) or factors (slope, land cover) alone is insufficient and should only be a starting point when thinking about past route choice.

Furthermore, archaeologically, a single person traversing once across the landscape will leave no trace; it is only the route travelled so many times that it wears into the ground that we can detect. These hollow ways are not the one-off decision of a single person, but the end result of shared (and probably also personal) experience over time of getting between one place and another. Whether or not the ancient traveller's route choice was perfect the first time is not what matters: it is the learned behaviour from personal or shared experience over time that archaeologists detect and the route choice decisions that were collectively important and made by the many. Therefore, the hollow ways of the North Jazira will record the route choices and travel preferences of the full population of travellers that utilized those routes. If existing routes were no longer preferable, then it is expected that new, alternative routes would have been created. If a route was travelled across multiple time periods, then it must have fit the preferences of travellers across multiple time periods, either because those preferences were the same or because they manifest themselves spatially in the same way. For example, one might imagine an easiest route through a steep mountain pass, and a fastest route through the same steep mountain pass would be identical or near identical, because ascending and descending steep mountain slopes is both difficult and time consuming.

Furthermore, the limited studies available suggest that people optimize over time, learning from their own experiences and each other. For this reason, it can be expected that if a population had a preference for taking the easiest route, for example, then they should be very good at creating a route overtime that matches the optimal easiest route. This is important, because it supports the use of least cost path models (easiest, fastest, shortest, etc.) as a means for hypothesis testing. Therefore, in the next chapter, describing the methodology for quantitative route analysis, least cost paths will be used in exactly this manner: to model hypothesis.

Chapter 7: Methodology for Quantitative Route Analysis

This chapter describes the methodology that will be applied in Chapter 9. While humans have the biological capacity for route optimization and the cultural tools to navigate strategically to places, there is no single, universal variable according to which that humans can be expected to optimize. Instead our complex dual physical and cultural landscape allows for no assumptions about a culture's preferences in route choice. For this reason, a methodology that can quantitatively assess the significance of any matches between a route model and a preserved route or route system is valuable. It opens up the possibility for researchers to build route models based on both complex cultural and simpler physical hypotheses and test those hypotheses against the archaeological and/or historical records.

This study builds optimal, least cost path route models of single variables and assesses the significance of each individual variable one at a time against preserved hollow way routes in the North Jazira of the fourth and early third millennia B.C. These models represent what the route(s) would look like if a population optimized their travel according to the chosen hypothetical variable. The degree to which the model matches or overlaps the preserved hollow way routes provides information about the travel motivations of the populations that created and used the hollow way routes.

The construction of an effective optimal, least cost path route model involves not only the conscious selection or development of a function that matches the researcher's hypothesis, but also consideration of the relevant variables incorporated into the cost surface whose least cost will be calculated. Only then can the route model be constructed and run. The routes generated by the model are *only* the expression of the researcher's hypothesis, they are not reconstructions of movement. The testing of the hypothesis occurs when these models are statistically compared using quantitative analysis to preserved archaeological routes or known historical routes. Through the repeated testing and quantifying of different route models against preserved/known routes it is expected that it will eventually be possible to generate formulas that accurately express the travel preferences of specific cultures that can

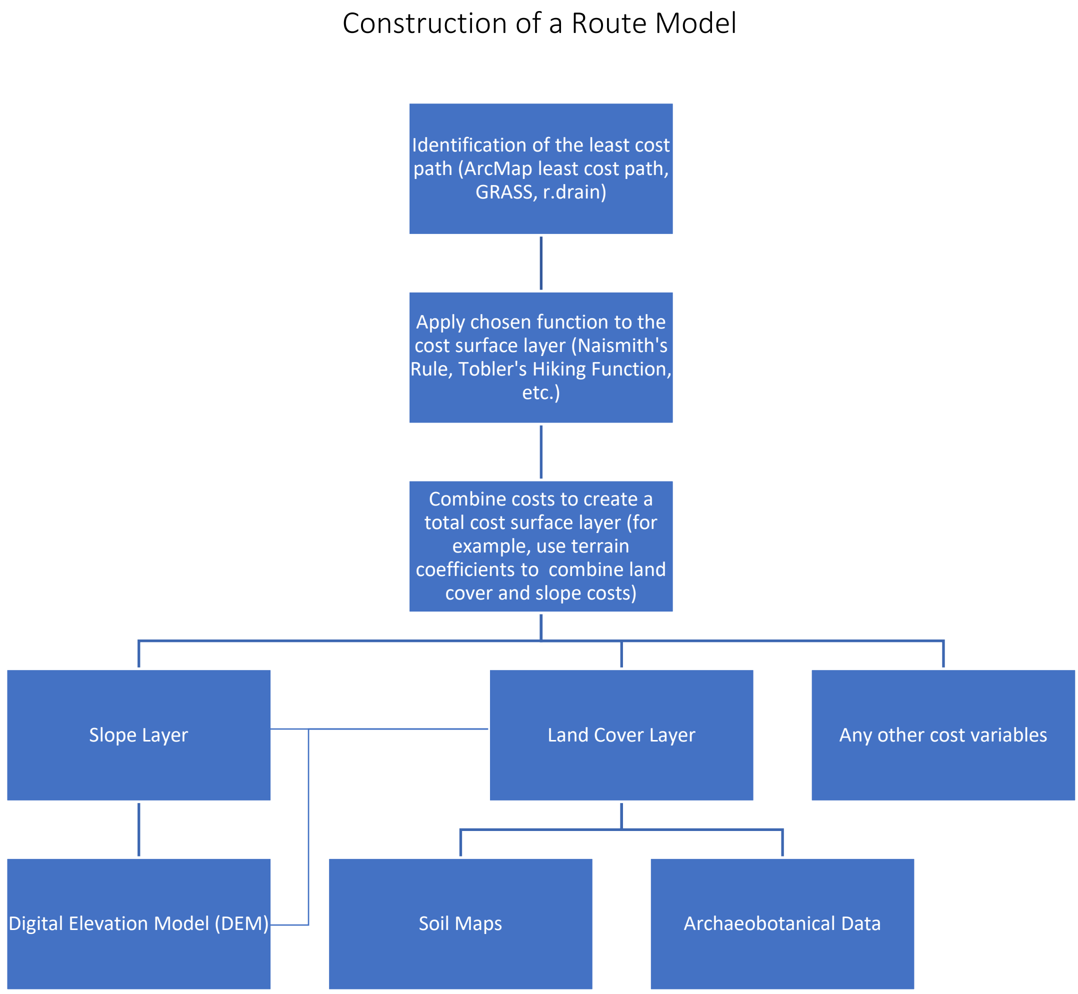

Figure 7.1 A flow chart depicting the construction of a route model.

be used to fill in gaps or intelligently predict the locations of routes where none are preserved through careful use of analogy between cultures – a sort of calibrated route prediction.

7.1 Common Functions for Generating Optimal, Least Cost, Paths

7.1.1 Energy (Easiest)

All versions of the GIS program ArcMap, since at least 8.9, have a default function for generating least cost paths that will minimize energy consumption; this is called Least Cost Path. The routes generated can drastically increase the length of the route taken between two locations or result in a route that takes much longer than necessary, because distance and time are not considered at all. The route it generates, given only a slope layer, is a least cost energy path only.

ArcMap calculates horizontal and vertical costs difficulty in a pair of tools that can be run simultaneously called Cost Distance and Cost Backlink.[32] The user creates a layer to define the source locations; the start and end points of the modelled route. Then, the user adds a cost surface layer containing the data on any variables that may affect ease of movement. In archaeology, the cost layer is often a simple slope layer derived from a digital elevation model (DEM) with the slope value for each cell calculated either in degrees or percentages. (There is, however, no software limitation to the sophistication of the cost layer added here.) Using the cost layer values provided, the tools calculate the cost from each source location to each other source location in the following way. First, the difficulty of travelling to each of the cells around the initial source location is calculated, followed by the next adjacent cells until the other source location(s) are reached. This is repeated for each source location and the path between any given two source locations is calculated in both directions (source A to source B and source B to source A). The smallest possible value a cell can receive from all these calculations is retained as the value of that cell. The four specific formulas used to calculate these values are as follows:

[32] The Path Distance and Path Distance Backlink tools are an alternative option that allow users to apply custom functions, including Tobler's Hiking Function.

1. For perpendicular movement: $x_1 = \frac{(c_1+c_2)}{2}$ where c_1 and c_2 are the values of a cell (1) and its adjacent cell (2), and x_1 represents the cost of travelling between the two cells.
2. For diagonal movement: $x_1 = \sqrt{2}\frac{(c_1+c_2)}{2}$ where c_1 and c_2 are the values of a cell (1) and a diagonally adjacent cell (2), and x_1 represents the cost of travelling between the two cells.
3. For each additional cell by perpendicular movement: $x_2 = x_1 + \frac{(c_2+c_3)}{2}$ where c_2 and c_3 are the values of cell (2) and adjacent cell (3), x_1 represents the cost of moving between cell (1) and cell (2), and x_2 represents the total cost of travelling between cell (1) and cell (3).
4. For each additional cell by diagonal movement: $x_2 = x_1 + (\sqrt{2}\frac{(c_2+c_3)}{2})$ where c_2 and c_3 are the values of cell (2) and adjacent cell (3), x_1 represents the cost of moving between cell (1) and cell (2), and x_2 represents the total cost of travelling between cell (1) and cell (3).

This method of calculation, sequentially considering the cost of travel to each succeeding set of neighbouring cells by adding the least possible cost of travel from all previous cells, uses Dijkstra's algorithm (Rees 2004, 204). To find the easiest routes, the user then inputs these cost distance and cost backlink layers generated earlier through use of the Cost Distance and Cost Backlink tools into the cost path function. This creates a final layer that shows the least cost path between the locations by selecting a path of cells between those locations with the lowest possible values (ESRI 2011).

With this method, if a user inputs the slope layer, without modification, into these tools, the result is a linear calculation of degree of difficulty. In perpendicular movement, a 30 degree slope will be twice as difficult as a 15 degree slope and half as difficult as a 60 degree slope. In diagonal movement 30 degrees would be nearly three times as difficult to cross as a 15 degree slope and about a third as difficult as a 60 degree slope.

7.1.2 Time (Fastest) – R.Walk and Naismith's Rule

By contrast, the cost measurement behind the R.Walk function in GRASS is time. It makes use of Naismith's Rule, 'a simple formula, that may be found useful in estimating what time men in fair condition should allow for easy expeditions, namely, an hour for every three miles on the map, with an additional hour for every 2,000 feet of ascent' (Naismith 1892, 136). As a result, R.Walk's natural routes will be the fastest route, but may not be the easiest to traverse.

In GRASS, cost values again taken from a user-generated slope layer or other cumulative cost layer are inputted into the R.Walk function, which is analogous to the Cost Distance and Cost Backlink functions in ArcMap.

> 'The formula from Aitken 1977/Langmuir 1984 (based on Naismith's rule for walking times) has been used to estimate the cost parameter of specific slope intervals:
>
> T= [(a)*(Delta S)] + [(b)*(Delta H uphill)] + [(c)*(Delta H moderate downhill)] + [(d)*(Delta H steep downhill)]
>
> where:
> T is time of movement in seconds,
> Delta S is the distance covered in m,
> Delta H is the altitude difference in meter.
>
> The a, b, c, d parameters take in account movement speed in the different conditions and are linked to:
>
> - a: underfoot condition (a=1/walking speed)
> - b: underfoot condition and cost associated to movement uphill
> - c: underfoot condition and cost associated to movement moderate downhill
> - d: underfoot condition and cost associated to movement steep downhill' (GRASS 2011).

GRASS defines a moderate downhill as less than 12 degrees slope and a steep downhill as greater than 12 degrees' slope. The values for variables a, b, c, and d are from Langmuir 1984; unless otherwise specified by the user. These values are:

- a = 0.72
- b = 6.0
- c = 1.9998
- d = -1.9998

(from GRASS R.Walk 2011)

To generate the least cost (time) path the resulting R.Walk layer and source locations are incorporated into the R.Drain function. The source locations can be a layer file, as with ArcMap, or manually typed coordinates with a defined starting point from which R.Drain searches both the immediately surrounding cells and the next cells beyond ('Knights move' – named after the chess piece) in succession until it reaches the destination point(s) in order to generate the least cost, fastest, path(s).

7.1.3 Distance (Shortest)

By definition, the shortest length between two points is a straight line. Shortest distance routes that do not factor any other variable (for example, avoiding cliffs) will always be straight lines for this reason. Unlike ease and time, shortest distance routes are not dependent on topography or other ground/surface features. For investigation into single preserved routes, construction of a shortest optimal model is simple; but in instances where movement between sites in a densely settled network of preserved routes is being investigated, generating shortest routes indiscriminately between each site to every other site can quickly fill the study area, generating so many routes that high rates of overlap are inevitable, thus increasing a type II error (a false positive correlation). Instead a more judicial application is required either based on a known understanding of travel at the time/place, allowing for the meaningful reduction of sites under consideration, or some other means of simplification.

7.1.4 Other Variables

The possibilities of what can be tested are not limited to those exemplified here. Any hypothesized scenario can be modelled given enough data and information about the underlying criteria. This includes the modelling of cultural variables. For example, the most scenic route requires knowledge of the types of landscapes and landscape features the culture values or valued, such as high points that yield wide views across the landscape; and the data to find those features, like a digital elevation model run through viewshed analysis.

7.2 Important Variables for a Cost Surface Layer

7.2.1 Cost Layer Construction

In critically constructing a route model based on either Dijkstra's algorithm or Naismith's rule, the factor with the single greatest effect on the results is the cost layer. Though it is common to use a slope layer to define the cost values, it is possible to add other factors into the equation, such as the next most common cost layer type which combines both slope and land cover.

7.2.2 Slope

As already mentioned in this chapter, Naismith's rule advises adding 'an additional hour for every 2,000 feet of ascent' – equal to adding 10 minutes for every 300 m of elevation change when estimating the duration of a hill walk – values that suggest walking time is doubled at about 6 degrees of slope (Langmuir 1997, 39). Langmuir observed a reduction in difficulty for descending slopes between 5 and 12 degrees, an increase in difficulty for ascending slopes of 5-12 degrees, and a further increase for traversing slopes greater than 12 degrees regardless of whether a person is ascending or descending. Significantly, a quick survey of the general population's interpretation of the terms 'hill', 'mountain', 'cliff', and 'gorge' correlates with these observations (see Chapter 8).

7.2.3 Land Cover

Like slope, land cover is an ever-present physical feature of the landscape that can be favourable or impede movement across the landscape. Most people will be intuitively familiar with the relative ease of traversing across a green lawn versus loose sand at the beach or the thick mud of a swamp, but a computer can only understand these differences through terrain coefficients – dimensionless values that serve as relative costs that are applied by multiplying the existing cost layer by them. Modern land cover, however, may not be representative of the land cover contemporary to the routes of interest. Instead, this should be reconstructed based on available evidence whenever possible (see chapter 8, this volume).

The primary study that quantified these terrain coefficients was Soule and Goldman (1972). The study included eight male subjects (average age 21), then six additional subjects (average age 22) who were walked at fixed speeds. This design held V (velocity or speed) at a fixed value and allowed for calculation of *n* (the terrain coefficient) based on the difference in energy consumption measured through oxygen consumption using a Max Planck gasometer. The resulting values alongside those from the few other studies conducted are presented in table 7.1.

While these values are dimensionless (literally without a dimension or unit), it does not follow that coefficients based on energy can be used for time-based functions and vice versa. A follow on study by de Gruchy, Caswell, and Edwards (forthcoming) has demonstrated that statistically significant differences in terrain coefficients based on velocity (time) occur on an entirely different scale than those based on oxygen consumption and metabolic rate (energy). Whereas, the studies from the 1970s find significant variations at only a single decimal place for energy based terrain coefficients (see table 7.1), the time based terrain coefficients generated by de Gruchy, Caswell, and Edwards (forthcoming) find significant differences occur in the second decimal place.

It should be noted that all the energy based terrain coefficients are derived from healthy, young, mature adults, all male. Not everyone in the past was male, in their early 20s, or healthy! For example, there are six adult skeletons from Tell Beydar dated to the third millennium B.C. with enough preservation to comment on their walking abilities (Bertoldi 2014). Three (one male 35-40, a male 40-45, and a 25 year old female) have arthritis in all of their main joints. Two of these three also had inflamed connective tissue in their fibulae, while the third had tendon issues with one of their ankles. A fourth adult (male 45-50) was not arthritic but had problems with his tendons in his legs and toes. In the remaining two adult skeletons (a young adult and a potential male of underdetermined age) no health issues that could affect their walking were identified, but this does not rule out other soft tissue diseases or afflictions.

There is little evidence (for or against) variation between different age/sex categories in the way they are affected by different terrains. The study by de Gruchy, Caswell, and Edwards (forthcoming) included 5 male subjects and 5 female subjects from two broad age categories (20-35 and 36-50). Across six terrain types, age was not found to cause significant differences, and it was only on the lawn grass terrain that a significant difference occurred between male and female subjects (table 7.1). It is

	Terrain Coefficients for Energy-Based Models	Terrain Coefficients for Time-Based Models
Blacktop surface/pavement	1.0	1.00
Dirt Road	1.1	-
Grass	1.1	1.03
Light Brush	1.2	-
Heavy Brush	1.5	-
Swampy Bog	1.8	1.79
Loose Sand	2.1	1.19
Hard Packed-Snow	1.3	-
Ploughed Field	1.3	-
Disturbed Ground – Disused Quarry	-	1.24
Tall Grassland	-	1.35

Table 7.1 Terrain coefficients measured by oxygen consumption and metabolic rate and terrain coefficients measured by velocity. Performance on blacktop, pavement for males is artificially set to 1.0 in all terrain coefficient studies as the base from which all other relative values are calculated (Giovani and Goldman 1971; Soule and Goldman 1972; Pandolf, Giovani, and Goldman 1976; Pandolf, Giovani, and Goldman 1977; de Gruchy, Caswell, and Edwards, forthcoming).

suspected, however, that age would become a significant factor if elderly subjects or children were included.

Larger studies of both metabolic and velocity based terrain coefficients are still required to increase the robustness of the results and the diversity of terrains and age/sex categories represented.

7.2.4 Cell Size

Another factor that has been found to affect the results of an optimal, least cost path analysis is the cell size of the cost layer. In a single study, it was observed that different results were achieved for when using five cost surfaces of cell sizes when using methods that utilize Dijkstra's algorithm (Harris 1997, 121). This should not be surprising and is related to the same phenomenon that makes histograms change shape depending on how wide each bar is (see **figure 7.2**). With wider or larger pixels, variability is smoothed. The larger the pixel, the greater the smoothing effect, which can result in a much more homogenous landscape. At first, the smallest pixel size possible may seem desirable, but as with the width of the bars in a histogram, this is not necessarily advantageous and may make meaningful analysis more difficult.

7.2.5 Modern Landscape Features

The topography of modern landscapes are typically represented using digital elevation models (DEMs), in programs such as ArcGIS. The landscape they represent is palimpsest of the general topography of the landscape during the geological past – including the relatively brief amount of time *Homo sapiens sapiens* has roamed the planet. So, for example, while hills and mountains are generally still in the same locations they were a million years ago, they will not be exactly the same shape or height. No modern DEM will be an exact, precise representation of the topography of the past. The more distant the time of interest, the more changed the precise details of the topography. Beyond catastrophic events such as volcanic explosions that can remove the top of a mountain in just hours, there is the constant erosion and build-up of soils that gradually shrinks mountains and raises valleys. Human activity shapes the landscape through terracing slopes, digging canals, and, in the Near East, building hill-like tell sites through long-term continued occupation in the same location, as well as activities such as the herding of sheep. Wilkinson (1993, 557) notes that if just 1 mm

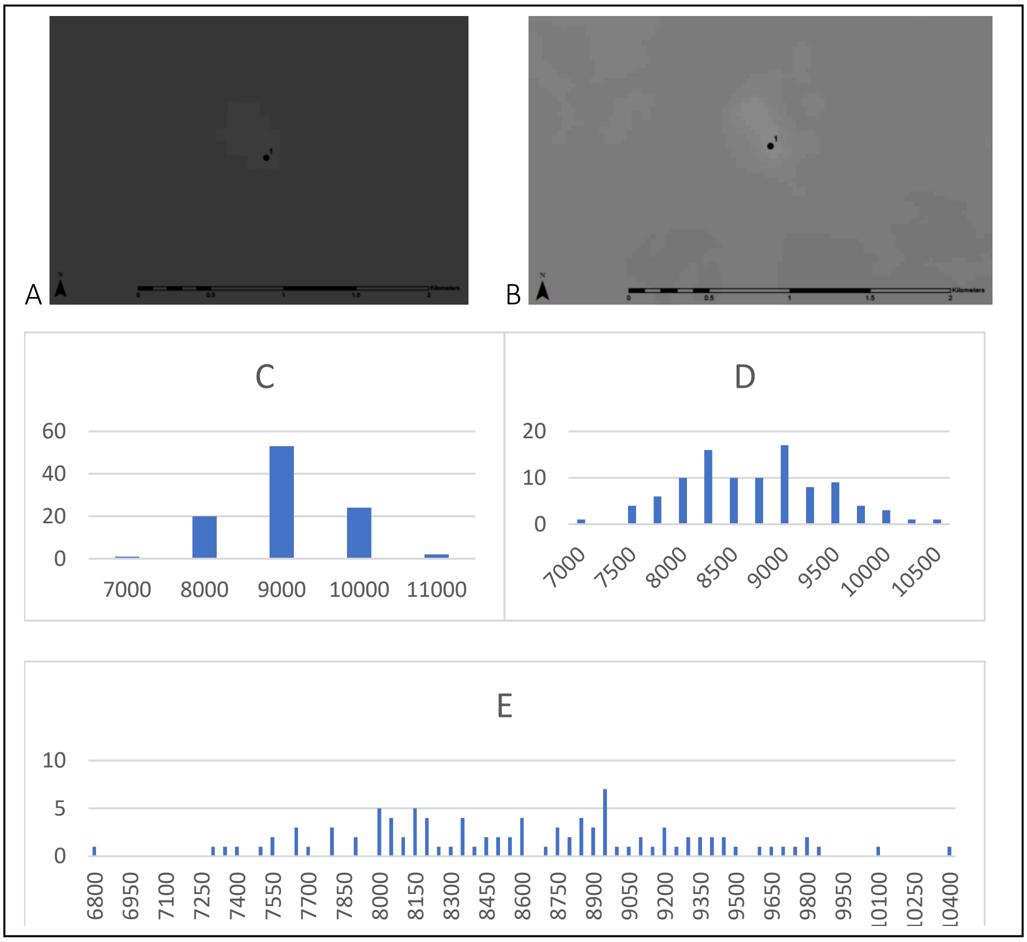

Figure 7.2 Digital elevation models (and all rasters) behave in a similar way to histograms. A low resolution digital elevation model can oversimplify the data, but too high of a resolution can pick up every feature on the landscape, including modern roads, ditches, and buildings. In this figure, a 90 m (SRTM v.2) DEM of the area around Al-Hawa (A) is placed next to a 30 m (ASTER) DEM of the same area, while C-E show increasingly higher resolution histograms of the same data of random model overlap rates.

of dust per year is dispersed by treading hooves of sheep walking to pasture, after 3,000 years this would equate to 3 m of erosion! The start of the Late Chalcolithic is about 6,000 years ago. A high quality DEM with one-meter or sub-meter resolution would record not only the modern, general elevations of a landscape, but every modern wall, house, dam, bridge, more recent ruin or feature that people have built and left etched on the landscape. Even on relatively low resolution DEMs, the largest of these features like tells and dams are apparent. There are ways of smoothing or subtracting these features, using the data of surrounding cells, but the smaller the cell size of the DEM, the more subtracting and smoothing of modern features is required – effectively removing the fine detail the higher quality DEM provides. As with histograms, a cell size that is good enough to sufficiently capture the meaningful variation, but low enough not to lose sight of that variation in the details is best.

7.3 The Route Model: Visualisation of the Hypothesis

Once a function or method has been selected, the cost surface constructed, and the function or method has been applied, the result is a route model – not an answer. If well-constructed, the model should accurately express the hypothesis of the researcher and it is now ready to be tested. Does the route model match the preserved routes? Is the match statistically significant? Does the hypothesis offer an explanation or can it be rejected? For this, quantitative analysis is required.

The challenge with statistically comparing routes and route models is that they are lines. It is not possible to enter graphic displays of lines into statistical tests like Z-Tests and T-Tests. Tests need numbers: the size of the population or sample, the mean value of that population or sample, the standard deviation. Lines do not have these properties, but linear arrangements of individual cells do!

A route model is generated by selecting individual cells. Even when a model is not generated using a function like ArcMap's Least Cost Path or GRASS's R.Walk and R.Drain, the lines drawn can be sampled by placing points at regular intervals along the lines. Now there is a sample of cells or points, each located a unique distance from the nearest preserved route. That sample has size (the number of cells or points) with a mean value (the mean distance of the cells/points from the locations of the preserved routes) and a standard deviation. The route model is more than a line or set of lines, it is a sample that can be compared to the preserved routes and tested for significance.

7.4 How to Compare Route Models to Preserved Routes

The simplest way to compare route models to preserved routes is to create point vector files of both. For the route models it is possible to convert the raster files into point features where points are automatically placed in the centre of every route pixel. For the preserved routes, it is easiest to digitize them as lines first, then create a new point shapefile into which points can be generated at user-defined intervals along these lines. In ArcMap it is possible to do this through the editor tool bar.

Where preserved routes are incomplete, it may be more desirable to measure how much of the preserved routes match a given model in order to avoid false mismatches due to gaps in preservation. While the gaps could be filled in, this would make assumptions about the shape of the missing segment of route.

To measure the overlap between the preserved routes and a route model, there are two equally valid approaches. In the first, buffers are generated equal to the greater value of either the pixels of the cost layer used to generate the route model or the preserved route. So, for example, if the cost layer has $30m^2$ pixels and the preserved routes are 70m wide, then the buffers should be 70m wide. Alternatively, if the cost layer has $90m^2$ pixels and the preserved routes are 70m wide, then 90m buffers should be used. This is to avoid a Type I error (a false interpretation that the model and route do not overlap); however, it is important to keep the buffers equal to the widths of the routes, otherwise the chance of making at Type II error is increased. Use of a tool that allows the selection of points by location like ArcMap's tool Select by Location, then can be made to select the points of the route model that match the preserved routes. The second approach is identical, except instead of generating buffers to identify overlapping points, a search radius is defined in the select by location tool to identify overlapping points between the route model and preserved routes. The search radius serves the same purpose as the buffer in avoiding a Type I error.

Once the overlapping points are selected in either the preserved route file or the route model file (depending on the approach chosen – amount of preserved routes overlapping the route model or amount of route model overlapping the preserved routes), then the corresponding attribute table can be opened to obtain a quick count of the number of overlapping points.

An important additional step is to use this process of selecting overlapping points to code points in the route model according to their distance to the preserved routes (or vice versa) and colour code these points to generate a map that highlights the specific locations where overlap occurs. Beyond generating a pretty map, this step also identifies if the overlaps are due to perpendicular crossings of the model and the preserved route(s) or if the route model and preserved routes are aligned (**figure 7.3**). Perpendicular alignments between a route model and preserved route(s) will increase the rate at which the model overlap the preserved route(s), but these overlaps are not indicative of the model's success in matching the preserved route(s).

7.5 Testing Significance

Knowing how much a route model and preserved route overlap has no meaning unless the significance of the result is known. Even if the overlap rate is high, it does not mean anything if any random model would also intersect at the same high rate. The rate of overlap only becomes meaningful if it statistically significant – in either direction – from the mean.

7.5.1 A Poor Man's Monte Carlo

In order to understand whether any overlap between a route model and a preserved route is significant an entire population of comparable route models needs to be generated. Unfortunately, by definition, there is only one truly optimal route – perhaps two or three[33] that are equally the most optimal. To get around this problem a "poor man's Monte Carlo"[34] simulation is a quick and effective solution. A full Monte Carlo simulation would involve generating a series of random route models with the same specifications that somehow differ from the optimal route model being tested and each other. The poor man's Monte Carlo involves using a random point generator to place random points across the map. The advantage is that the points are completely random, the disadvantage is that they are completely independent of each other whereas in a route model, the next selected space is dependent on the previous one. Still, the method is effective for testing whether the overlap results are

[33] Theoretically, there could be more than two or three routes that are equally optimal, but it is unlikely. Across the innumerous (although the number certainly exceeds 10,000) optimal route models that I have generated across my M.A. and Ph.D. research, I cannot recall ever seeing more than three equally optimal routes and even scenarios with three equally optimal routes are rare.

[34] The name given to the process by an anonymous reviewer during the peer-review process for de Gruchy (2015), which I have now adopted. Perhaps poor person's Monte Carlo would be more a better phrase.

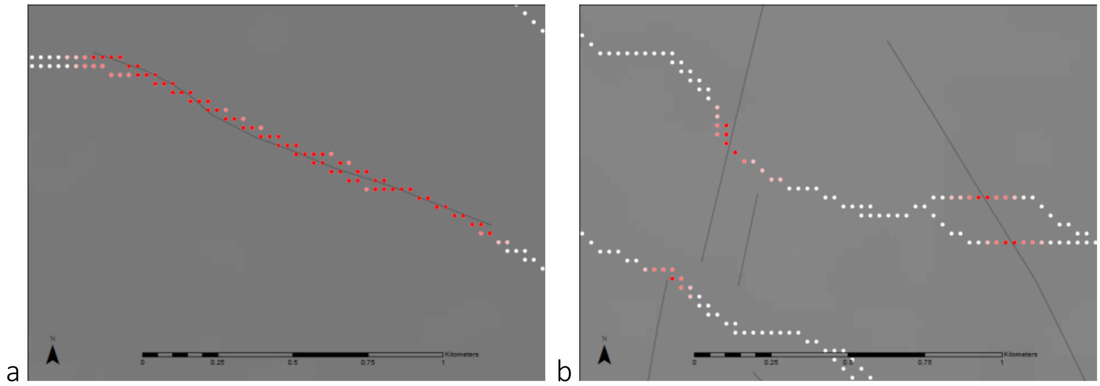

Figure 7.3 Examples of parallel and perpendicular overlap between a route model (shown as colour-coded dots) and preserved route ways (dark grey lines).

simply a matter of so many spaces being occupied in a confined area – in other words if the level of overlap has nothing to do with the model itself, but density.

Using a random point generator, such as the one in ArcMap, the poor man's Monte Carlo involves placing a minimum point spacing equal to the size of the pixels in the cost layer of the route model. If the cost layer has 30m^2 pixels, then the minimum point spacing is 30m. The number of points generated should be the same as the number of points in the route model point shape file. The area the points are generated within also needs to be defined. I define this area as the total area that encompasses all the sites involved in the route analysis and all the optimal route models I have generated. Once the random points are generated, then the same process of selection used for determining overlap between the route model and the preserved routes can be repeated for the random points to test how frequently the random points overlap the preserved routes.

7.5.2 Sequential Sampling

The poor man's Monte Carlo needs to be repeated enough times to generate a sample population. The easiest way of accomplishing this is through sequential sampling and recording the rate of overlap between the random points and the preserved routes in a table or spreadsheet program like Excel. In one column the overlap rate is recorded, while in the second column a cumulative mean is generated. The mean from the first row will simply be the first overlap rate, the mean in the second row is the mean of the first and second overlap rates, the mean in the third row is the mean of the first through third overlap rates, and so on until the means start to repeat.[35] When the cumulative mean no longer changes, the sample is sufficiently large to provide an accurate estimate of the population mean; and the standard deviation can be calculated from the sample population.

7.5.3 Statistical Tests

By placing the sample population overlap rates into a histogram, it is possible to see if the sample population of models with the same general specifications as the optimal route model are normal. In all six populations generated for this thesis, the sample populations are normal. For this reason, and in order to learn the most from the results of a given model, a two-tailed Z-Test is used to assess the significance of the optimal route models:

$$Z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$$

The Z-Test compares the sample mean to the population mean (factoring in the standard deviation of the population) in order to determine where the sample mean is located on the population curve. The overlap rate of the optimal route model is $\bar{x}$, the mean overlap rate of the sample population is μ, the standard deviation calculated from the sample is σ, and n is the number of poor man Monte Carlos in the sample population.

While some might prefer a one-tailed test to know if their hypothesis is correct, a two-tailed Z-Test is used throughout this thesis in order to also identify whether a hypothesis is so wrong that it is statistically significant (and can inform future hypotheses). When the results of a Z-Test are significant in a positive direction, the variable may have been important to the ancient travellers. When the results are not significant, then the variable was not important (even if there is a high degree of overlap). However, when the results are significant in a negative direction, which can only be determined in a two-tailed Z-Test, the variable was not important and something else *is* learned. While the tested variable may not be correct, it is clear in

[35] It is up to the researcher to decide the level of precision desired. The precision I chose was the first decimal point or tenth placemark (1.1 versus 1.2, not 1.11 versus 1.12 or 1.111 versus 1.112).

this last scenario that at least one of the variables that was important to the ancient travellers should act against the tested variable. This can help guide decisions in developing a new hypothesis.

If a sample population did not have a normal distribution, then an alternative method for assessing significance is bootstrapping. While bootstrapping does tend to overstate significance (de Gruchy 2016), it is a relatively easy non-parametric method for determining significance. To use bootstrapping: all the overlap rates of the sample population are ordered from smallest to largest, then it is checked where the optimal route model overlap rate fits into this population (top 5%, bottom 5%, somewhere else). As with any other test of significance the significance level needs to be decided by the researcher. In this thesis, a 95% significance level is used.

7.6 Calibrated Route Prediction

In the last type of quantitative route analysis, no information is known about the actual routes and their locations must be entirely reconstructed. It is easy to assume a basic, single-variable optimal route system (easiest, fastest, shortest), and in some cases this may be the only option for a starting place; but ideally a closely related area whose routes are known, or otherwise those of an analogous area with similar sociopolitical, economic, and ideological traits can be found. From this known related or analogous area, a model (or models) can be constructed that recreates the known route system with consideration for the individual culture. This is a calibrated prediction, because it is a predictive model that has been constructed to match a known, hypothetically similar system. Once run in the area of study, these calibrated predictive routes only act as suggestions of where to look for the actual routes, narrowing the search area – nothing more. The route prediction still needs to be verified with physical evidence through remote sensing or ground truthing. In the absence of evidence, such as areas where the suspected route location has been anthropogenically modified, the same traditional methods of examining historical and archaeological evidence to confirm or refute connections between sites, such as the prevalence of exchanged material culture can be used.

This last type of route analysis is not possible yet. Not enough variables have been tested to generate a function that could inform route prediction, but it is a possibility for the future when more route choice variables have been tested and a better understanding of route choice for at least one culture at one time exists.

7.7 Discussion

The theory demonstrates humans are not only capable of optimal route travel, as a population, but should be expected to optimize their travel to one or more variables. This enables the testing of route choice variables, like a preference for taking the fastest routes or the easiest routes, through the construction of optimal route models and quantitative comparison of those models against preserved routes. The method, however, for actually accomplishing this needed to be developed. In order to apply the method described with the rigor argued for, development of another entirely new method was required: the reconstruction of land cover from archaeobotanical remains.

For many archaeologists, the consideration of land cover in route modelling will only require an understanding of the modern land cover; however, it is known that the land cover of the North Jazira during the Late Chalcolithic and early third millennium B.C. would not be expected to correspond to that of today (Ur 2015; Charles, Pessin, and Hald 2010; Wossink 2009). For this reason, an additional mini-project was required, the methods, data, and results of which are presented in the following chapter. After, in chapter 9, a series of case studies are presented.

In these case studies, three common physical variables are assessed for importance in route choice decisions made by travellers along long distance routes between sites in the North Jazira during the early third, late fourth, and early fourth millennia B.C: easiest, fastest, and shortest. All three route models are informed by a slope layer calculated from an ASTER DEM (30m resolution) and a contemporary land cover reconstruction (see chapter 8). The land covers for each case study region and time period are assigned terrain coefficient values based on energy when used to generate a cost surface for an easiest route model, and terrain coefficients based on time when used to generate a cost surface for a fastest route model. Shortest route models are, by definition, straight lines between sites and are not dependent on surface factors like slope or land cover, so no terrain coefficient were needed. The resulting models are assessed using the method described for comparing, quantitatively, route models to preserved route ways and matches between the route models and hollow ways are displayed graphically in maps. As will be shown, none of the physical variables so frequently used to predict route locations are important to travellers across the North Jazira in the Late Chalcolithic and early third millennium B.C. (EJZ 0-3a).

Chapter 8: Reconstructing Land Cover

Past land cover cannot be assumed to resemble modern land cover. Climate change increases and decreases both temperature and moisture levels over time, impacting land cover. Animals and people, too, are constantly modifying land cover. Nonetheless land cover, like slope, is an important factor to consider in route choice. Just as no one would jump off a cliff to achieve the shortest route, it is unlikely a person would wade through a bog or marsh when a few meters' deviation would lead them to solid, if slightly higher, ground. In fact, in terms of physical costs to movement, land cover may play a larger role than slope (Caswell 2016; Caswell, forthcoming).

Since, the climate of the North Jazira during the fourth and early third millennia B.C., was cooler and wetter than it is today (Jones, Djamali, and Stevens 2013; Finné, Holmgren, and Sundqvist 2011; Kuzucuoğlu 2007; Pustovoytov, Schmidt, and Taubald 2007; Staubwasser and Weiss 2006; Wossink 2009, 15–26; Riehl and Bryson 2007, 524–25; Wick, Lemcke, and Sturm 2003), it is necessary to spatially reconstruct the land cover using a methodology that allows for land cover types not currently represented in the modern Middle East. For this reason, a new bottom-up methodology was developed based on the Muir Web approach developed by the Mannahatta Project (Sanderson 2009), which incorporates:

- archaeobotanical seed and grain remains from dated layers at sites local to the North Jazira,
- the cumulative observations made across the Near East by horticulturalists over the last two centuries on those same identified archaeobotanical seed and grain taxa, and
- when necessary, by mid-20th to 21st century physical geography data.

Additional data sources may be incorporated as well, as in de Gruchy et al. (2016),[36] which also made use of charcoal remains and isotope data. This spatial land cover

[36] I developed the methodology for this thesis and reconstructed the land cover based on seed/grain data prior to collaborating with Simone Riehl and Katleen Deckers. As described in the article itself,

reconstruction then enables the consideration of different land cover types in the route analysis.

The methodology described in this chapter does not use climate model data[37], but relies entirely on archaeobotanical evidence, allowing for the possibility that ecoregions were not only different in their spatial extents, but potentially different in their content – that species combinations that do not exist today could have existed in the past under different climatic conditions and different human-environment interactions. In this way, it is the opposite of the top-down approach developed by Soto-Berelov et al. (2015), which assumes the ecoregions and species combinations in the area of study in the past are the same as those that existed in the late 20th century or today. Instead of utilizing archaeobotanical data, Soto-Berelov et al.'s (2015) method models predefined modern ecoregions and relies on fluctuations in a climate model to inform where modern ecoregions would occur based on past temperature and rainfall. Their computer learning top-down approach has the advantage of expediency and enables the user to minimize inputs to only those that the computer finds to be significant in predicting the location of predetermined ecoregions. Nonetheless, assuming past ecoregions are the same as modern ecoregions may be a reasonable assumption for more recent time periods, but it is increasingly less likely the further back in time one goes. It is probably for this reason that Soto-Berelov et al. (2015) reconstruct land cover in the Levant for a series of time slices back to precisely 4.2 KYA – the approximate date of the transition between the Mid and Late Holocene periods – and not any further (Wanner et al. 2015; Roberts et al. 2011; Zanchetta et al. 2011; Roberts, Meadows, and Dodson 2001). The time periods reconstructed in this chapter predate the 4.2 KYA event.

8.1 The Modern Land Cover

Land cover is composed of the natural vegetation and affected by land use, including construction of the built environment and use of the natural vegetation, such as for

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the charcoal data from Deckers added clarity to the reconstruction, while the isotope data analysed by Riehl provided an independent picture of moisture levels.

[37] Most of the sources for proxy climate data in the Middle East are located hundreds of kilometres from the North Jazira (see de Gruchy, Deckers, and Riehl 2016, fig. 2).

pasture or clearing land for agricultural fields. Consequently, both vegetation and land use are described in order to present a full picture of the modern land cover.

8.1.1 Vegetation

The modern vegetation is 'a virtually uninterrupted agro-desert, ploughed year after year to produce wheat and barley' (Wilkinson and Tucker 1995, 9). Where there are spaces between the fields, there is *Artemisia* steppe with *Pistacia-Amygdalus* steppe forest on the Jebel Abd-al-Aziz and Xerophilous deciduous oak (*Quercetea brantii*) steppe-forest on the Jebel Sinjar (Hald 2008, 8; Wilkinson and Tucker 1995, 10).

8.1.2 Land Use

Until the start of the conflict in Syria, the region was primarily utilized for industrial-scale wheat and barley agriculture supported by irrigation (Hald 2008, 9–13; Wilkinson and Tucker 1995, 7–11; de Gruchy and Cunliffe, forthcoming; Ur 2010, 16). Irrigation is challenging east of the Khabur Valley due to lower water table levels (Hald 2008, 10–11), and as recently as the early 20th century A.D. the region was inhabited by groups of pastoral nomads (Ur 2010, 12–13). In the 1980s, the Hasseke and Mosul Dams were constructed along with extensive irrigation canals to enable more frequent cropping (de Gruchy and Cunliffe, forthcoming; Cunliffe 2013, 34). **Figures 8.1** to **8.4** show the largely agricultural land use in each of the survey areas. Shallow wells were less common in recent decades as water resources were being gradually depleted; instead drilled wells reaching the Upper and Lower Fars aquifers (Wilkinson and Tucker 1995, 11). Recently released imagery, however, reveals a new trend: with a large proportion of Syrians now residing as refugees outside the country, there is no one to maintain the freshwater resources (canals, etc.) and, as a result, the rivers are changing and some reservoirs have all but disappeared – including the pair north west of Hasseke (Müller et al. 2016, see also fig. 8.5).

Figure 8.1 The modern land use in the survey areas around Tell Brak (Google Earth, Image dated Dec 2016).

Figure 8.2 The modern land use in the Tell Leilan Regional Survey area (Google Earth, image dated Dec 2016).

Figure 8.3 The modern land use in the Tell Hamoukar Survey area (Google Earth, image dated Dec 2016).

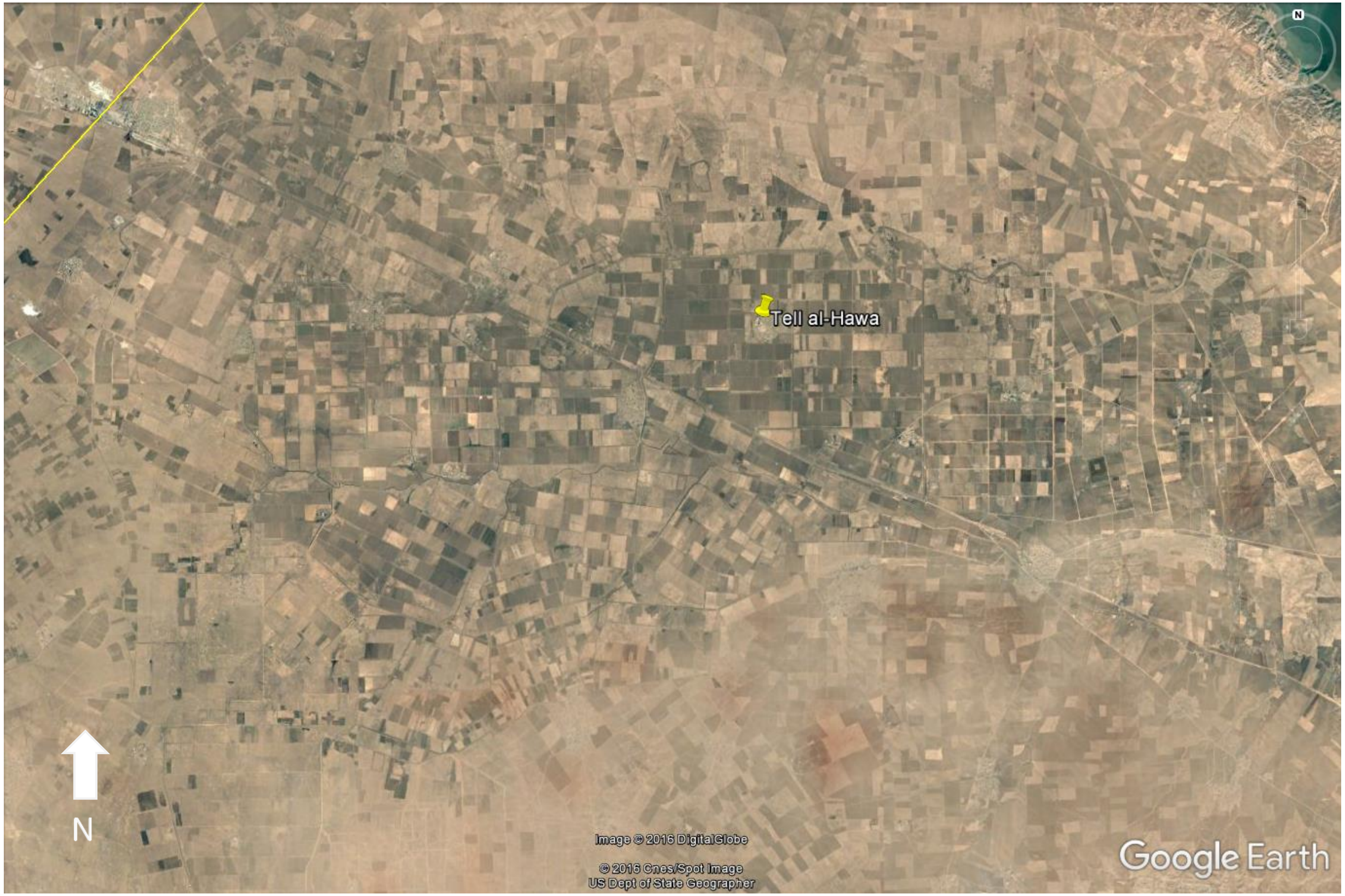
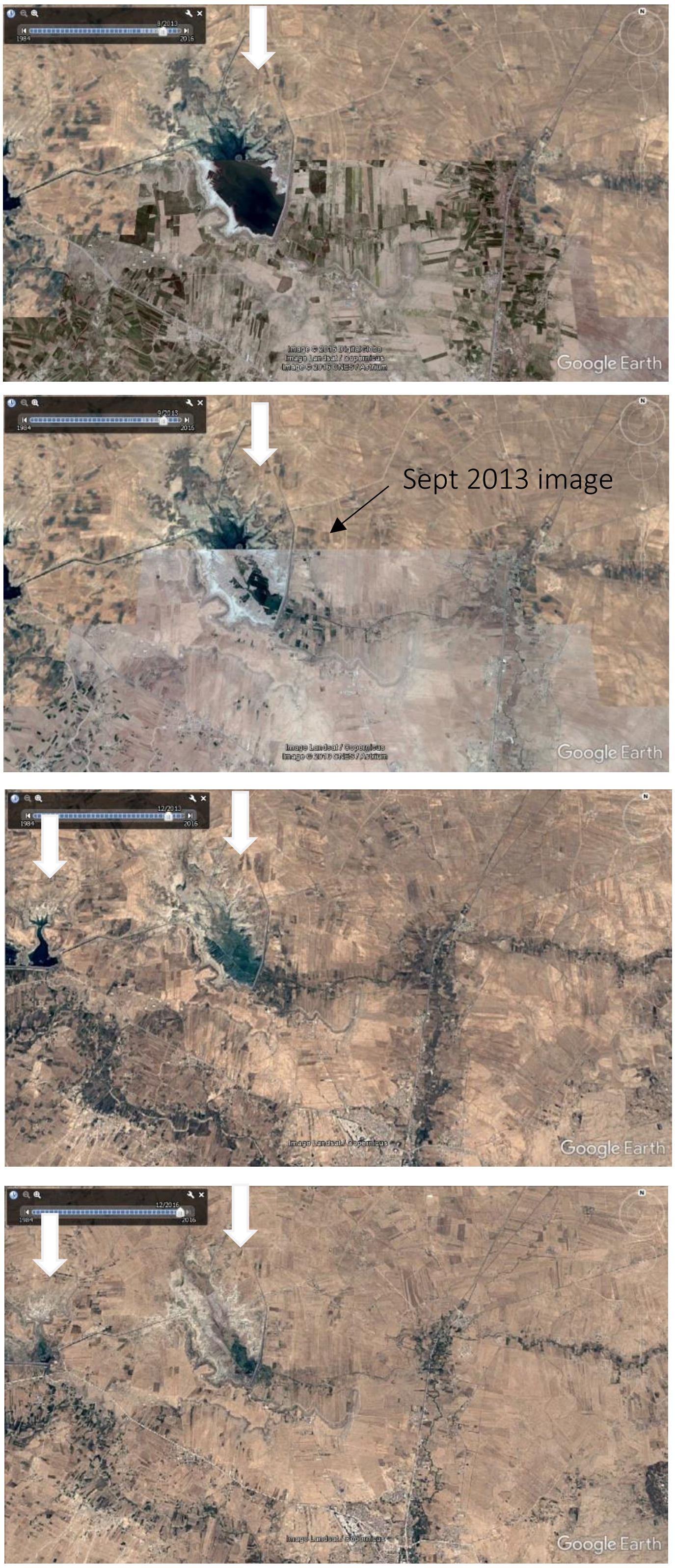


Figure 8.4 The modern land use in the North Jazira Survey area (Google Earth, image dated Dec 2016).



Aug 2013
CNES/
Astrium

Sept 2013
CNES/
Astrium

Dec 2013
Landsat/
Copernicus

Dec 2016
Landsat/
Copernicus

Figure 8.5 The reservoirs northwest of Hasseke, Syria have all but dried up.

Additionally, there are six major highways that cross the modern North Jazira: 1/M4, 6, 7, 712, 716, and E90 and at least two railroads (Google Earth 2015, Wilkinson and Tucker 1995, fig. 24). There also two cities, Hasseke (approximately 28 km^2) and Qamishli (approximately 24 km^2) and numerous smaller towns and villages (Google Earth 2015).

8.2 The Physical Geography of the 3rd and 4th Millennia B.C.

8.2.1 Topography

The topography of the North Jazira 5,000-6,000 years ago would have resembled the modern topography: a large, flat plain bound by the Taurus Mountains to the north with jebels to the south and east, including the Jebel Abd al-Aziz and Jebel Sinjar. Nonetheless, it can be expected that a certain amount of erosion from the jebels and accumulation of soil on the plain would have taken place.

A good indicator of this accumulation over at least the past 5,000 years are the hollow ways. These features, whose bases date to at least the third millennium B.C., are filled with 1-1.4m of sediment (Wilkinson et al. 2010), suggesting that soil accumulation since this time amounts to an increase in elevation of less than 2 m across the plain. This, of course, is not an exact measure and does not account for periods of reuse that may have partially re-eroded the hollow ways. Nonetheless, it is the only available data.

8.2.2 Soils

The soil data used for the fourth and early third millennium B.C. are the modern soil data dated to 1960/61 (**figure 8.6**). While the choice to use this data ignores gradual erosional processes over the last five to six thousand years, the changes in soil from the fourth and third millennia B.C. until the 20th century A.D. are not expected to be great given the shallow accumulation of soil over time described above. It is also fortunate that these maps, the most detailed for the region, pre-date the introduction of mechanized tractors to the area and the modern irrigation schemes mentioned above (Cunliffe 2013; Nyrop et al. 1971, 237–51; W. Smith and Nyrop 1979, 153–71).

The Syrian soils come from a 1:500,000 scale map illustrated by Cherkess (1961). The Iraq soils are from the 1:1,000,000 scale soils map by Buringh (1960). Both maps were

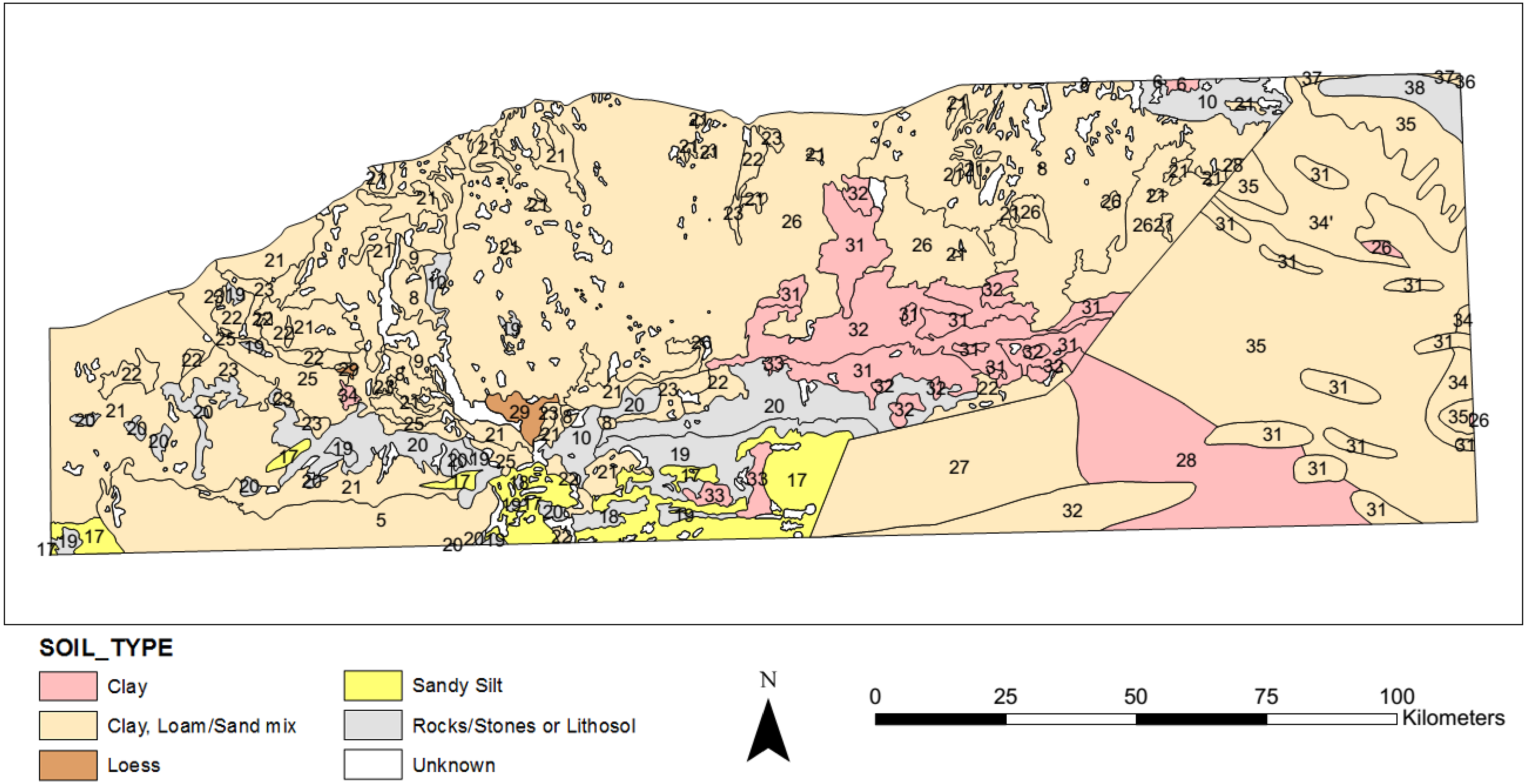


Figure 8.6 Soil map of the North Jazira based on Cherkess (1960) and Buringh (1961).

Key to figure 8.6 Soils of the North Jazira based on Cherkess (1960) and Buringh (1961).

Iraq:26:Valley bottom soils/ Alluvial soils (semi-humid region)/ -
Iraq:27:Reddish-brown soils, medium and shallow phase/ Reddish-brown soils/ Lithosols
Iraq:28:Reddish-brown soils, deep phase/ Reddish-brown soils/ Lithosols
Iraq:31:Lithosolic soils in sandstone and gypsum/ Lithosols/ Reddish-brown and Brown soils
Iraq:32:Reddish-brown soils, deep phase/ Reddish-brown soils/ Lithosols
Iraq:34':Brown soils, shallow and medium phase, deeply eroded/ Brown soils/ Lithosols
Iraq:34:Brown soils, medium and shallow phase over gypsum/ Brown soils/ Lithosols
Iraq:35:Brown soils, deep phase/ Chestnut soils/ Reddish Chestnut and Chemozem soils
Iraq:36:Chestnut soils, shallow, strong and sloping/ Chestnut soils/ Reddish Chestnut, Rendzina soils and Lithosols
Iraq:37:Chestnut soils, deep phase/ Chestnut soils/ Reddish Chestnut and Chemozem soils
Iraq:38:Rough broken and stony land/ Lithosols and Rendzina soils/ Brown and Chestnut soils

Syria:10:Rocky badlands
Syria:17:Gypsiferous soil (reddish-yellow brown) on lagoonal Miocene, fine sandy silt, smooth surface
Syria:18:Gypsiferous soil (reddish-yellow brown) on lagoonal Miocene, with abraded irregular surface
Syria:19:Gypsiferous soil (reddish-yellow brown) on Gypsiferous crust, usually shallow, smooth surface
Syria:20:Deep Calcareous soil on Gypsiferous subsoil
Syria:21:Conglomerate and shallow Cinnamonic on Conglomerate
Syria:22:Red Grumusol and Cinnamonic Conglomerate
Syria:23:Cinnamonic on Gravels
Syria:25:Pleistocene river Alluvials, usually coarse textured
Syria:26:Red Grumusol and Cinnamonic, deep level
Syria:28:Holocene river Alluvials, gray clay and silt
Syria:29:Loess
Syria:31:Grey and black Groundwater soils
Syria:32:Brown Groundwater soils
Syria:33:Swamp lands
Syria:34:Drained Swamp lands
Syria:5:Soils on inland hills, Cinnamonic (reddish-yellow brown)
Syria:6:Grumusol, deep (dark red brown, brown, dark brown and black)
Syria:8:Red Grumusol and Cinnamonic (reddish-yellow brown), deep
Syria:9:Red Grumusol and Cinnamonic (reddish-yellow brown), shallow and stony

digitized using ArcGIS10.0 into a single shapefile, retaining the original soil descriptions. As a result a false boundary appears at the Syrian/Iraqi border (**figure 8.6**).

The western portion of the North Jazira is predominantly a mix of 'deep calcareous soil on gypsiferous subsoil' and 'conglomerate and shallow cinnamonic on conglomerate'(Cherkess 1961). Moving eastward, patches of conglomerate continue, but mostly the soils are 'red grumusol and cinnamonic' (Cherkess 1961). In the centre of the North Jazira, still on the Syrian side of the border, are various ground water soils. Finally, on the eastern side of the North Jazira, in Iraq where the soil map is half the scale, most of the area has 'reddish brown soils' and 'brown soils' (Burgess 1960). Using more familiar terms, the maps indicate the North Jazira has mainly clay soils across the whole region.

8.2.3 Climate

There is no local proxy data for examining climate change in the North Jazira. Instead, the nearest sources are located along the Eastern Mediterranean, Turkey, and Iran, with sources to the south including the Red Sea and Persian Gulf (de Gruchy, Deckers, and Riehl 2016, fig. 2; Bar-Matthews 1999; Bar-Matthews et al. 2003; Baruch and Bottema 1999; Finné, Holmgren, and Sundqvist 2011; Bar-Yosef and Ayalon 2004; Van Zeist and Bottema 1982; Jones, Djamali, and Stevens 2013; Pustovoytov, Schmidt, and Taubald 2007; Arz et al. 2003; Niklewski and Van Zeist 1970; Rosen 2007). These sources of evidence contradict each other such that periods where the Eastern Mediterranean becomes wetter, Northwest Iran becomes drier, and vice versa. One explanation for this is a change in rainfall patterns. Studies suggest that monsoon patterns, responsible for the modern wet-dry seasonal regimes of the modern Middle East and South Asia have changed multiple times before, during, and since the Late Chalcolithic (Donges et al. 2014; Fleitmann et al. 2003; Arz et al. 2003; Moustafa et al. 2000). In fact, one shift in monsoonal patterns occurred during the middle of the Late Chalcolithic coinciding with a period when 'monsoon precipitation decreased abruptly' (Donges et al. 2014; Fleitmann et al. 2003, 1738).

Generally, across the Near East the climate during the third and fourth millennia B.C. was cooler and wetter than the modern climate, but gradually warming and drying until the start of the second millennium B.C. when modern climate conditions set in after the 4.2 KYA Event (Deckers 2011, 94; Wossink 2009, 19; Van Zeist and Bottema 1982; Jones, Djamali, and Stevens 2013; Pustovoytov, Schmidt, and Taubald 2007; Finné, Holmgren, and Sundqvist 2011; Riehl and Bryson 2007, 524–25). An exception to this trend is at the end of the fourth millennium B.C. when there is evidence of a severe drought (Staubwasser and Weiss 2006; J. Clarke et al. 2016).

Nonetheless, the relationship between regional means and local variation (including microclimates) should not be ignored. Recognition of this complexity in which broad climatic trends express themselves on local scales, has been discussed before in the context of Eastern Mediterranean prehistory (Maher, Banning, and Chazan 2011; S. Smith et al. 2011). While a region may have been cooler and wetter or warmer and drier at a given time period, conditions on a local scale will be influenced at least as much by topography and soil properties that affect plant growth, which in turn affect erosion, exposure, and land cover. For these reasons, climatic proxy data are not given any consideration in the reconstruction of land cover in this chapter. Rather the results of the independently reconstructed land cover are compared to this proxy data.

8.2.4 Natural Waterways

The relatively wetter conditions before the 4.2 KYA event were potentially due to melting glaciers and/or increased rainfall leading to higher water levels (Rothman 2011, 54; Jones, Djamali, and Stevens 2013; Stevens et al. 2006, 496). The Khabur River had a higher mean annual discharge rate that estimates suggest could have been double modern values (350-500 cms vs. 225 cms), and its tributary, the Wadi Jaghjagh, was a permanent stream (Riehl and Bryson 2007, 526; Riehl and Deckers 2007). It is uncertain how many of the other hundreds of wadis in the region would have been streams 4,500-6,000 years ago. It is not even possible to determine the precise paths all these waterways followed. Many palaeochannels are visible in imagery (**figure 8.7**), and some of them could be 6,000 years old, but without dating evidence they could also be 600,000 or 6 million years old.

Additionally, the hollow ways central to this project would have acted as drainage features (Wilkinson 2008, 10; Wilkinson 2003a, 111–17). Their primary

Figure 8.7 CORONA image of the North Jazira (from CORONA Atlas of the Middle East). The locations of many wadi channels are visible, but the age of many channels are uncertain. In this image from within the Leilan Regional Survey Area, north of the former Wadi Radd marsh, modern wadi (indicated by blue arrows) flows near a palaeochannel of unknown of age (indicated by yellow arrows).

function as routes led them to be long, low points in the landscape that lead down and away from tells and into the broader landscape. Before the accepted interpretation of these features as hollow ways, they were even considered potential irrigation features (McClellan and Porter 1995; McClellan, Grayson, and Ogleby 2000).

8.2.5 Vegetation

Reconstructions of the vegetation in North Jazira prior to this study include: grassy open oak woodland dominated by *Quercus brantii*, open oak parkland, 'denuded or degraded' wood or scrub, and dwarf shrubland (Deckers 2011, 94–95; Wossink 2009, 19; Wilkinson and Tucker 1995, 37; Bottema and Cappers 2000, 38; Moore, Hillman, and Legge 2000, fig. 3.18a-d). While these types of broad reconstructions of vegetation are sufficient for many purposes, route analysis requires a more precise reconstruction in order to inform the construction of the cost layers described in Chapter 7.

8.2.6 Land Use

While the major exports from the north imported by southern Mesopotamia may have included various stones, metals and timber (Hald 2008, 18; Algaze 2008), these would have come from quarries, mines, and forests north of the Jazira. Instead, the primary land uses of the North Jazira during the fourth and early third millennia would have been agricultural and pastoral interrupted by urban centres.

8.2.6.1 Agriculture

Over the course of the fourth millennium B.C. settlement patterns changed from one of predominantly small agricultural villages and self-sufficiency, with the likely exception of Tell Brak, to a four-tier hierarchy of sites in which the largest centres must have relied on food mobilised from the surrounding countryside in order to sustain themselves (as described in Chapter 4). Archaeobotanical data from Tell Brak evidences a wide variety of crops that were either grown at or mobilised to the site during the fourth and early third millennia B.C.: various types of wheat, barley, peas, beans, figs, dates, pistachios, grapes, alfalfa, and flax (see Appendix C, Riehl and Kümmel).

8.2.6.2 Pastoralism

Akkadian texts indicate animals were both grazed on pasture land and supported by grain fodder (T. J. Wilkinson 2003a, 120–122, 6.16; Riehl et al. 2013, 126). Specifically, it has been observed that in the mid-third millennium:

> 'Emmer (ziz) was mainly used as fodder for animals in MC [Middle Chronology] twenty-fourth century Beydar. Besides barley, emmer was given to sheep, nanny goats, and oxen, which were fed before slaughter, and to "plough oxen" and even birds as well. Donkeys, however, were always fed barley, and especially, the donkeys of the ruler's entourage were fed richly with barley' (Riehl et al. 2013, 126).

The primary animals kept during the fourth and early third millennium B.C. were sheep and goat (Wilkinson 2003a, 121), and there is evidence suggesting that sheep, specifically, became the preferred herd animal starting at the end of the fourth millennium B.C., when fat-tailed sheep first appear (Vila and Helmer 2014).

Modern figures from Syria calculate that in 1961 there were 7.9 ha of pasture per sheep, whereas in 1993 there were only 2.6 ha of pasture per sheep (Vercueil 2003, 231). Figures from Iraq are lower during the mid-20th century. In 1950, there were 2.0 ha of pasture per sheep. In 1956 and 1965, there was 1.6 ha of pasture per sheep, and in 1971 there were 2.3 ha of pasture per sheep (Vercueil 2003, 231). Borrowing figures from Wilkinson et al. (2007) that imagine household-based pastoralism with herds up to 25 animals, a 50 ha site like al-Hawa in the Late Chalcolithic would utilize around 47,500 ha of pasture, but possibly much more[38]. Even if herds were partly reliant on fodder and pastured on fallow and harvested fields, the area of pasture would be roughly three to four times the area of agriculture around a site, and possibly much larger, resulting in the likelihood that nearly all the free space between sites served as pasture land, assuming only local pasture was used.

[38] Based on a population density of 100 persons per hectare, but 40 percent of the population under 14 (see Chapter 4), and a prevalence of multi-generational homes with grandparents, resulting in a figure of between 750-1125 households, but using a mid-value of 950 households for calculations, 25 sheep per household, and a mid-value of 2 ha of pasture per sheep.

8.3 Methodology for Reconstructing Past Land Cover

The first step to reconstructing land cover is a complete listing of all identified plant taxa contemporary to the relevant time period. Next, it is necessary to compile data on all the conditions and locations each identified taxon has been observed to grow in the local region. These conditions and locations serve to both limit the potential range of each taxon and inform the types of habitats each taxon is associated with. Fortunately, for the Near East, Simone Riehl has led the construction of an archaeobotanical database (www.ademnes.de) that records all published archaeobotanical taxa for all sites across the entire region. From this database, a list of all taxa identified from archaeobotanical samples in the region of the North Jazira and dated to either the fourth or early third millennia B.C. could be created. Further chronological divisions were impossible. Then, the observed conditions and locations were recorded for each of these taxa as recorded in the *Flora of Iraq*, *Flora Iranica*, *Flora of Palestine*, *Flora of Egypt*, *Flora of Turkey*, and *Flora of Syria, Palestine, and Sinai* (Ghazanfar, n.d.; Rechinger, n.d.; Zohary, n.d.; Boulos, n.d.; Guest, n.d.; Post, n.d.). Only taxa identified to the genus or species level are included. For taxa identified to the genus level, the observations are compiled from all the observations associated with every species of the genus that grows in modern Syria, Iraq, or Southern Turkey.

All plant species, and even genera, have limits on where they grow: soil, moisture/rainfall levels, light, elevation, and slope. Of these variables, soil, elevation, and slope are the most accessible variables to use to define the potential ranges of taxa identified in the archaeobotanical record. With more precise local climate and soil data, moisture or rainfall levels could also be accounted for. Light is nearly impossible to reconstruct, however, since it is dependent on the very land cover that is unknown (for example, trees providing shade in an otherwise open and sunny landscape).

Plants are also associated with different types of habitat: forest, steppe, desert, etc. Individually, a single plant taxon is unlikely to be diagnostic of a particular habitat type, but en masse a group of plants growing in the same area will be more informative with only one or perhaps just a few shared habitat types.

8.3.1 The Archaeobotanical Database of Eastern Mediterranean and Near Eastern Sites and Other Local Species Data

The archaeobotanical database constructed by Riehl aimed to compile all published data gathered from archaeobotanical sampling across the entire Near East. The database records site and sample location information, stratigraphic and dating information, the sampling methods, sample type (seed, grain, chaff, etc.), the taxa found, the number count, proportion, and ubiquity values for each taxon, modern growth information about the taxa, including locations and habitat types in which it is found.

At the time of data collection in August and September 2013, the database had all seed, grain, and chaff information for the North Jazira and some modern growth information about the taxa recorded from *Flora of Turkey*.

8.3.2 Data Selection and Collection

Using this archaeobotanical database at Tübingen, all known taxa from layers dated to the fourth and third millennia B.C. in the vicinity of the study area were exported. The taxa come from four sites: Hammam Turkman (Late Chalcolithic), Tell Brak (Late Chalcolithic and Ninevite V), Karrana (Late Chalcolithic and Ninevite V), and Mozan (Ninevite V) (**figure 8.8**). All of the published plant remains at the time of the query (August 2013) were of seed, grain, or chaff. The chaff entries were of the same taxa as the grain, so only seed and grain (technically also seed) were used in this analysis. In addition, species of *Triticum* recovered in the archaeobotanical samples were excluded from the analysis, since they are domesticated crops that (unlike *Hordeum* or *Lens*) are not recorded as a weed in any natural habitat, so would not reveal anything about the surrounding natural (non-urban, non-agricultural) land cover.

Initially, the plan was to make use of ubiquity or number counts of each of the taxa to incorporate interpolations based on these values when determining where a plant may have potentially grown. Unfortunately, with many more samples taken at Tell Brak, many taxa would falsely appear is if they grow only in the centre of the study area. Additionally, some taxa (for example, *Hordeum sativum*, *Malva nicaeensis*, *Polygonum corregioloides*, *Rumex pulcher*, but also others) lack sufficient growth information to include in the reconstruction (Appendix C).

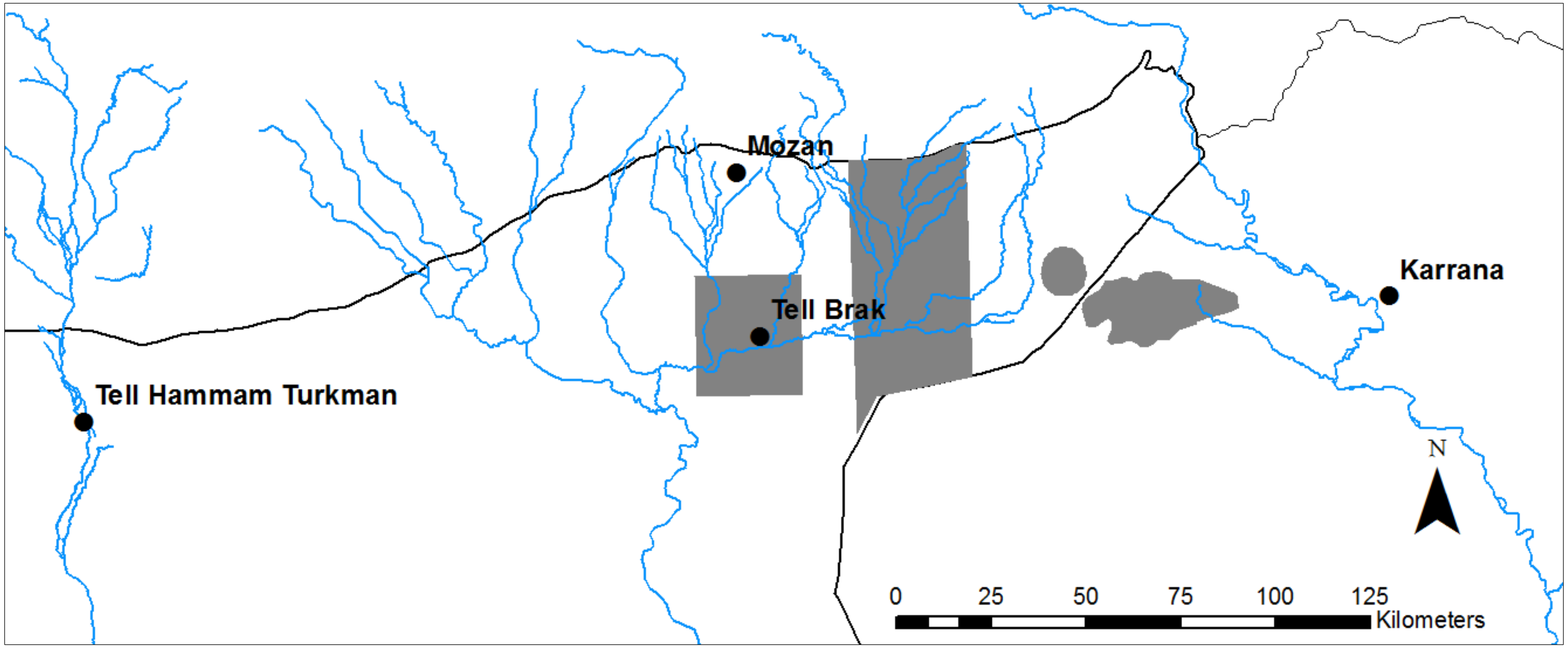


Figure 8.8 The archaeobotanical sample locations in relation to each of the case study areas, from west to east: Tell Brak Survey, Tell Leilan Regional Survey, and Hamoukar and North Jazira Surveys (Hamoukar and NJS Survey areas - FCP database, hydrology – FCP database, country borders – DGAM).

For each taxon, a profile including growth height, elevation limits, and observed growth locations, including geographic locations, was constructed using the combine observations already in the database and published in the nearly 200 total volumes across the series: *Flora Turkey*, *Flora Palestina*, *Flora of Syria, Palestine and Sinai*, *Flora Egypt*, *Flora Iraq*, and *Flora Iranica* (Appendix C). For taxa identified only to the genus level, all species of the taxa which have been observed to grow in modern Syria, Iraq, and/or Southern Turkey were considered. Within the recorded observations are many types of data:

- soil/matrix information (sand, limestone, igneous rock, scree, gravel, clay, etc.)
- elevation information (in metres above sea level),
- slope information (valleys, hills, cliffs, mountain sides), and
- habitat or land cover information (steppe, fields, batha, open pine woodland, etc.)

Together, the first three are used to define the potential ranges of each taxon, while the fourth is used to interpret the land cover.

8.3.4 Interpolation

8.3.4.1 Soil/Matrix

The first variable used to define where a plant taxon could potentially grow is the soil or other matrix (e.g., various rocks, walls, roofs) the plant has been observed to grow in. Using the soil map (**figure 8.6**), areas where the plants may grow were selected and used to form a new layer.

The soil maps by Cherkess (1961) and Buringh (1960), however, use different terminology than the *Flora* volumes, so it was necessary to correlate these terms by making use of the descriptions provided in the key to the Syrian soil map and the descriptions provided in *Soils and Soil Conditions in Iraq* (1960), with occasionally the aid of an old soils volume from 1970, *World Soils*, that helped bridge the terms.

Inevitably, not all plants have been observed to grow on all the soil types present in the North Jazira. Some prefer heavier soils like clay, while others prefer sandy soils (see Appendix C). In fact, soils are the main, and often only, limiting factor for plants in the North Jazira due to its elevation at mid-altitude and flat topography.

8.3.4.2 Elevation

At first, elevation data was taken from an ASTER (version 2) file that was altered by using the fill function of ArcGIS. The ASTER DEM file records modern topography of the region, but evidence from the hollow ways suggests erosion has changed the elevation of the North Jazira by less than two metres. Unfortunately, the 30m resolution of the ASTER records topographic details like modern structures, including roads and canals. An attempt was made to reduce their prominence the ASTER DEM with the fill function in ArcGIS 10 to fill any anomalous sinks in the digital elevation model and through resampling. In the end, it became clear that it would be necessary to resample the ASTER DEM such that it would be the same as a 90m resolution SRTM DEM. As a result, an unaltered SRTM was used instead. Regardless, data on the elevations plants grow to or from are not precise to the meter and should be seen as approximate.

8.3.4.3 Slope

Plants are impacted by slope and even limited in where they might grow based on slope, particularly at mid-latitudes due to differences in shortwave energy reception (Holland and Steyn 1975). A single study by Holland and Steyn (1975) has examined this phenomenon on a global scale; but no study has focused specifically on any region of the Middle East. Reworking the data provided by Holland and Steyn (1975, figure 1), however, it is possible to construct a profile of the differences in shortwave energy specific to the latitude of the North Jazira (**figure 8.9**).

The slope data used to define the potential ranges of taxa derives from the same filled ASTER file as the elevation data. Slope information is recorded in the flora volumes as qualitative like “hill”, “cliff”, “plain”, “depression” and so on. These are intuitive terms, not formally defined with precise degree angles. In the case of hills versus mountains, the formal definition is based on height. Nonetheless, the words are linked to human perceptions of topography, so assigning values can be achieved through two approaches: the relative difficulty of walking along different slopes and measuring the slopes of these features identified in photographs.

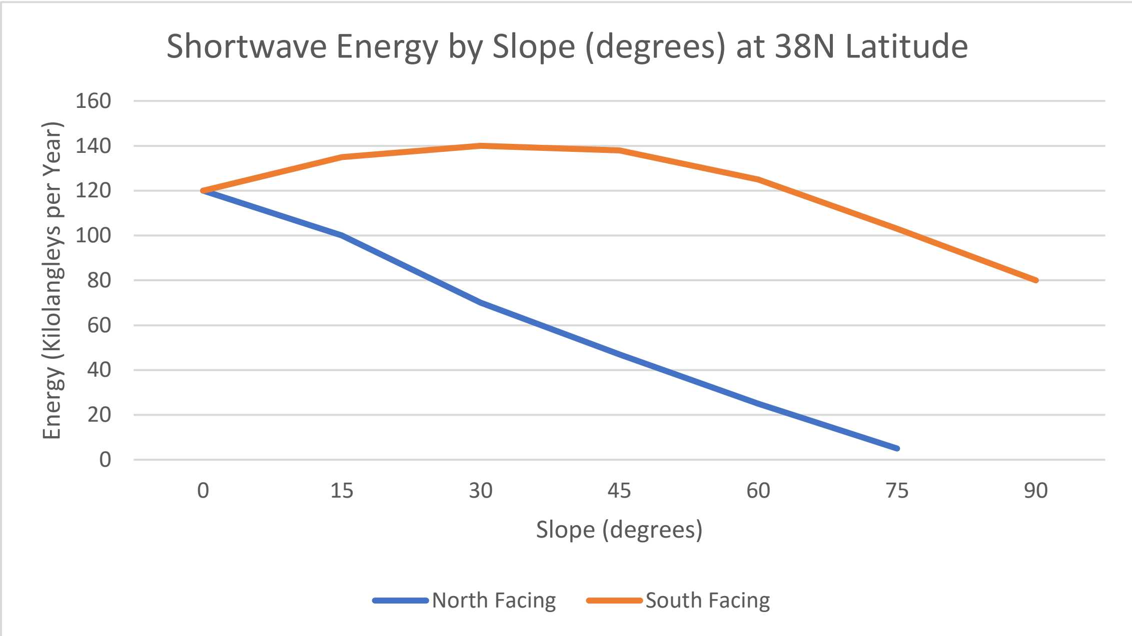


Figure 8.9 The amount of shortwave energy (required for photosynthesis in plants) reaching the ground at different aspects for slopes located at 38 degrees north latitude based on values derived from Holland and Steyn (1975, figure 1).

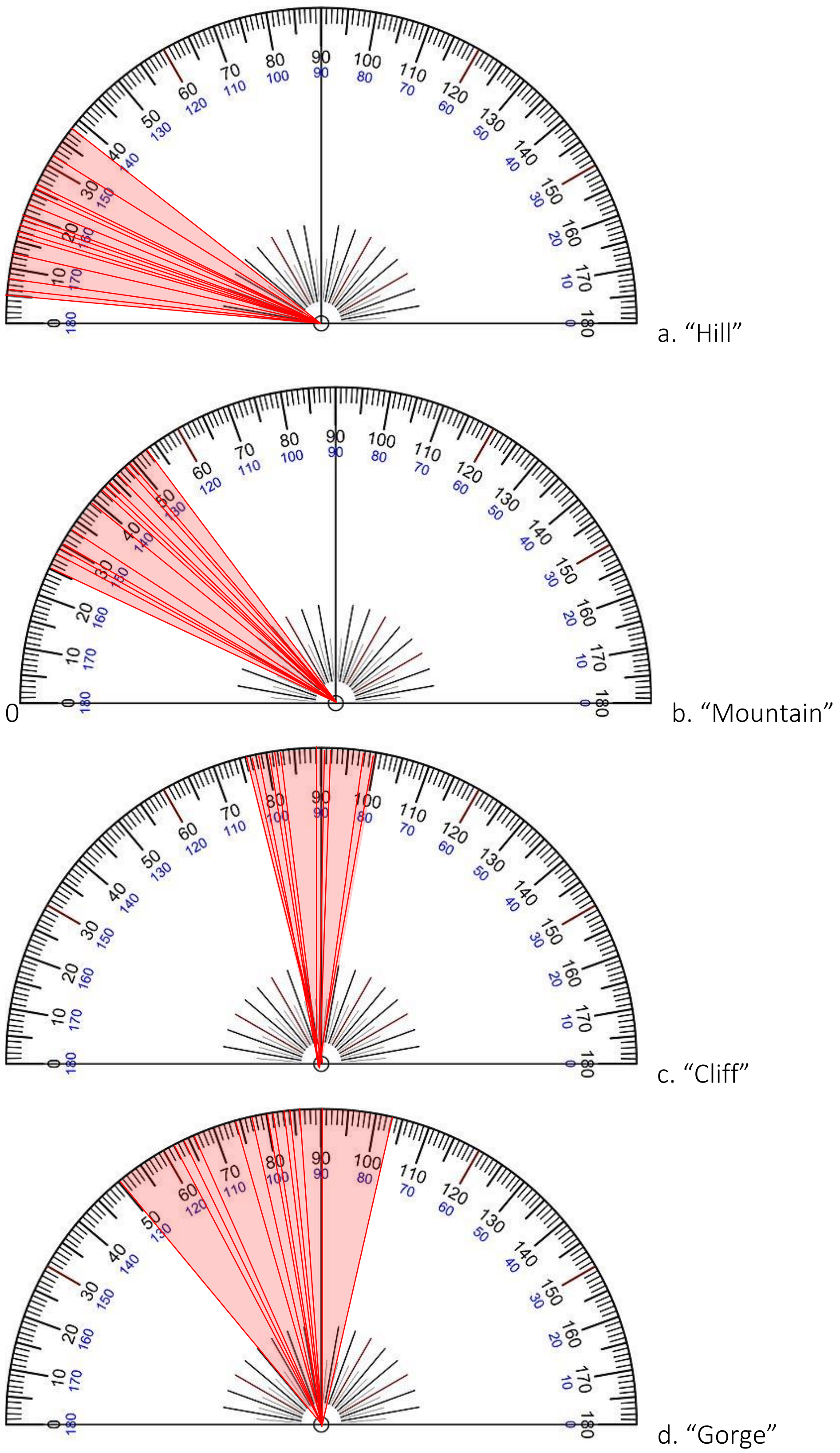


Figure 8.10 The slope, in degrees, of four common topographic terms based on the results of Google Image searches (protractor base image from Wikimedia Commons).

As could be seen already in **figures 1.5 and 1.6**, however, the North Jazira features no significant slopes greater than 50 degrees, though there are scattered individual pixels on the Jebel Sinjar and the hills in the northeast of the map, away from the specific study areas.

Google Images can be used to search for photographs of different subjects. Like the regular Google search engine, the most popular images – the ones most people decide match what they were looking for – appear first. Therefore, a search of terms like "hill" or "mountain" should reveal images that most people would agree reflect these terms. Searches were conducted for each of four terms: hill, mountain, cliff, and gorge. The first ten examples photographed were measured using a protractor. The results confirm the expectation that a slope of at least 5 degrees is commonly interpreted as a hill (**figure 8.10)**. Specifically, hills have slopes between 5 and 40 degrees (**figure 8.10a)**, while mountains (a term formally defined by height) have slopes between 25 and 50 degrees (**figure 8.10b**). Cliffs are not simply vertical features, but can have slopes as low as 75 degrees and greater than 90 degrees (**figure 8.10c**). Gorges are similar to cliffs, because they are essentially narrow, steep-sided valleys with sloping walls between 50 degrees to over 90 degrees (**figure 8.10d**).

None of the plants identified in Late Chalcolithic and 'Ninevite V' levels have slope limitations below 50 degrees. Based on these observations, the slope file created from the ASTER DEM was classified into slopes up to 5 degrees, slopes between 5 degrees and 50 degrees, and slopes greater than 50 degrees.

8.3.4.4 Waterways

Waterways were not considered in the reconstruction of land cover. At this time, there is insufficient data to reliably map the precise courses of even the larger waterways. The error involved would be so enormous that the alternative of not including this factor in the land cover reconstruction for the North Jazira during the fourth and early third millennia B.C. is viewed as the better option for this study.

8.3.4.5 Land Use

Unfortunately, the partial data available regarding site sizes does not allow the incorporation of field areas into the reconstructions. While site size estimates are available for the third case study area covering the Hamoukar and North Jazira Surveys, reperiodisation of the North Jazira survey sites led to the situation where not all sites have size estimates (see Chapter 3 and Appendix B). If site size estimates were available for any of the case study areas, the field areas could be calculated using the values from Wilkinson (1990) and approximated using buffers with the appropriate radius sizes. Likewise, areas of settlement, which sometimes are quite extensive, could be incorporated into the maps.

8.3.5 Error!

There is considerable error involved in the methodology presented. The resolution of the soil maps (in this study 1:500,000 and 1:1,000,000) have a significant role in determining the resolution of the final map, particularly in a flat landscape like the North Jazira where further divisions of the land cover based on elevation and/or slope are minimal.

Additional error is introduced from the possibility that a plant taxa observed to grow at elevations of at least 300 m (for example), might also grow at 299.5 m or maybe even 298 m; and the same applies to slope limits – they are fuzzy boundaries, not hard lines.

Also, this thesis has not considered seasonality or drought years. If the severity of droughts 6,000 years ago were analogous to those in the modern climate, then this could have an impact on land cover; particularly at the margins where more arid conditions are predicted.

8.3.6 Interpretation

Using ArcMap's ID tool, each unique polygon of each map was selected in order to identify the combination of plant taxa that could potentially grow in the polygon. This list is recorded, then using Excel a spreadsheet is created for that unique space listing all of the habitats associated with all of the potential plant taxa. No attempt is made to generalize the precise habitat descriptions in the broader categories. The frequencies of each habitat are counted, and the most common natural habitat type (not terms like 'field', 'fallow field', or 'roadside') is interpreted as the land cover for that space and time.

When steppe was the dominant habitat, an additional step was taken to determine the type of steppe. The relative values of desert, grass-, and shrub-type habitats were checked to assess whether any occur at least 75 percent as frequent as steppe. If so, the space was automatically assigned to that type of steppe. For example, if the dominant land cover was steppe, but desert was at least 75 percent as frequent, then the space was interpreted as desert steppe. Sometimes more than one habitat type occurred with sufficient frequency to be considered. The interpretation of dry shrub steppe was the result of desert and a single shrub-type habitat occurring at least 75 percent as frequent as the dominant habitat type: steppe.

If no natural habitat had a high enough relative frequency to refine the type of steppe present, then all grass-type habitats and shrub-type habitats were counted and compared. If grass-type habitats appeared less than 75 percent as frequent as shrub-type habitats, then the space was interpreted as shrub steppe. If the opposite occurs where shrub-type habitats appear less than 75 percent as frequent as grass-type habitats, then the space was interpreted as grass steppe. Finally, if the values are too even to distinguish between steppe types, then the space was interpreted as grass/shrub steppe. The defining value of 75 percent is an arbitrary value sufficiently high enough to be considered a clear majority.

This whole process was repeated for every unique polygon on each map.

8.4 Land Cover During the Fourth Millennium B.C.

8.4.1 Tell Brak Survey Area

Tell Brak is at the boundary between an area of desert steppe to the north and dry steppe with short woody plants to the south. This area of short woody plants is likely to have been supported by the tributary of the Khabur River that still flows through the area today, though it is impossible to map the precise location of this tributary during the Late Chalcolithic (**figure 8.12**).

8.4.2 Tell Leilan Regional Survey Area

The Tell Leilan Regional Survey Area is largely desert steppe with patches of dry shrub steppe. The southern-most portion of the survey, south of where the Wadi Radd

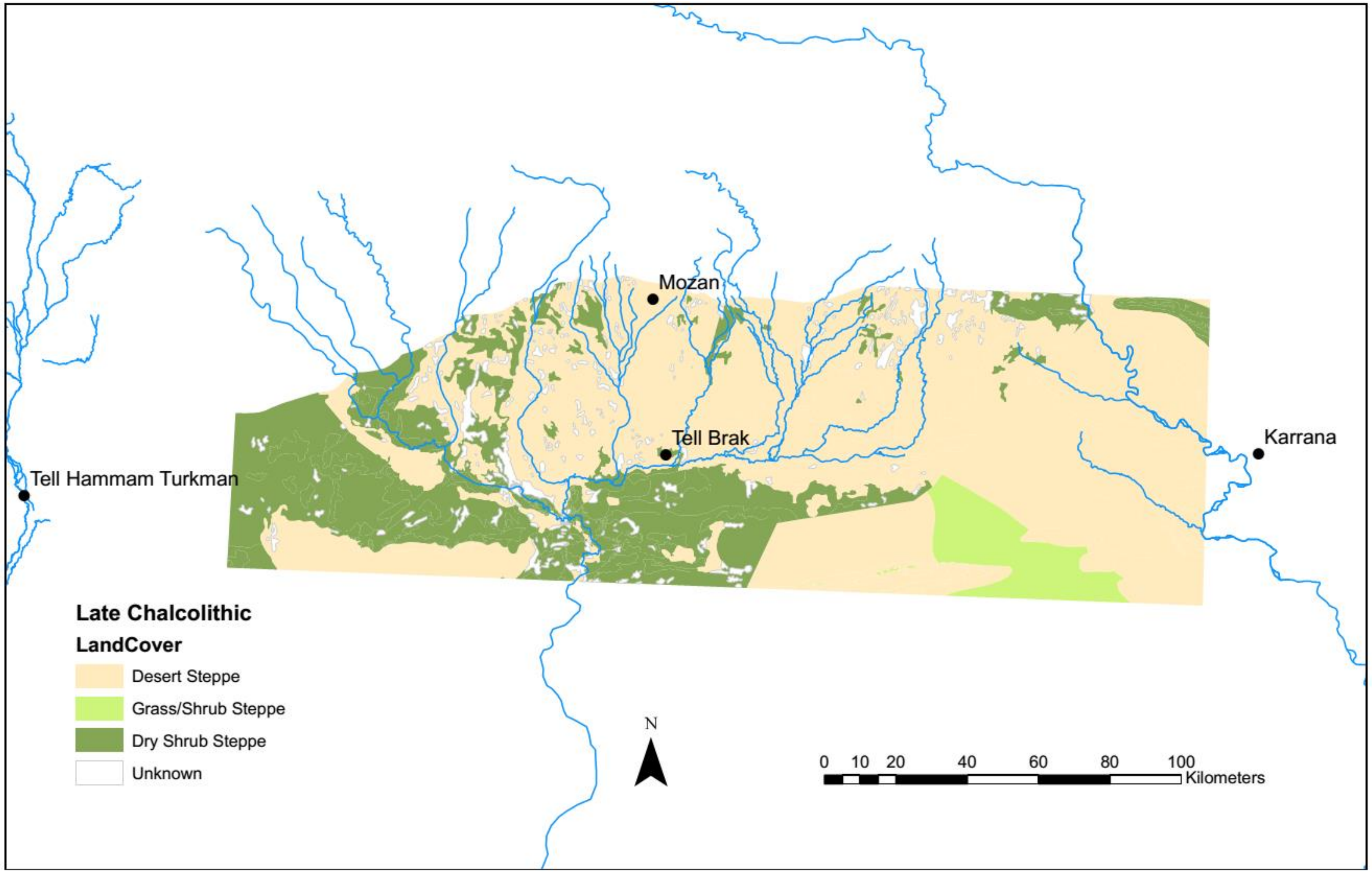


Figure 8.11 The reconstructed land cover of the North Jazira during the fourth millennium B.C.

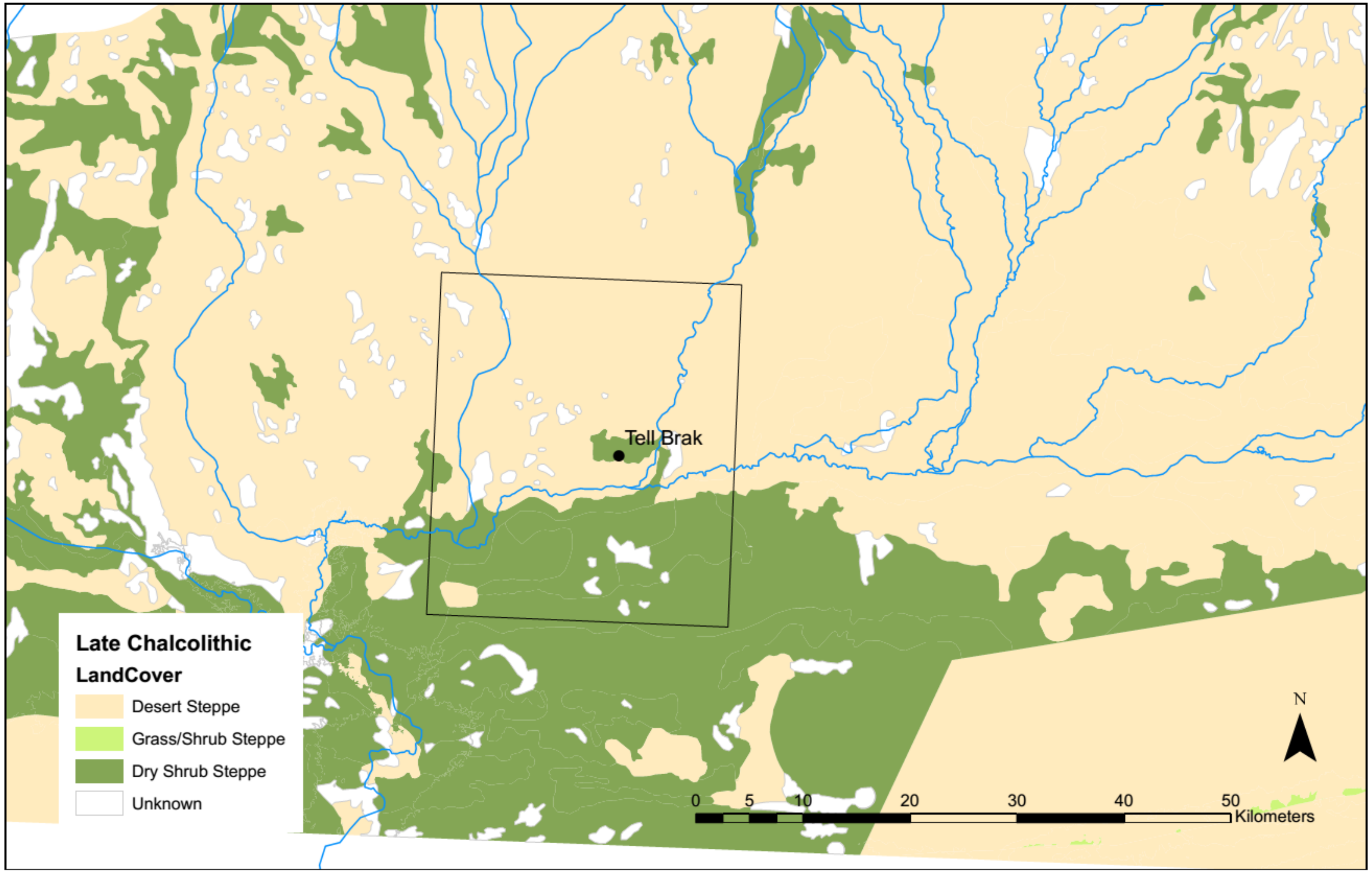


Figure 8.12 The reconstructed land cover in the area of the Tell Brak surveys during the fourth millennium B.C.

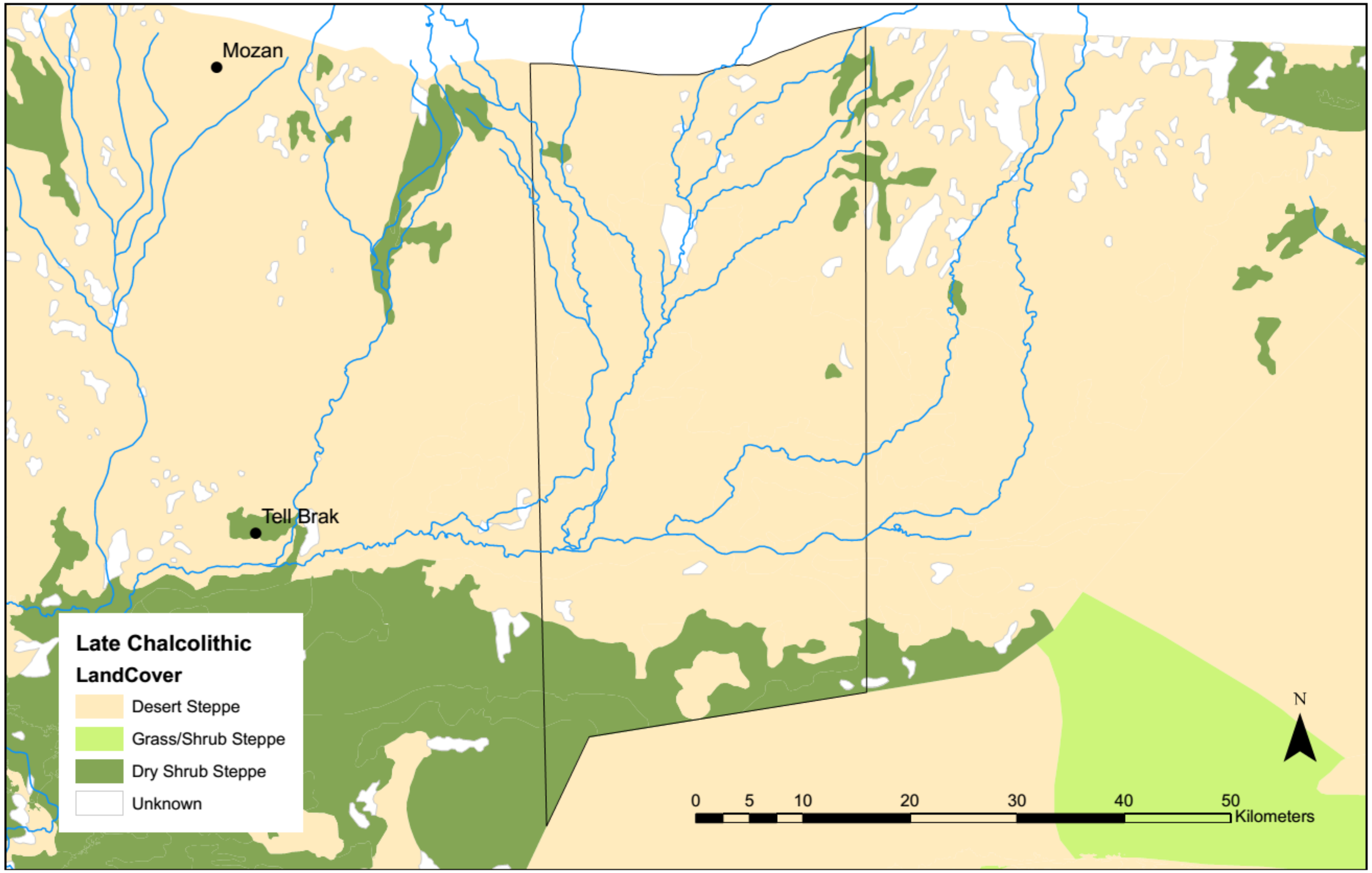


Figure 8.13 The reconstructed land cover in the Leilan Regional Survey Area during the fourth millennium B.C.

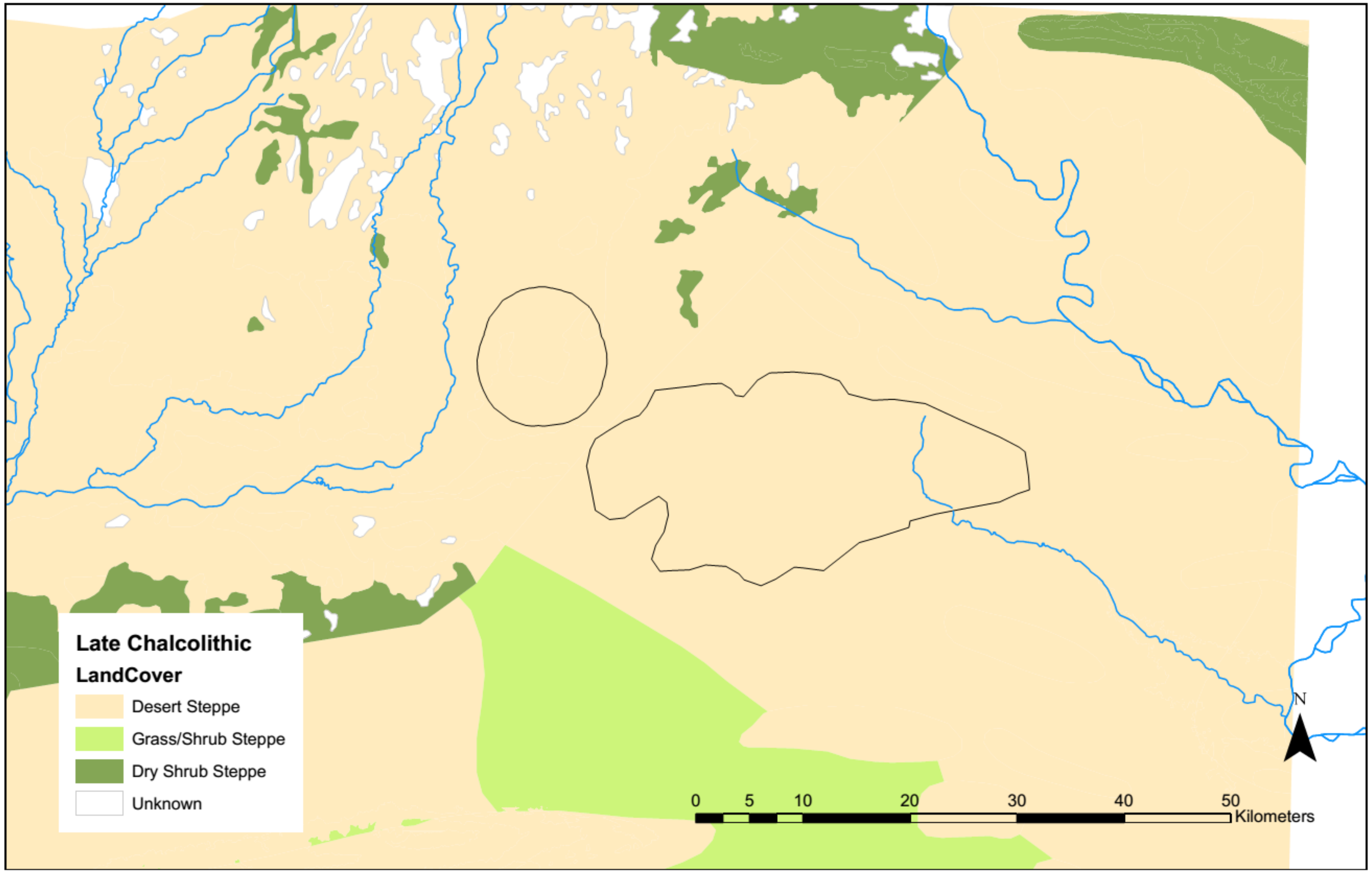


Figure 8.14 The reconstructed land cover in the Hamoukar and North Jazira survey areas during the fourth millennium B.C.

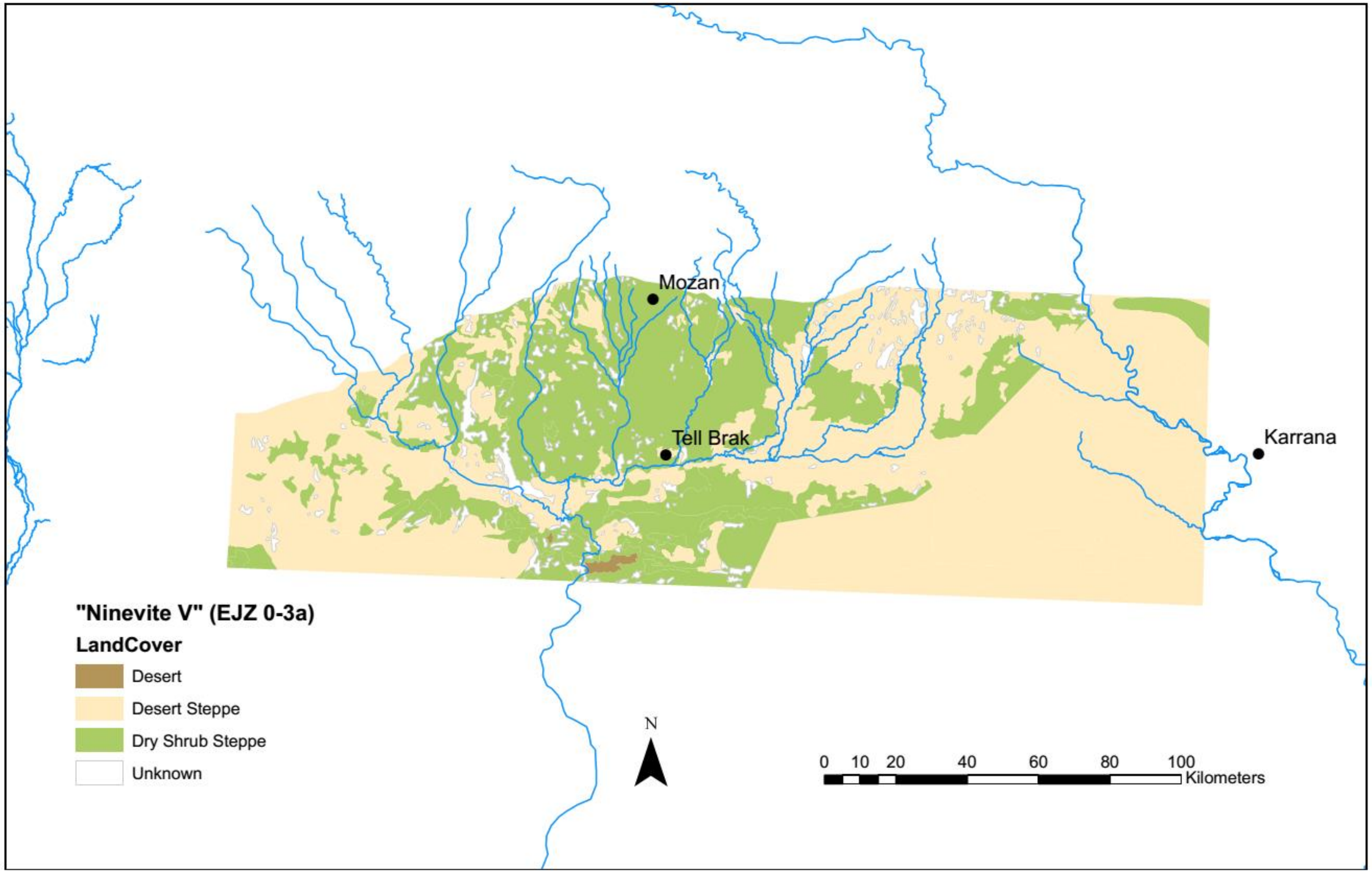


Figure 8.15 The reconstructed land cover of the North Jazira during the early third millennium B.C.

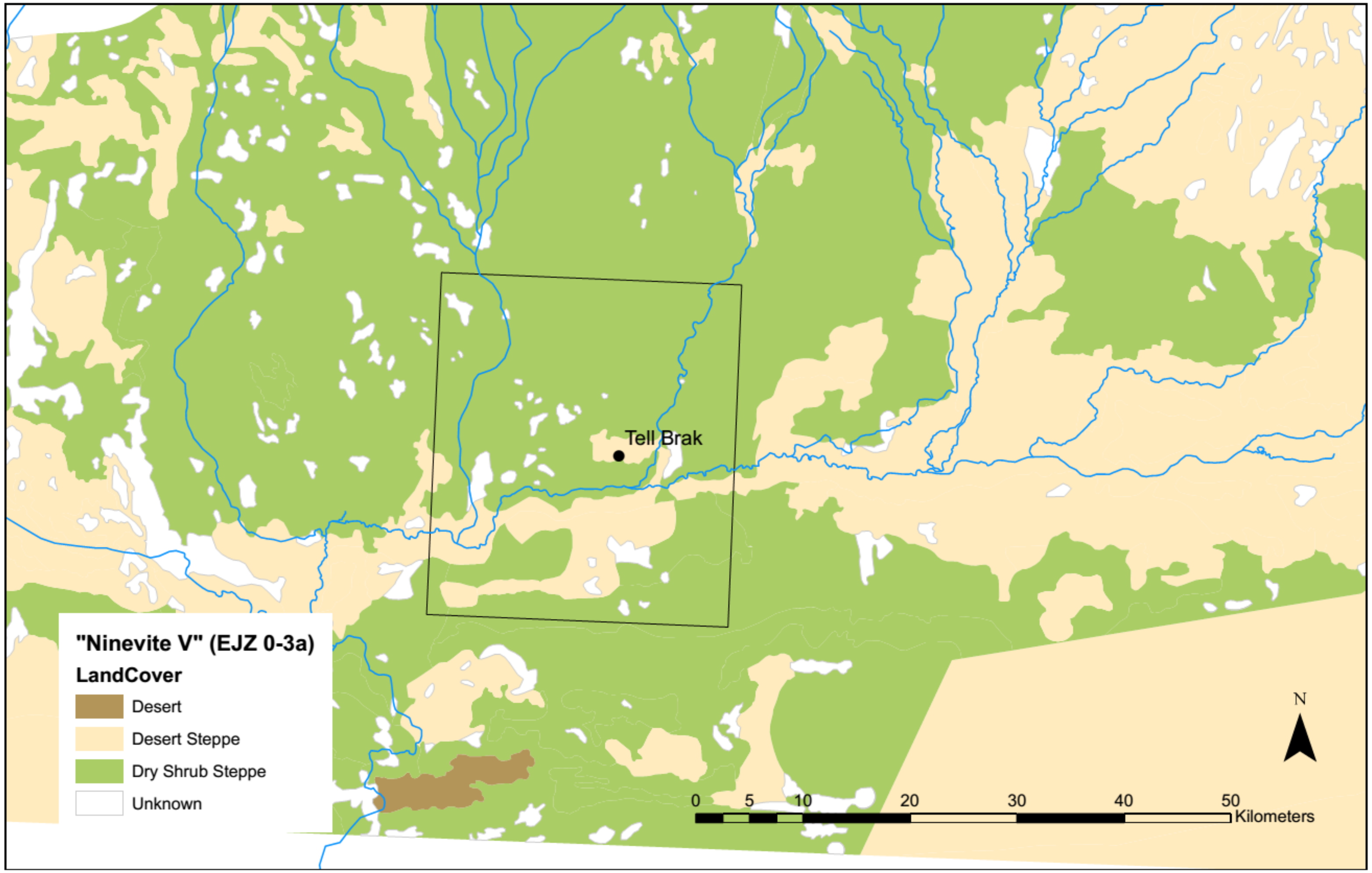


Figure 8.16 The reconstructed land cover in the area of the Tell Brak surveys during the third millennium B.C.

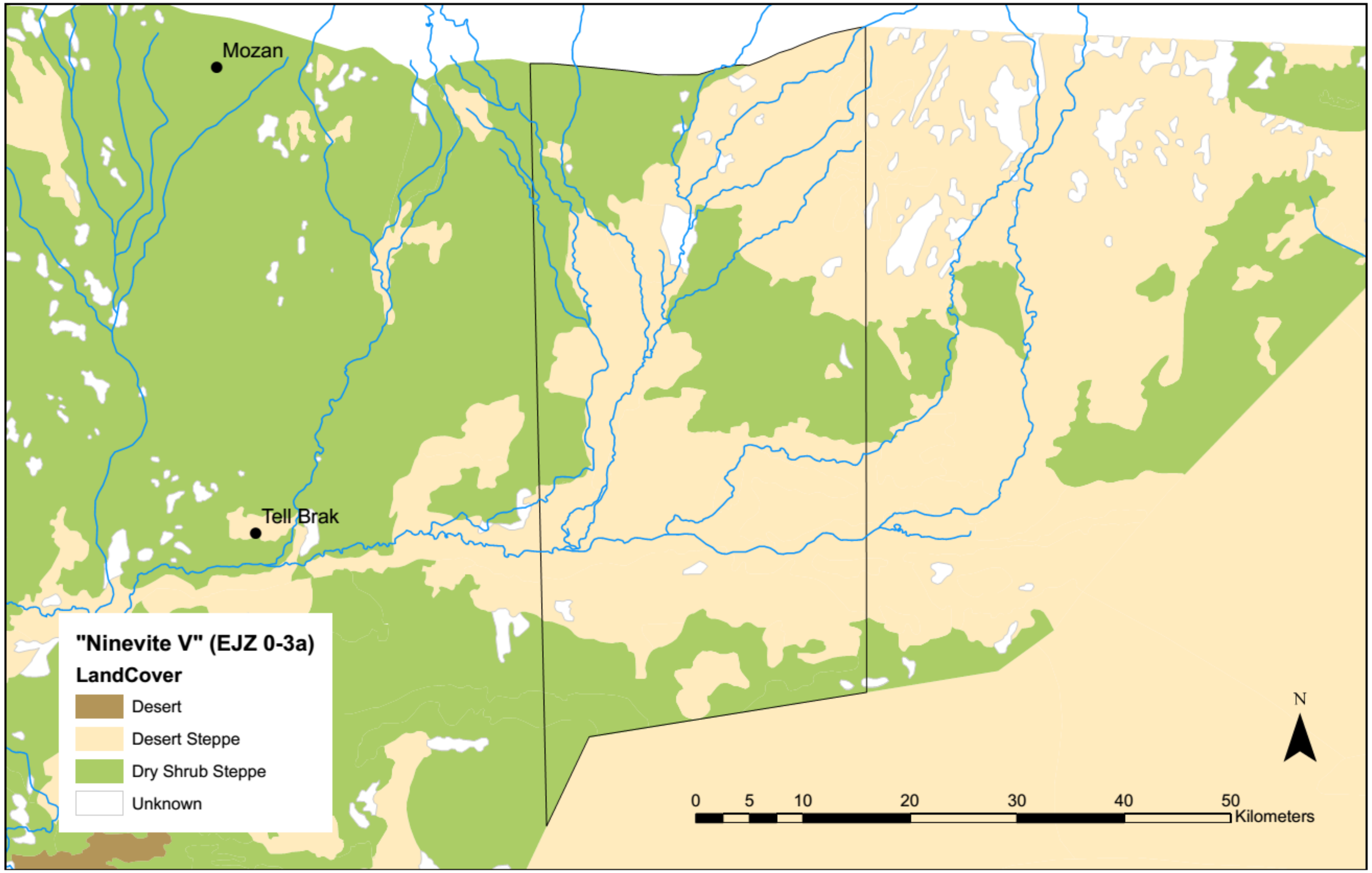


Figure 8.17 The reconstructed land cover in the Leilan Regional Survey Area during the third millennium B.C.

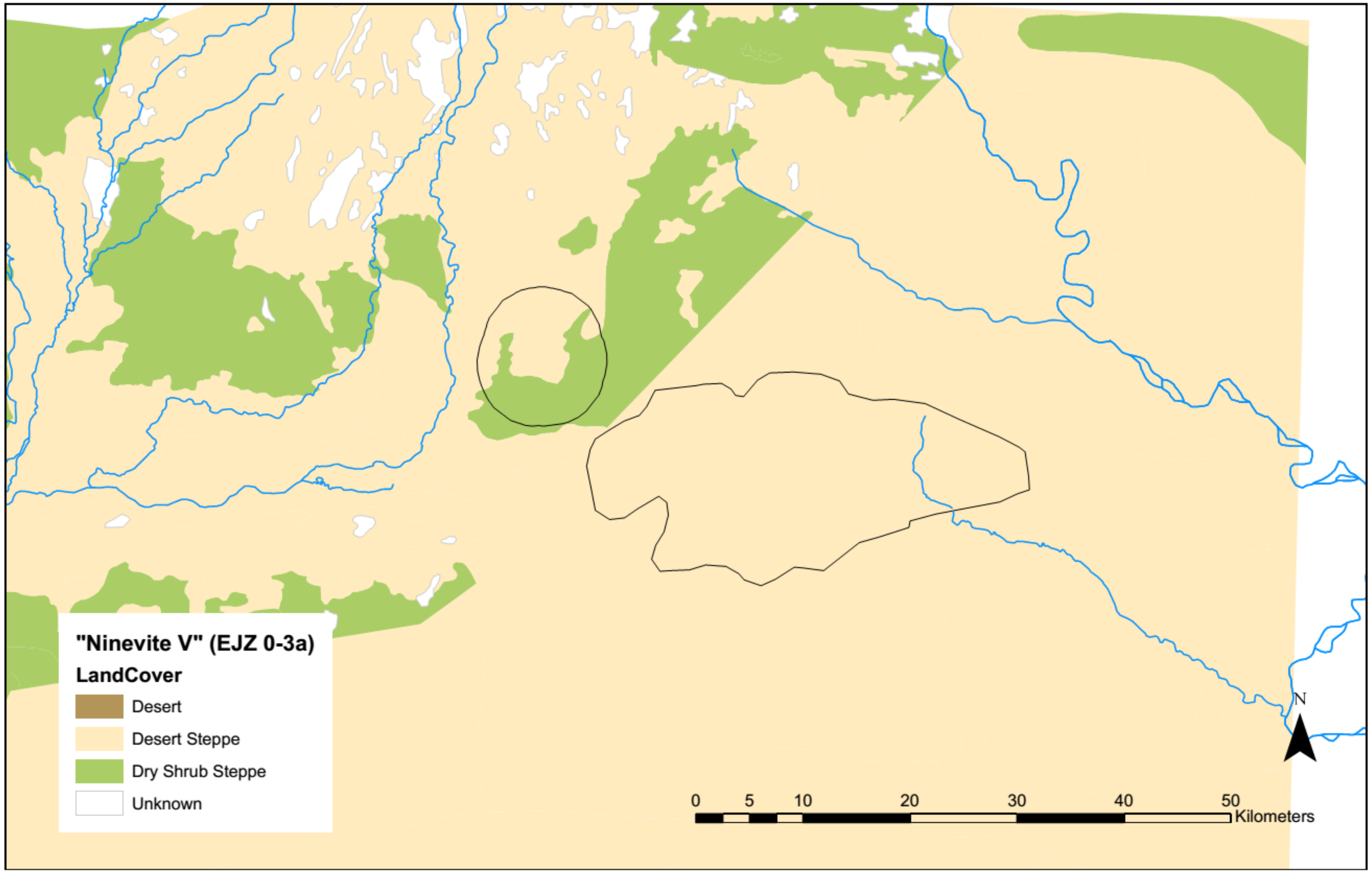


Figure 8.18 The reconstructed land cover in the Hamoukar and North Jazira survey areas during the third millennium B.C.

marsh would have been situated, there was a particularly large area of dry shrub steppe (**figure 8.13**)

8.4.2 North Jazira and Hamoukar Survey Areas

Al-Hawa and Hamoukar are located in an area of desert steppe. Part of the apparent domination of desert steppe (or any land cover interpretation for this area) is due to the single, large soil polygon in which al-Hawa is located. With a more detailed soil map of Iraq, it is possible the archaeobotanical remains would indicate more variety in the land cover. The interpretation of surrounding areas as desert steppe, however, should not be ignored. The area was certainly very dry during the Late Chalcolithic (**figure 8.14**).

8.5 Land Cover During the 3rd Millennium B.C.

8.5.1 Tell Brak Survey Area

Tell Brak is located in a landscape mainly of dry steppe with short, woody plants. A strip of drier desert steppe runs east-west just south of the site, oddly along the approximate location of the tributary of the Khabur River (**figure 8.16**).

8.5.2 Tell Leilan Regional Survey Area

In the third millennium B.C, the proportion of dry shrub steppe located within the Leilan Regional Survey Area increased, particularly in the centre of the survey area and the northwest (**figure 8.17**). The remainder was desert steppe.

8.5.3 North Jazira and Hamoukar Survey Areas

This is the only time period and case study area with site sizes estimated for all the sites, enabling the reconstruction of agricultural fields based on mid-range values from estimates in Wilkinson (1990). The natural land cover is largely desert steppe with a patch of dry shrub steppe south and east of Hamoukar (**figure 8.18**).

8.6 A Brief Diachronic View of the Land Cover

The land cover in all three case study areas changed very little between the Late Chalcolithic and early third millennium B.C. (de Gruchy, Deckers, and Riehl 2016). During both time periods the North Jazira is dominated by a mix of desert steppe and dry shrub steppe.

This is consistent with the climatic observations that the region would have been slightly cooler and wetter than the modern climate, but gradually becoming warmer and drier over time until approaching modern climatic conditions about 300 years after the reconstruction for the early third millennium. The archaeobotanical evidence currently available for reconstructing land cover is not sufficient for detecting the drought observed in climatic data at the end of the Late Chalcolithic period.

Neither the land cover present in the Late Chalcolithic nor the early third millennium is comparable to any 20th century A.D. land cover described by Zohary (1973). The plant taxa found in samples most closely match the plants described by Zohary (1973) in the contemporary North Jazira, but only very loosely. The vast majority of taxa found in the archaeobotanical samples are not listed by Zohary (1973, 183-188) as part of the modern land cover, nor are the majority of plant taxa identified by Zohary (*ibid.*) found in the samples. It is clear there is no modern approximation.

8.7 Significance

The land cover maps generated by this methodology are significant in two ways: first, they are reconstructions based on the seeds and grains of contemporary local plants, rather than general proxy data. Second, despite the various sources of error, this method has generated the most precise reconstructions of past land cover in the North Jazira to date. This precision allows for variation in land cover to be incorporated into route analyses with the use of terrain coefficients. The method itself is scalable, provided sufficient soil and elevation data exists for the desired area; and is replicable in any area with archaeobotanical data.

PART 4: Routes and the Nature of the Uruk Expansion

Chapter 9: Results

Three variables (easiest, fastest, shortest) were modelled for three case study areas (Brak survey areas, Leilan Regional Survey Area, and the Hamoukar and North Jazira survey areas), across three time periods (early fourth millennium B.C., late fourth millennium B.C., and early third millennium B.C.) creating a total of 24 models that were compared quantitatively to the preserved hollow ways. The models factored both slope and land cover, following the methodology described in Chapter 7 and using the reconstructed land covers presented in the Chapter 8. Below are the results, including:

- proof that sample populations are representative populations
- evidence that the shapes of the sample populations are normal/Gaussian
- the rates of overlap between the different models and the preserved routes
- maps highlighting the specific locations where the route models overlap the preserved routes
- discussion of an issue that arose when applying the methodology in areas of high density settlement
- discussion of the results

At the end of the chapter results from a related study by de Gruchy and Cunliffe (forthcoming) are summarized and updated. A full discussion relating the results to the wider Uruk Expansion follows in Chapter 10.

9.1 Representative Random Sample Populations

The charts produced by sampling for the population mean, demonstrate that the sample population produced is a representative sample for statistics. These are presented in **figures 9.1-9.2** (early fourth millennium B.C.), **figures 9.3-9.5** (late fourth millennium B.C.), and **figures 9.6-9.8** (early third millennium B.C).

9.2 Normal/Gaussian Data

Since the quantitative analysis utilized two-tailed Z-Tests to assess significance, which require data to be normally distributed, histograms are presented of the random sample populations of models for the earliest fourth millennium B.C. (**figure 9.9**), the late fourth millennium B.C. (**figure 9.10**), and the early third millennium B.C. (**figure 9.11**). Additionally, the means, medians, modes, and standard deviations are provided below each histogram to assist in assessing the shape of the histograms wherever that might be unclear visually,[39] such as when fewer models were needed to generate a representative sample population and determine the mean. Together these figures and the descriptive summary statistics beneath them illustrate that the overlap rate between the sample populations of route models and the preserved routes, consistently conform to normal distributions, justifying the choice for using a parametric test, the two-tailed Z-Test, to assess significance.

9.3 Results of the Quantitative Analysis

The overlap rates between each optimal model and the preserved hollow ways, as well as the results of the two-tailed Z-Test are summarized in **table 9.1**.[40] It is in this table that it becomes clear that none of the physical variables (easiest, fastest, shortest) play a significant, if any role, in the route choice for the inhabitants of the North Jazira from the early fourth through the early third millennia B.C. The repeated failure of both the easiest and fastest route models in particular, to match the preserved routes raises important implications for predictive route modelling in situations where physical evidence for routes is not preserved, and where it is often assumed that an easiest or fastest route can approximate actual routes of travel in the same way that Thiessen Polygons can roughly approximate territories.

9.4 Issue: High Density Settlement

It can happen that there is such a high density of sites that an each-site-to-every-other-site approach to route modelling can produce a map where large areas are blanketed by routes to the extent that every pixel is selected. This creates a problem where it is physically impossible for the hollow ways to select a free space, inflating

[39] The mean, median, and mode are equal in a normal distribution.

[40] In the Tell Brak area during the early third millennium B.C., settlement data are only published for the smaller of the two surveys. For this reason, a smaller mask was constructed that better reflects the area covered by this smaller survey. Otherwise, the procedure remains the same. The easiest route model in the Tell Brak area (**figure 8.39**) shows some matches between the model and the hollow ways, but most of the matches are portions of larger segments of hollow ways.

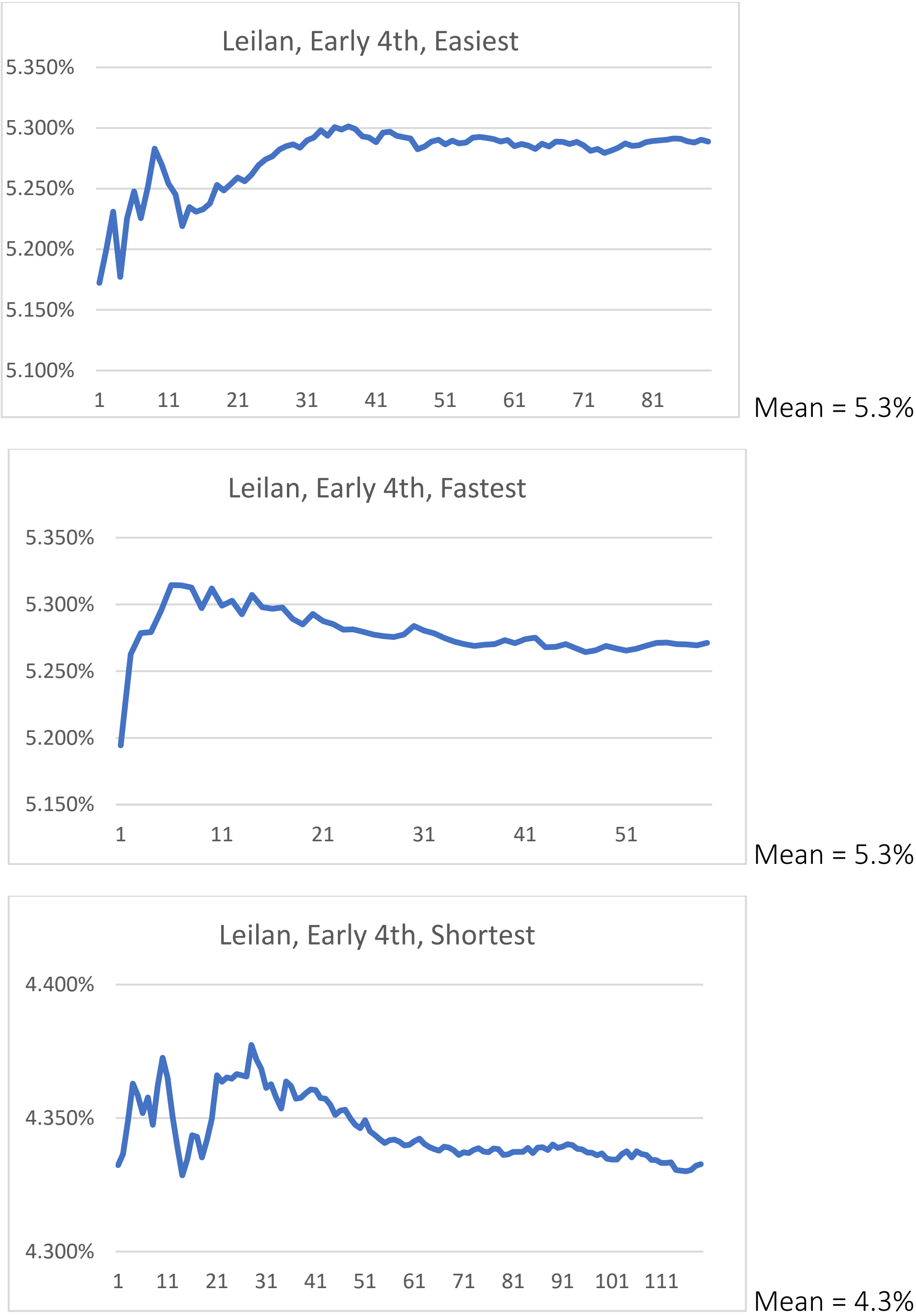


Figure 9.1 Charts from sampling for the population mean for all three physical route models (easiest, fastest, and shortest) in the Leilan Regional Survey Area during the early fourth millennium B.C. The vertical axes represent the percentage of the hollow ways each model overlaps with, while the horizontal axes denote the number of the random route models used to find the population mean.

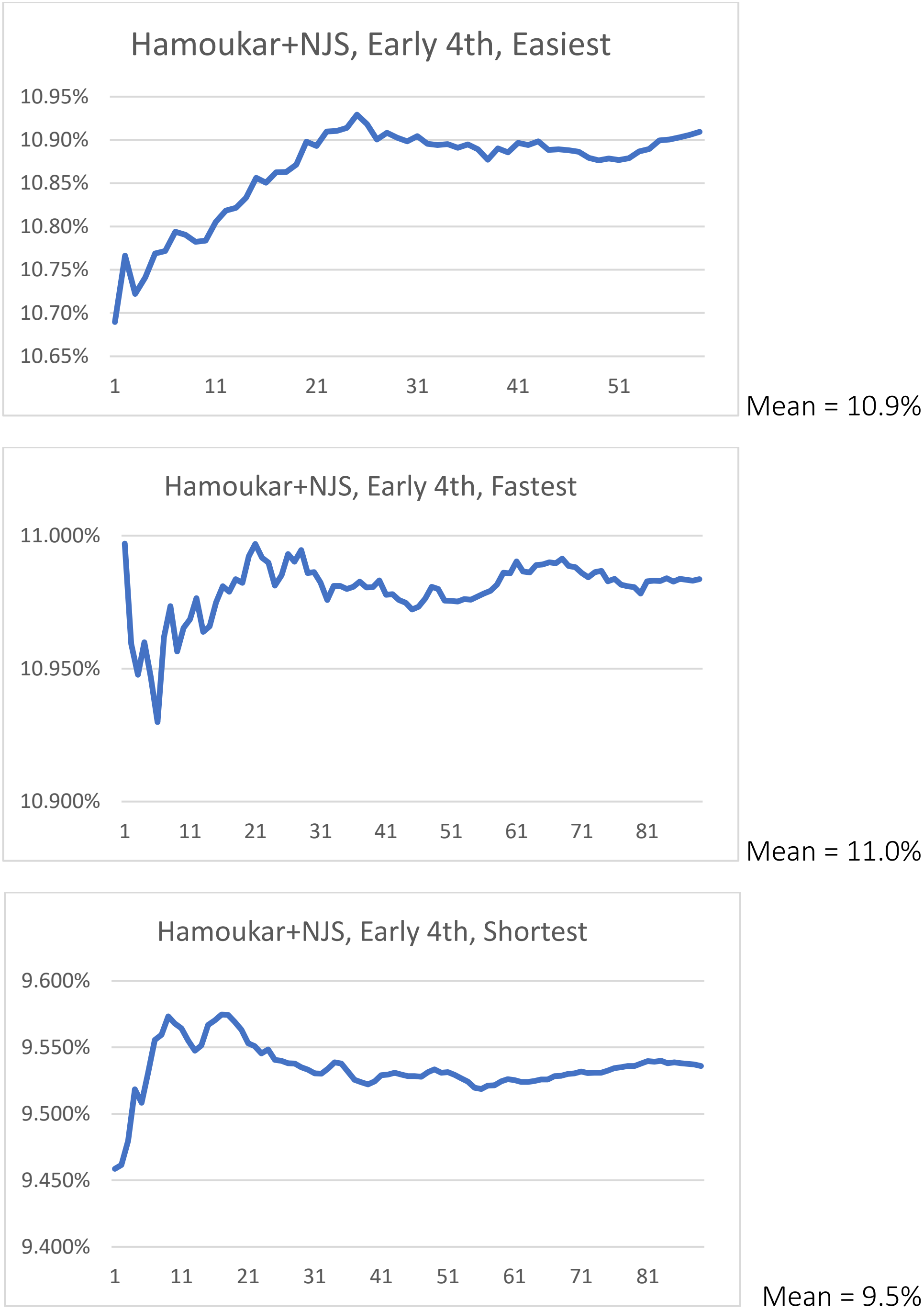
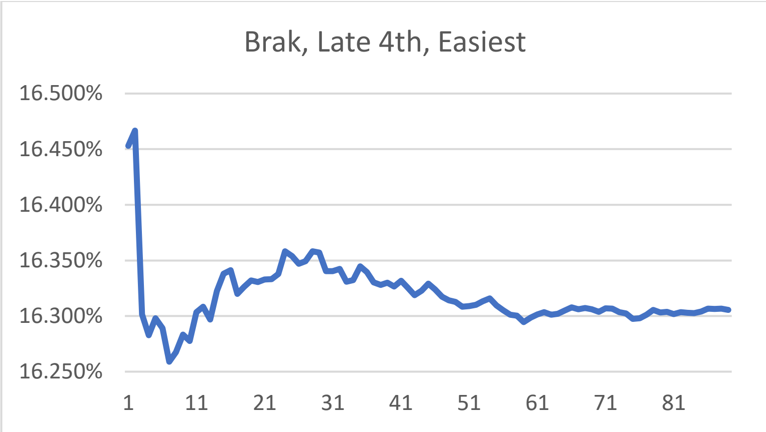
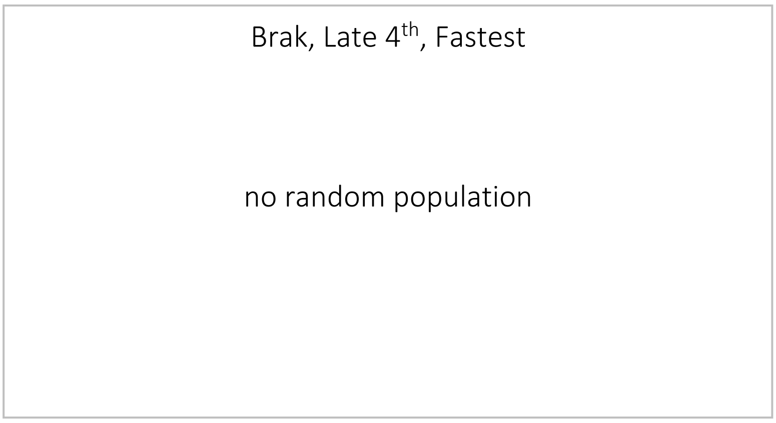


Figure 9.2 Charts from sampling for the population mean for all three physical route models (easiest, fastest, and shortest) in the Hamoukar and North Jazira Survey areas during the early fourth millennium B.C. The vertical axes represent the percentage of the hollow ways each model overlaps with, while the horizontal axes denote the number of the random route models used to find the population mean.



Mean = 16.3%



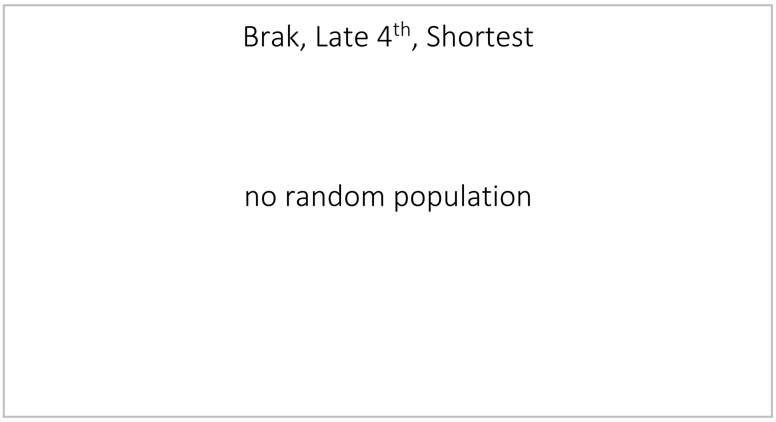


Figure 9.3 Charts from sampling for the population mean for all three physical route models (easiest, fastest, and shortest) in the Brak survey areas during the late fourth millennium B.C. The vertical axes represent the percentage of the hollow ways each model overlaps with, while the horizontal axes denote the number of the random route models used to find the population mean.

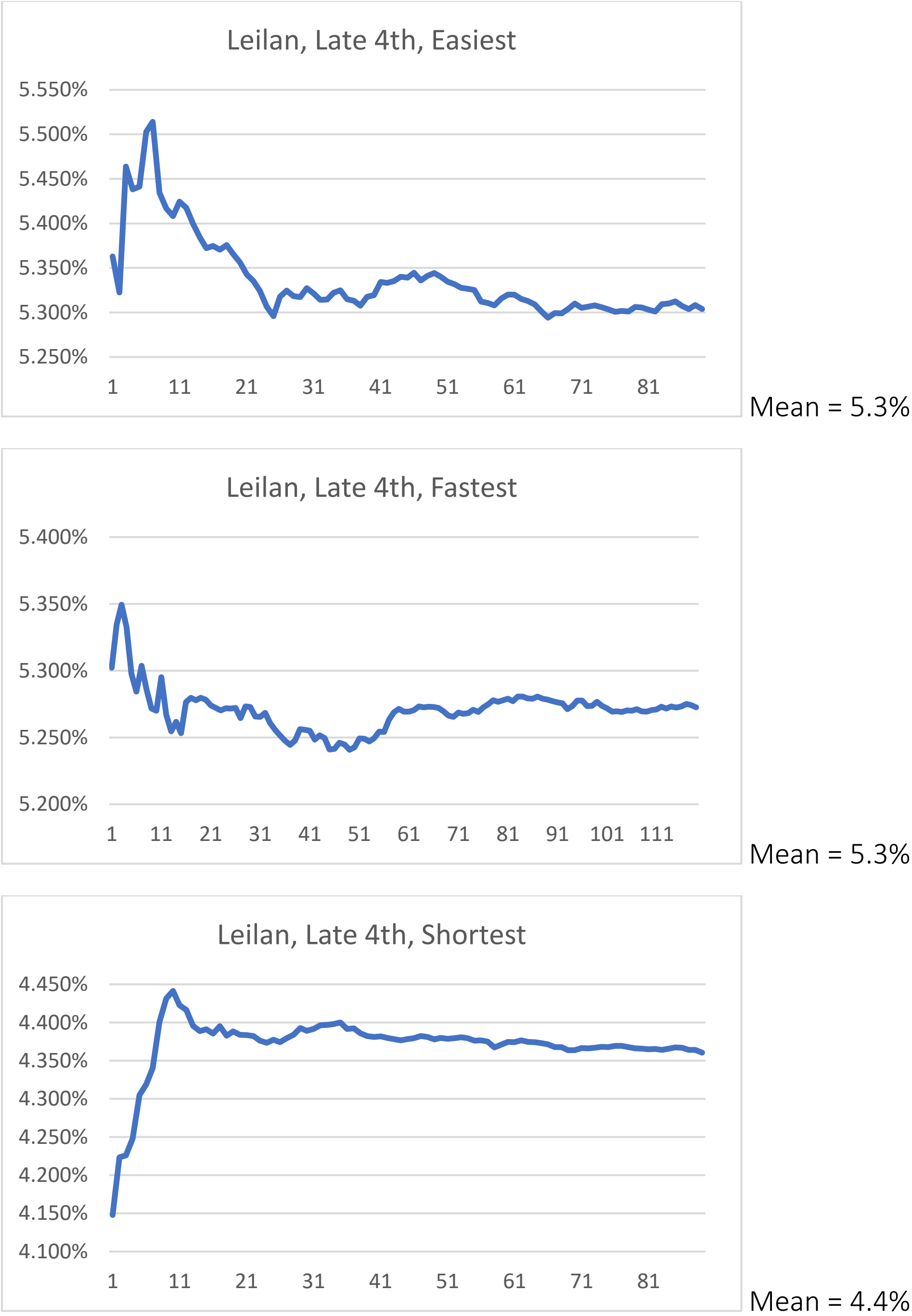
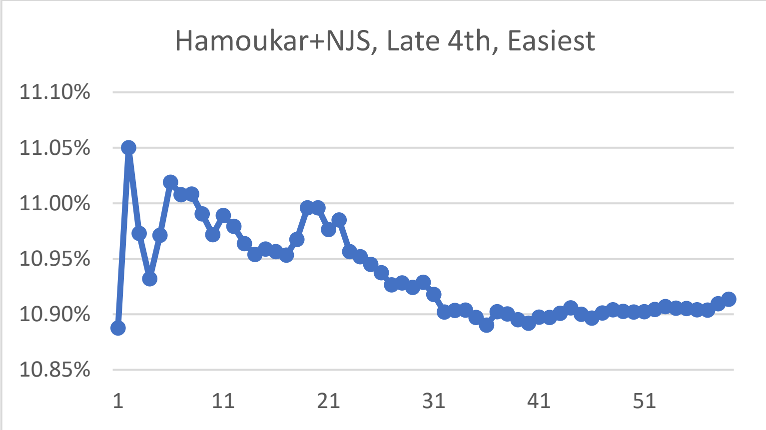
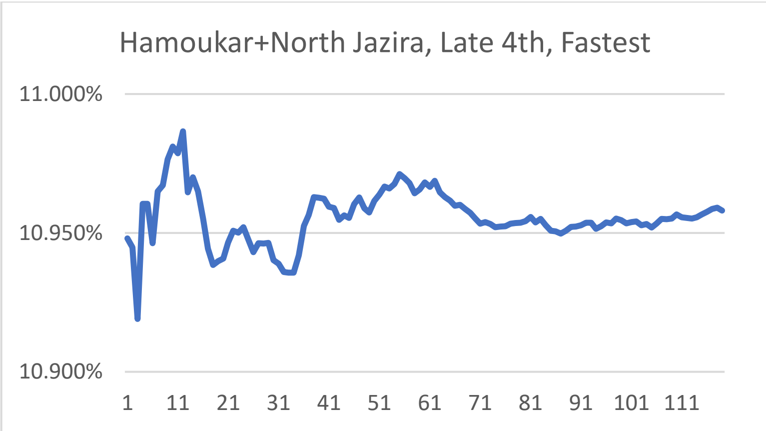


Figure 9.4 Charts from sampling for the population mean for all three physical route models (easiest, fastest, and shortest) in the Leilan Regional Survey area during the late fourth millennium B.C. The vertical axes represent the percentage of the hollow ways each model overlaps with, while the horizontal axes denote the number of the random route models used to find the population mean.



Mean = 10.9%



Mean = 11.0%

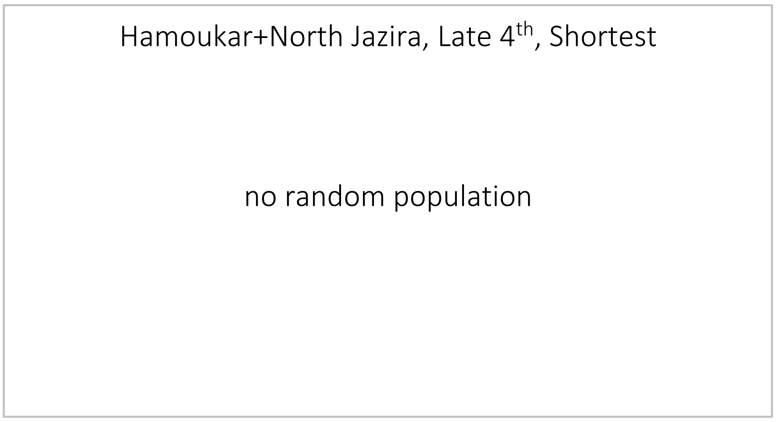
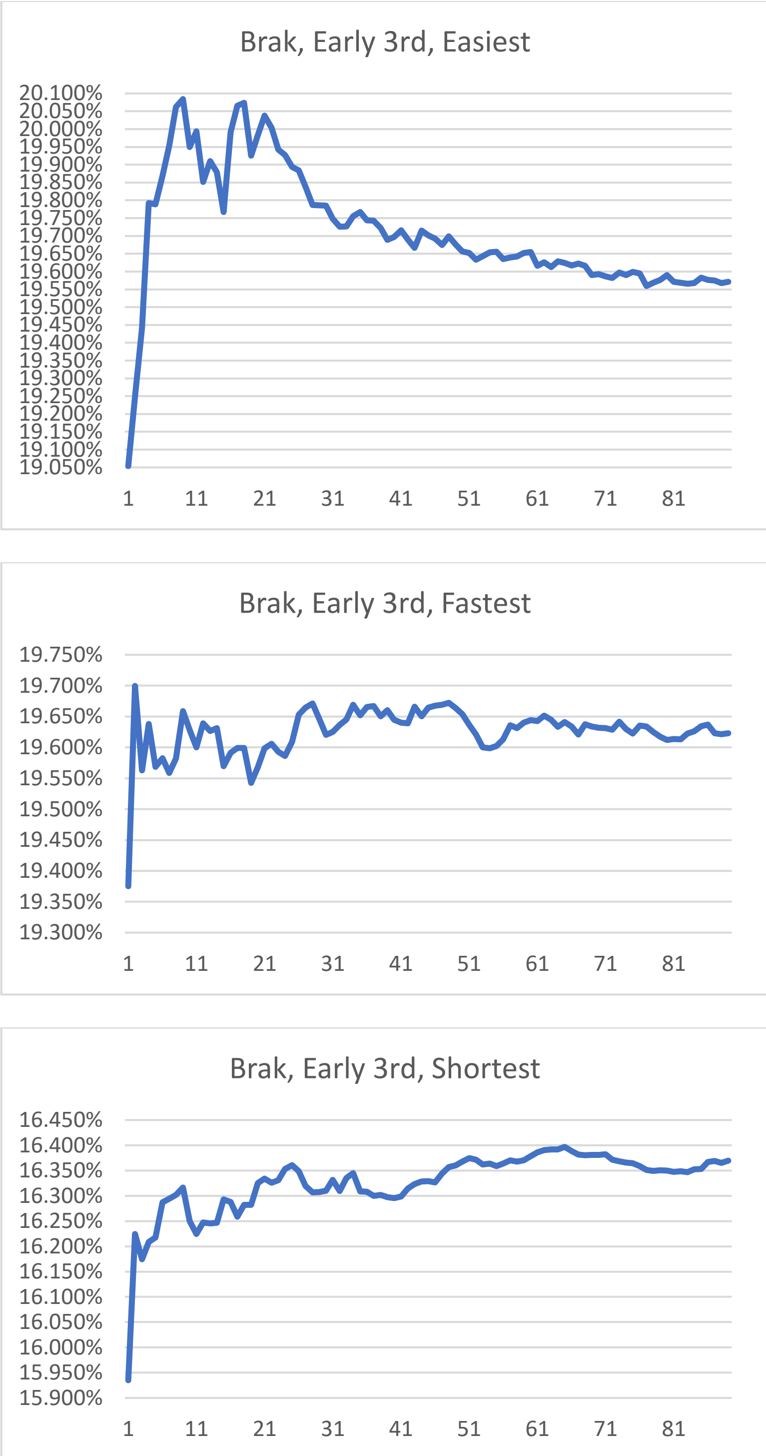


Figure 9.5 Charts from sampling for the population mean for all three physical route models (easiest, fastest, and shortest) in the Hamoukar and North Jazira survey areas during the late fourth millennium B.C. The vertical axes represent the percentage of the hollow ways each model overlaps with, while the horizontal axes denote the number of the random route models used to find the population mean.



Mean = 19.6%

Mean = 19.6%

Mean = 16.4%

Figure 9.6 Charts from sampling for the population mean for all three physical route models (easiest, fastest, and shortest) in the Tell Brak survey areas during the early third millennium B.C. The vertical axes represent the percentage of the hollow ways each model overlaps with, while the horizontal axes denote the number of the random route models used to find the population mean.

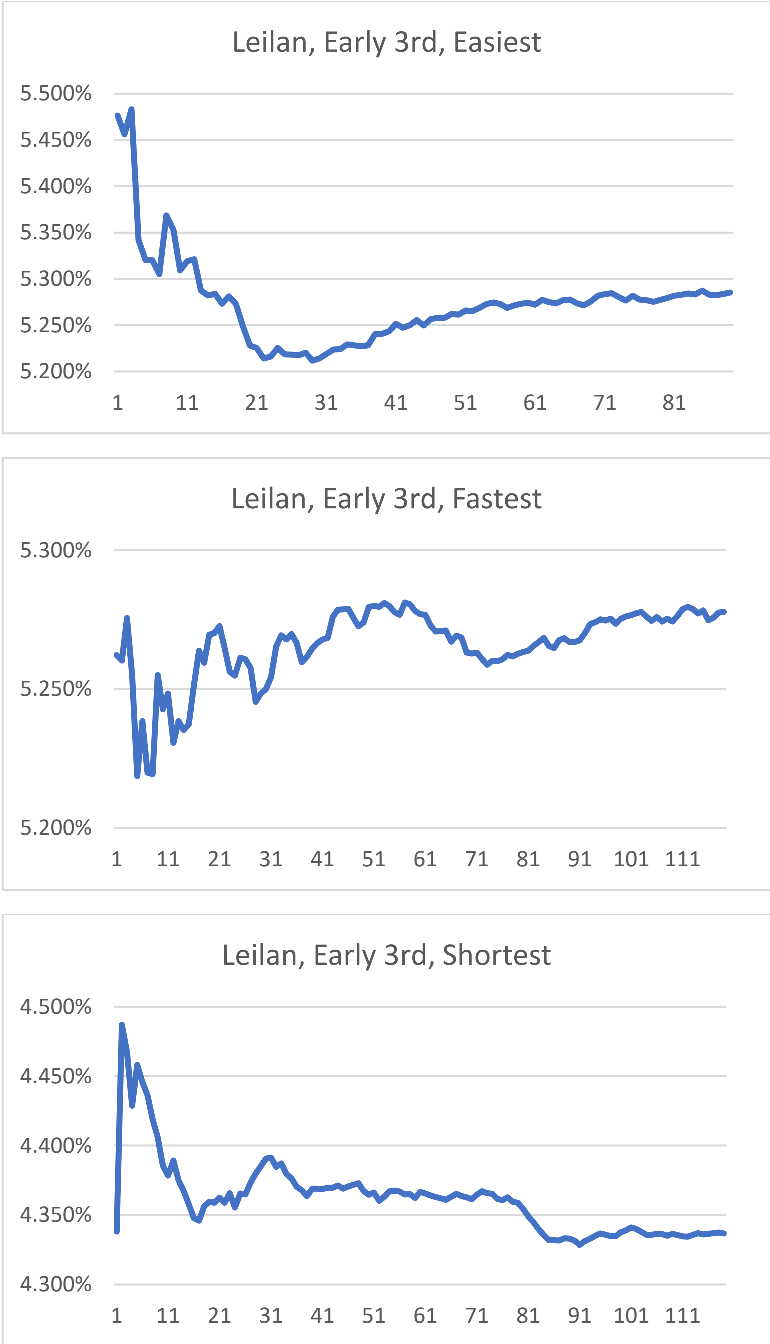
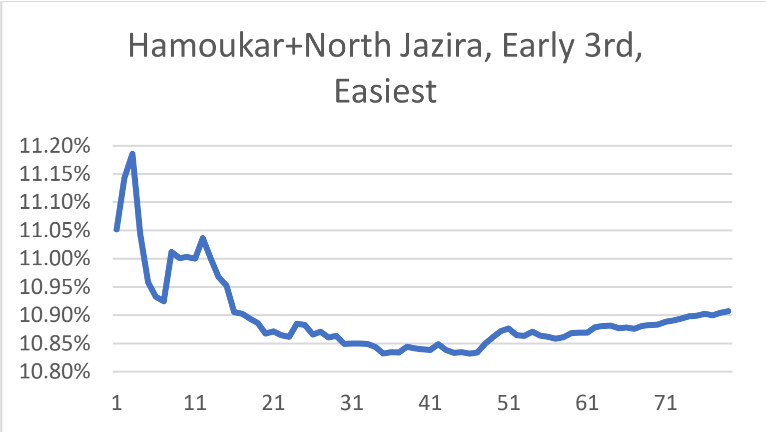
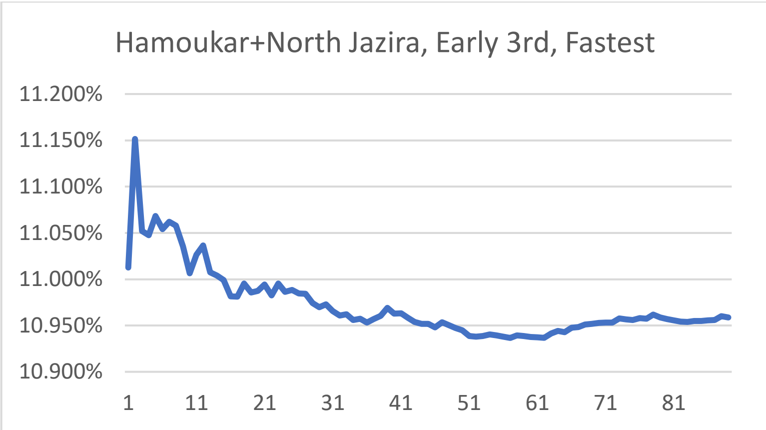


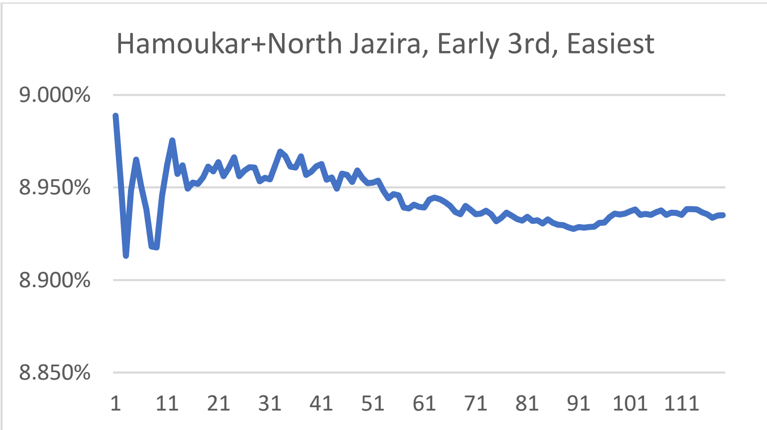
Figure 9.7 Charts from sampling for the population mean for all three physical route models (easiest, fastest, and shortest) in the Leilan Regional Survey area during the early third millennium B.C. The vertical axes represent the percentage of the hollow ways each model overlaps with, while the horizontal axes denote the number of the random route models used to find the population mean.



Mean = 10.9%

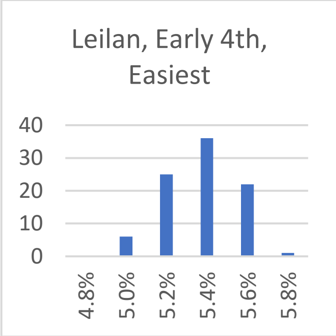


Mean = 11.0%

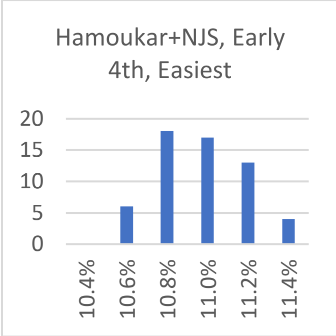


Mean = 8.9%

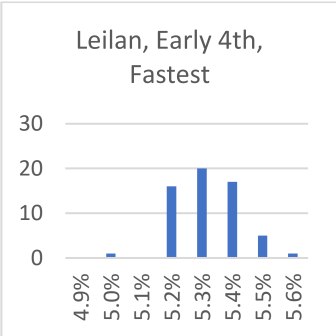
Figure 9.8 Charts from sampling for the population mean for all three physical route models (easiest, fastest, and shortest) in the Hamoukar and North Jazira Survey areas during the early third millennium B.C. The vertical axes represent the percentage of the hollow ways each model overlaps with, while the horizontal axes denote the number of the random route models used to find the population mean.



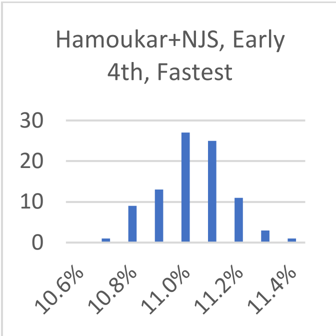
Mean: 5.3
Median: 5.3
Mode: 5.1



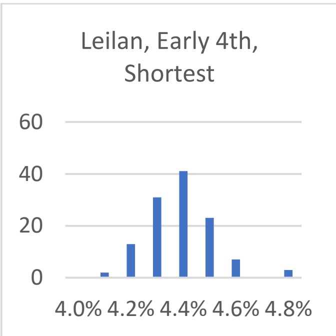
Mean: 10.9
Median: 10.9
Mode: 10.8



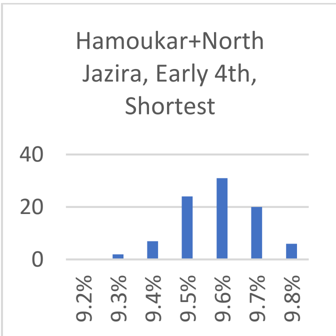
Mean: 5.3
Median: 5.3
Mode: 5.2



Mean: 11.0
Median: 11.0
Mode: 10.9

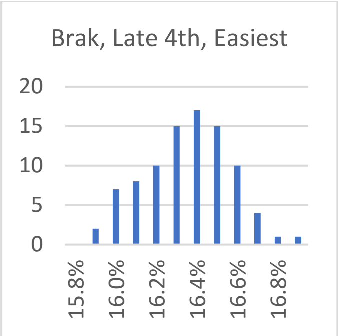


Mean: 4.3
Median: 4.3
Mode: 4.4

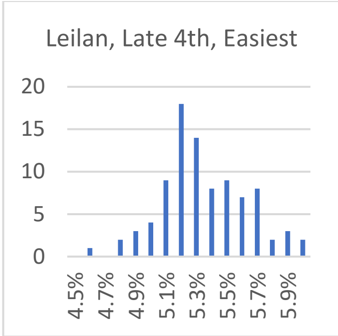


Mean: 9.5
Median: 9.5
Mode: 9.5

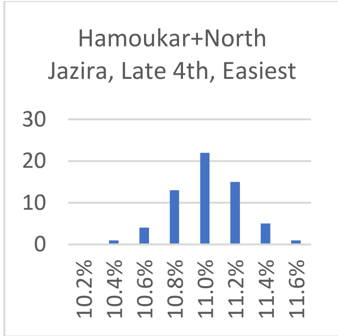
Figure 9.9 Histograms plotting the rate of overlap between the early fourth millennium B.C. random models and the preserved hollow ways.



Mean: 16.3
Median: 16.3
Mode: 16.5

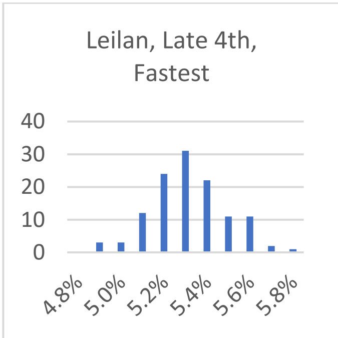


Mean: 5.3
Median: 5.3
Mode: 5.2

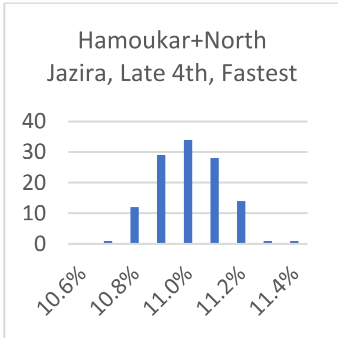


Mean: 10.9
Median: 10.9
Mode: 10.8

N/A

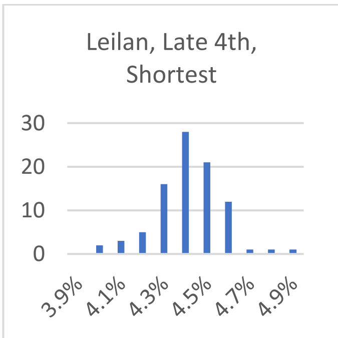


Mean: 5.3
Median: 5.3
Mode: 5.3



Mean: 11.0
Median: 11.0
Mode: 10.8

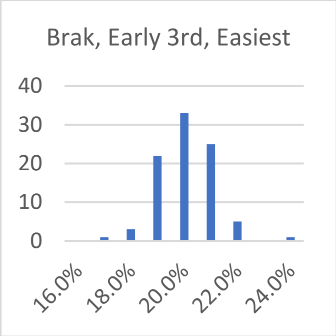
N/A



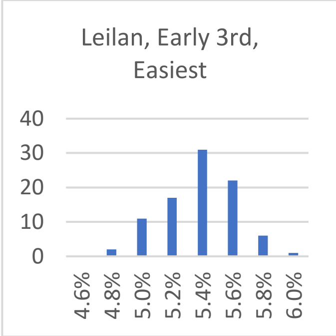
Mean: 4.4
Median: 4.4
Mode: 4.3

N/A

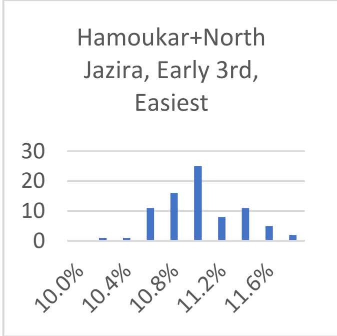
Figure 9.10 Histograms plotting the rate of overlap between the late fourth millennium B.C. random models and the preserved hollow ways. N/A denotes charts that could not be produced due to the failure of the random point generator to create the correct random models.



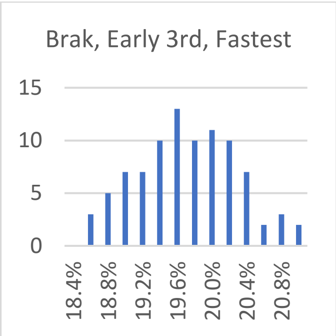
Mean: 19.6
Median: 19.6
Mode: 20.2



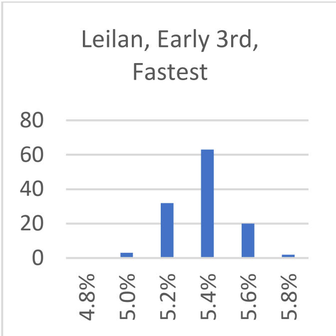
Mean: 5.3
Median: 5.3
Mode: 5.2



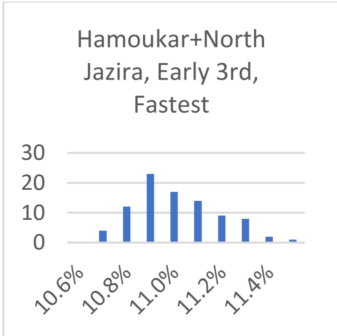
Mean: 10.9
Median: 10.9
Mode: 10.7



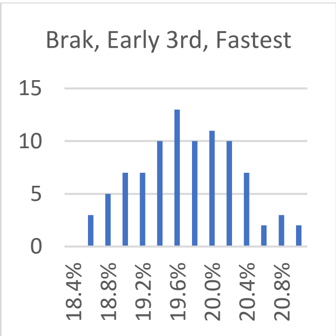
Mean: 19.6
Median: 19.6
Mode: 19.7



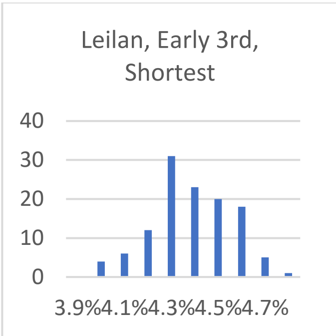
Mean: 5.3
Median: 5.3
Mode: 5.3



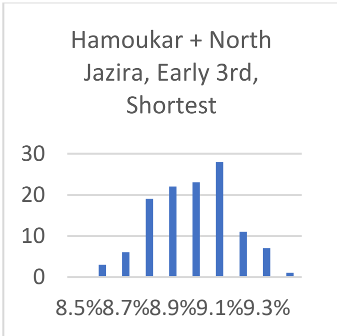
Mean: 11.0
Median: 11.0
Mode: 10.7



Mean: 16.4
Median: 16.4
Mode: 16.3



Mean: 4.3
Median: 4.3
Mode: 4.5



Mean: 8.9
Median: 8.9
Mode: 9.1

Figure 9.11 Histograms plotting the rate of overlap between the early third millennium B.C. random models and the preserved hollow ways.

	Tell Brak areas	Tell Leilan Regional	Hamoukar + NJS
Early 4th millennium B.C.			
Easiest	*No Data*	**5.3%** Significant – Less	10.6% Not Significant
Fastest	*No Data*	5.1% Not Significant	**10.4%** Significant – Less
Shortest	*No Data*	4.2% Not Significant	**11.2%** Significant – More
Late 4th millennium B.C.			
Easiest	**17.4%** Significant – More	5.0% Not Significant	11.1% Not significant
Fastest	*Unable to run statistics*	**5.8%** Significant – More	**10.7%** Significant – Less
Shortest	*Unable to run statistics*	**3.5%** Significant – Less	*Unable to run statistics*
Early 3rd millennium B.C.			
Easiest	**21.9%** Significant – More	**3.5%** Significant – Less	**8.9%** Significant – Less
Fastest	18.4% Not Significant	**4.4%** Significant – Less	**8.8%** Significant – Less
Shortest	**12.2%** Significant – Less	**3.5%** Significant – Less	**7.7%** Significant – Less

Table 9.1 The results of quantitative route analysis for the three case study areas and three time periods. The percent of preserved hollow ways which the model overlapped with is presented followed by whether that value is statistically significant or not. When values are significant, it is noted whether the value is significant because it matched *more* than or *less* than would be expected if the model were random.

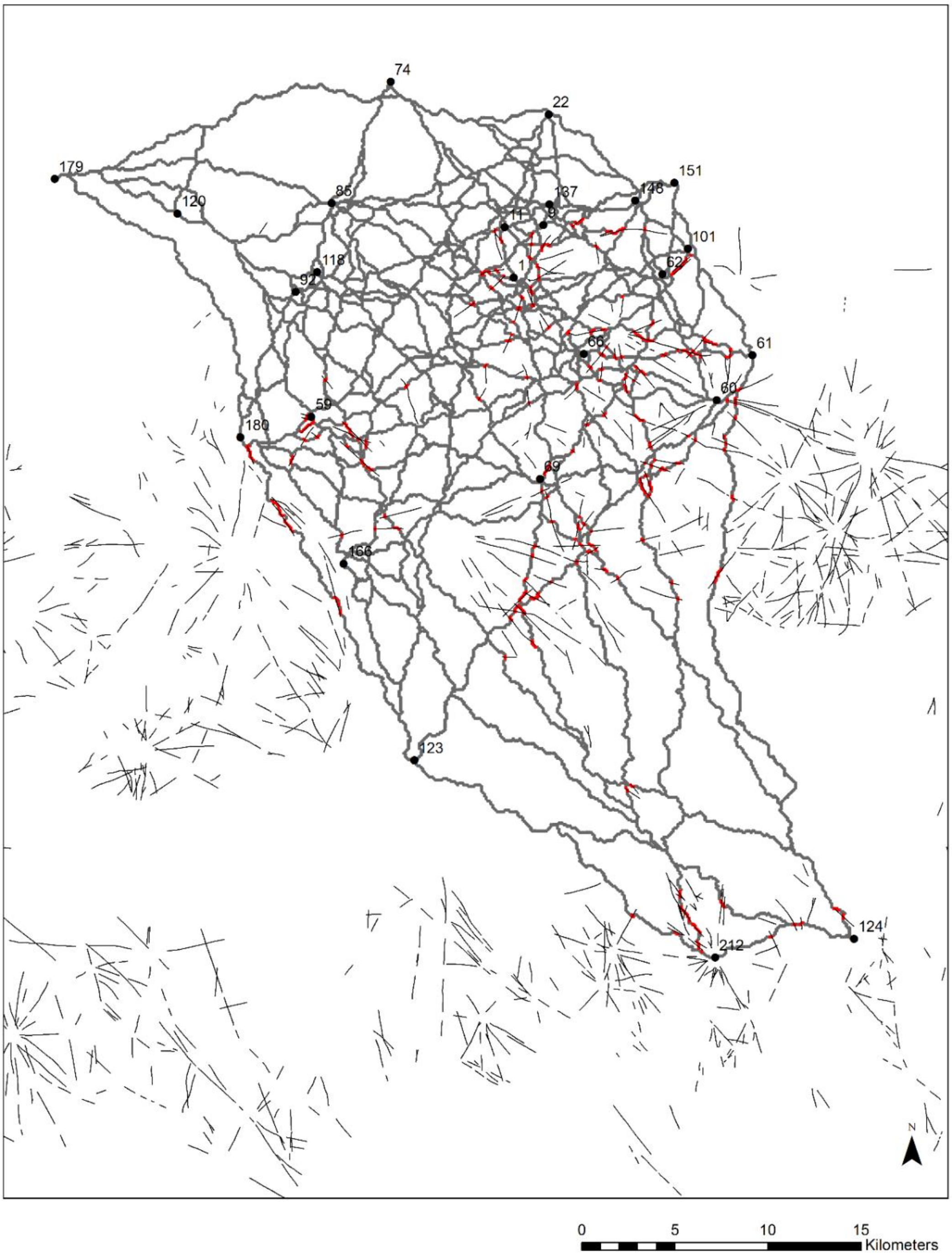


Figure 9.12 The easiest route model for the early fourth millennium B.C. in the Tell Leilan Regional Survey area. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. This model is statistically significant, overlapping the preserved hollow ways *less* than would be expected by random chance.

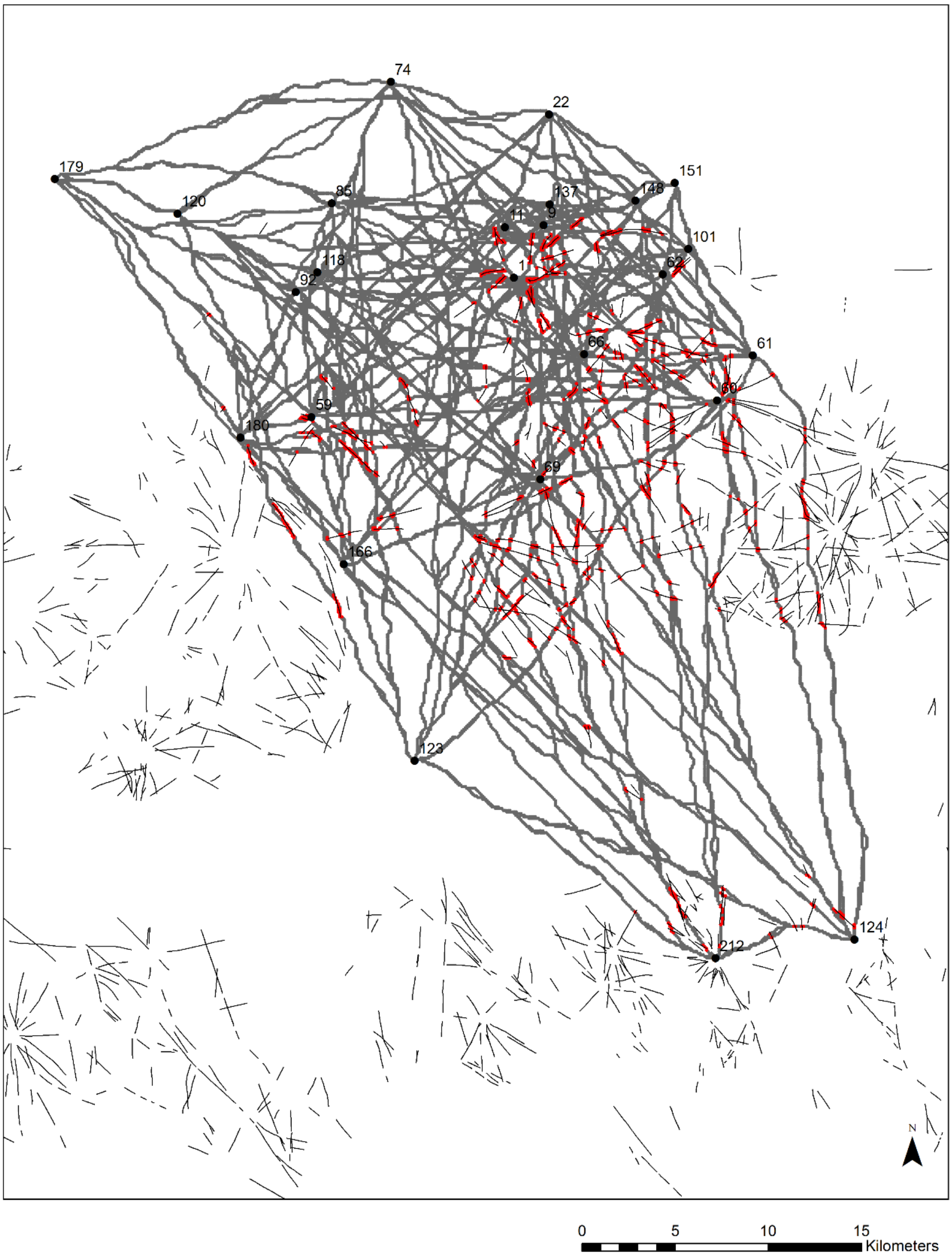


Figure 9.13 The fastest route model for the early fourth millennium B.C. in the Tell Leilan Regional Survey area. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. This model is not statistically significant.

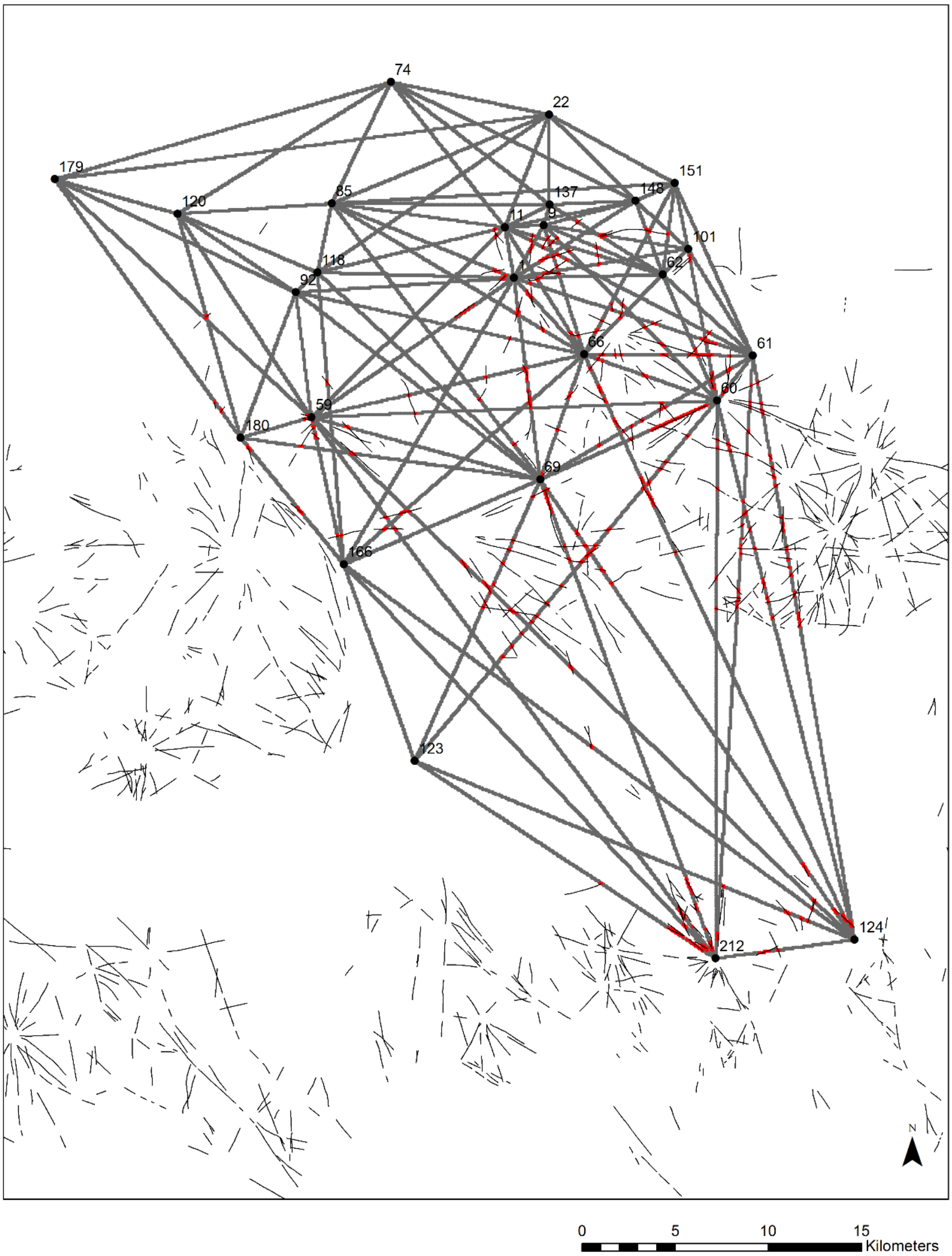


Figure 9.14 The shortest route model for the early fourth millennium B.C. in the Tell Leilan Regional Survey area. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. This model is not statistically significant.

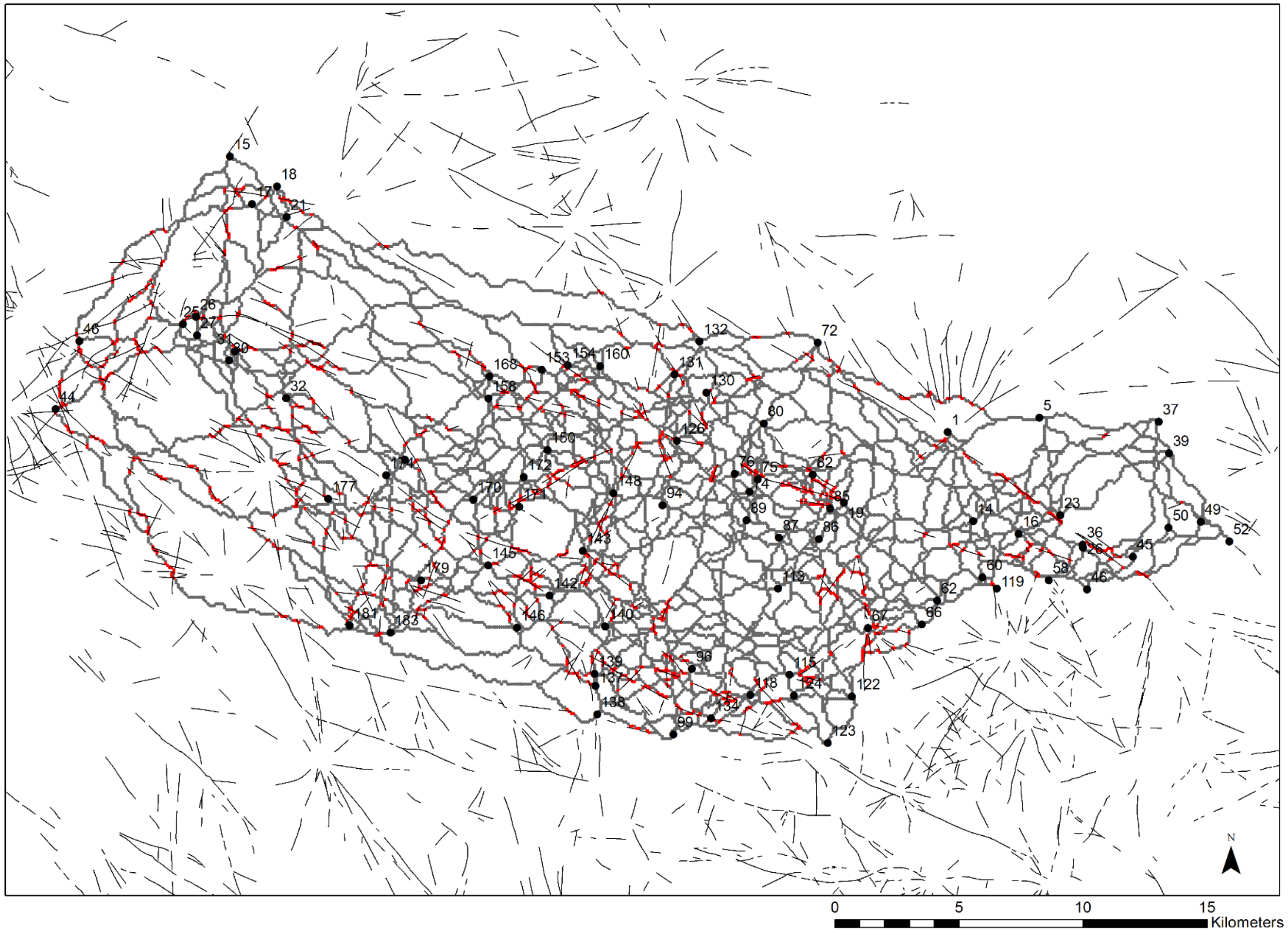


Figure 9.15 The easiest route model for the early fourth millennium B.C. in the Hamoukar and North Jazira Survey areas. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. This model is not statistically significant.

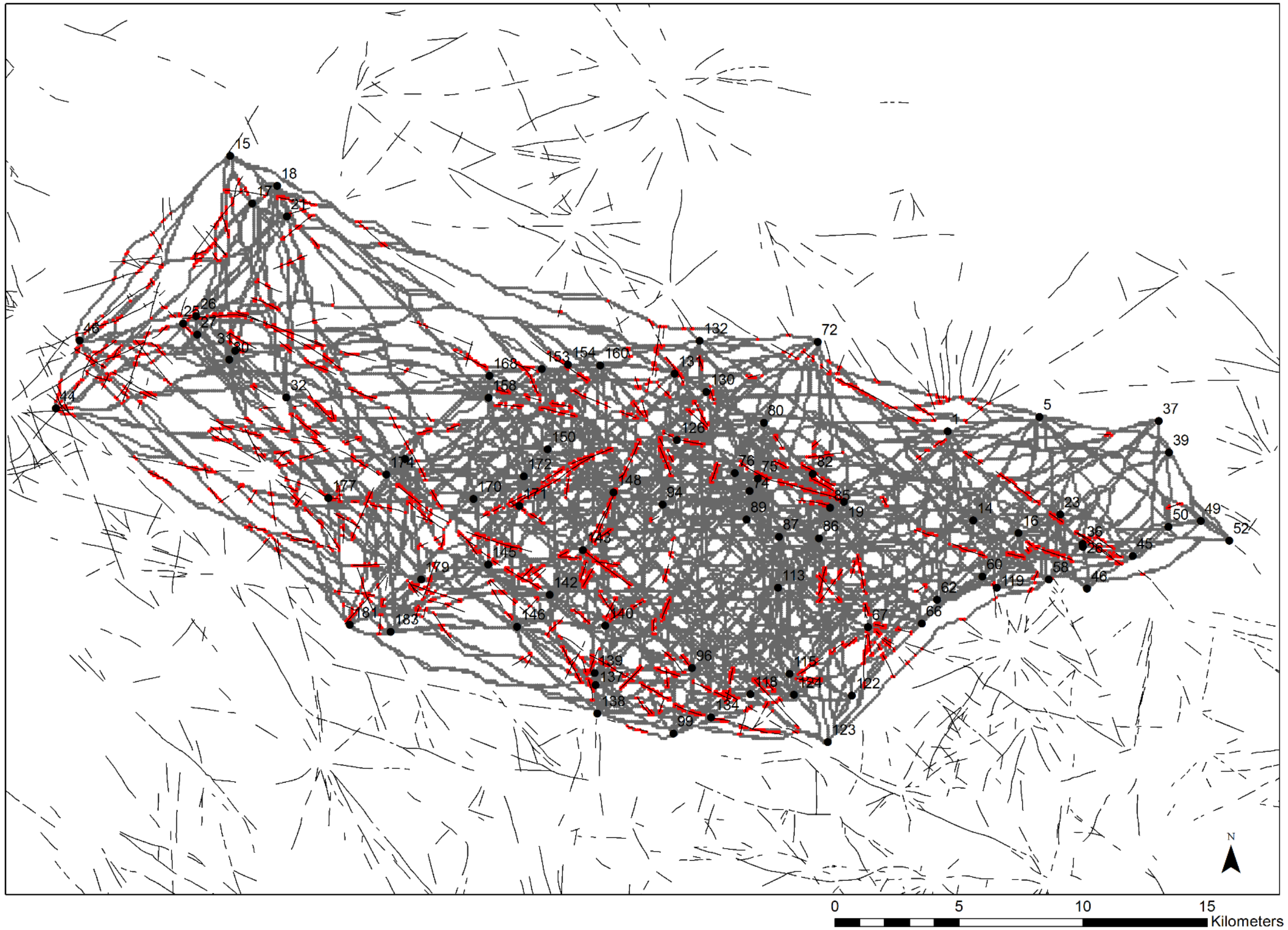


Figure 9.16 The fastest route model for the early fourth millennium B.C. in the Hamoukar and North Jazira Survey areas. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. This model is statistically significant, because it overlaps the preserved hollow ways *less* than would be expected by random chance.

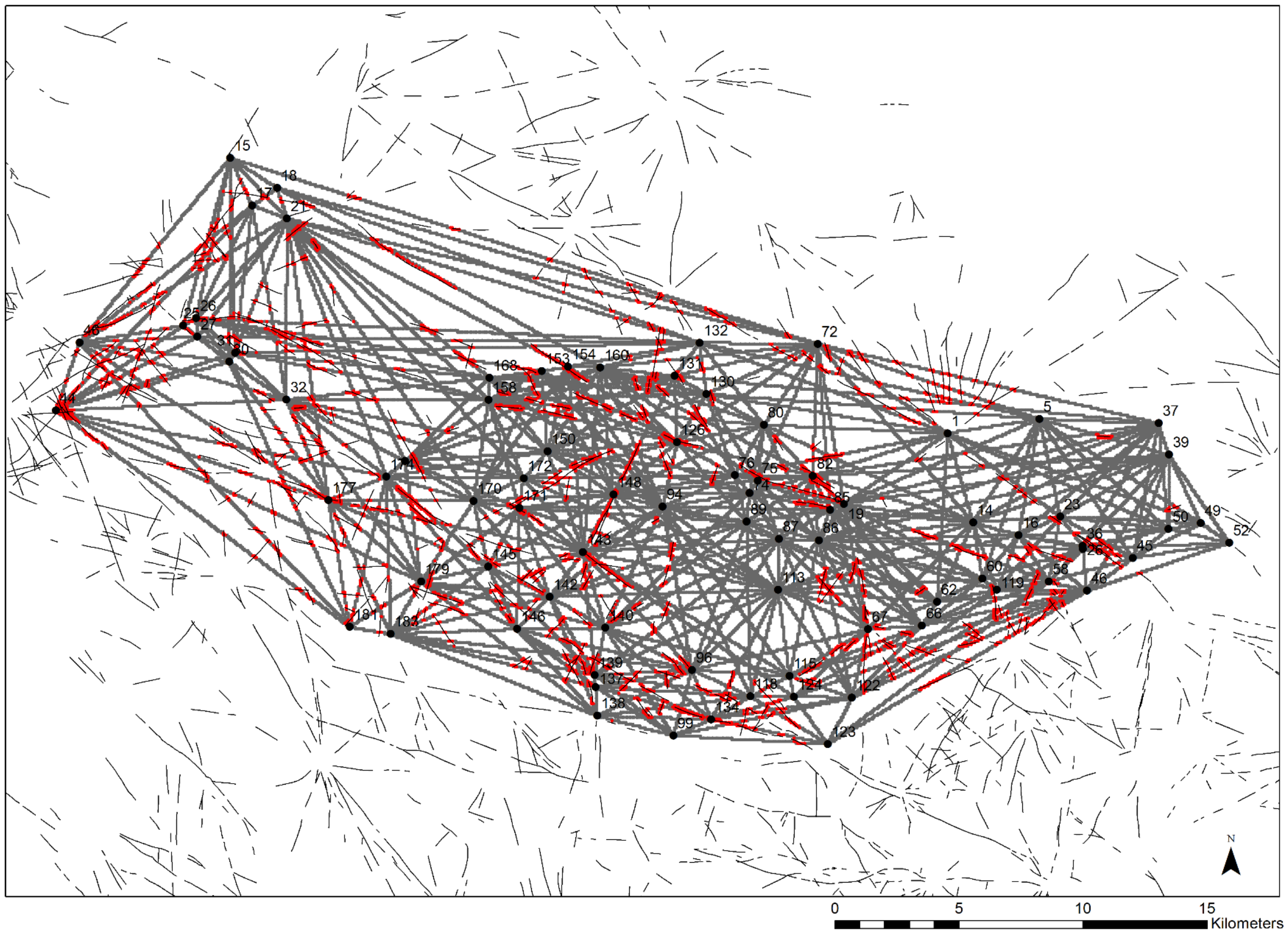


Figure 9.17 The shortest route model for the early fourth millennium B.C. in the Hamoukar and North Jazira Survey areas. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. This model is statistically significant, overlapping the preserved hollow ways *more* than w ould be expected by random chance.

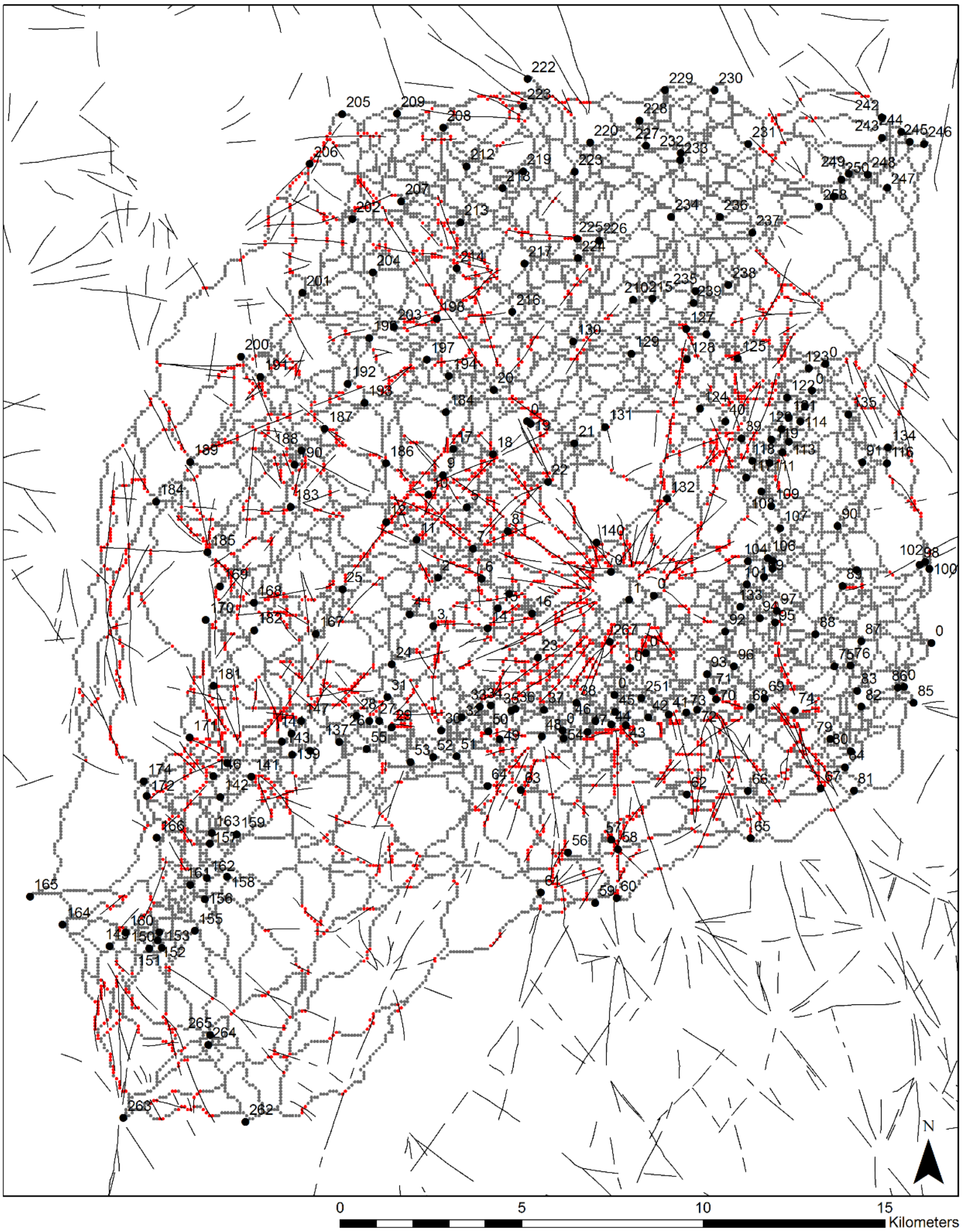


Figure 9.18 The easiest route model for the late fourth millennium B.C. in the Tell Brak survey areas. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. This model is statistically significant, because it overlaps the preserved hollow ways *more* than would be expected by random chance.

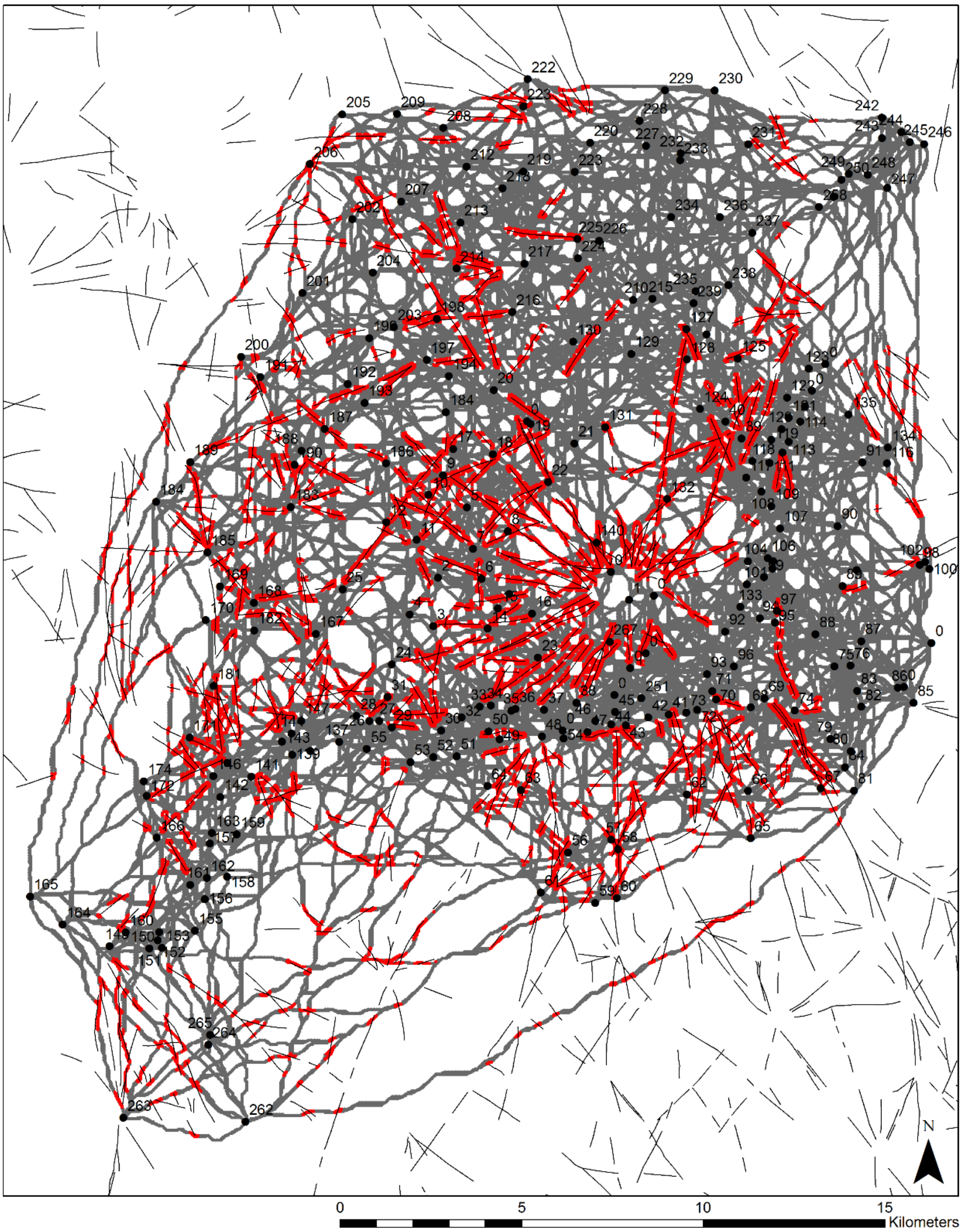


Figure 9.19 The fastest route model for the late fourth millennium B.C. in the Tell Brak survey areas. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. It was not possible to determine the statistical significance of this model. The density of routes created by this model, creates patches in many areas of the map instead of distinct, linear routes.

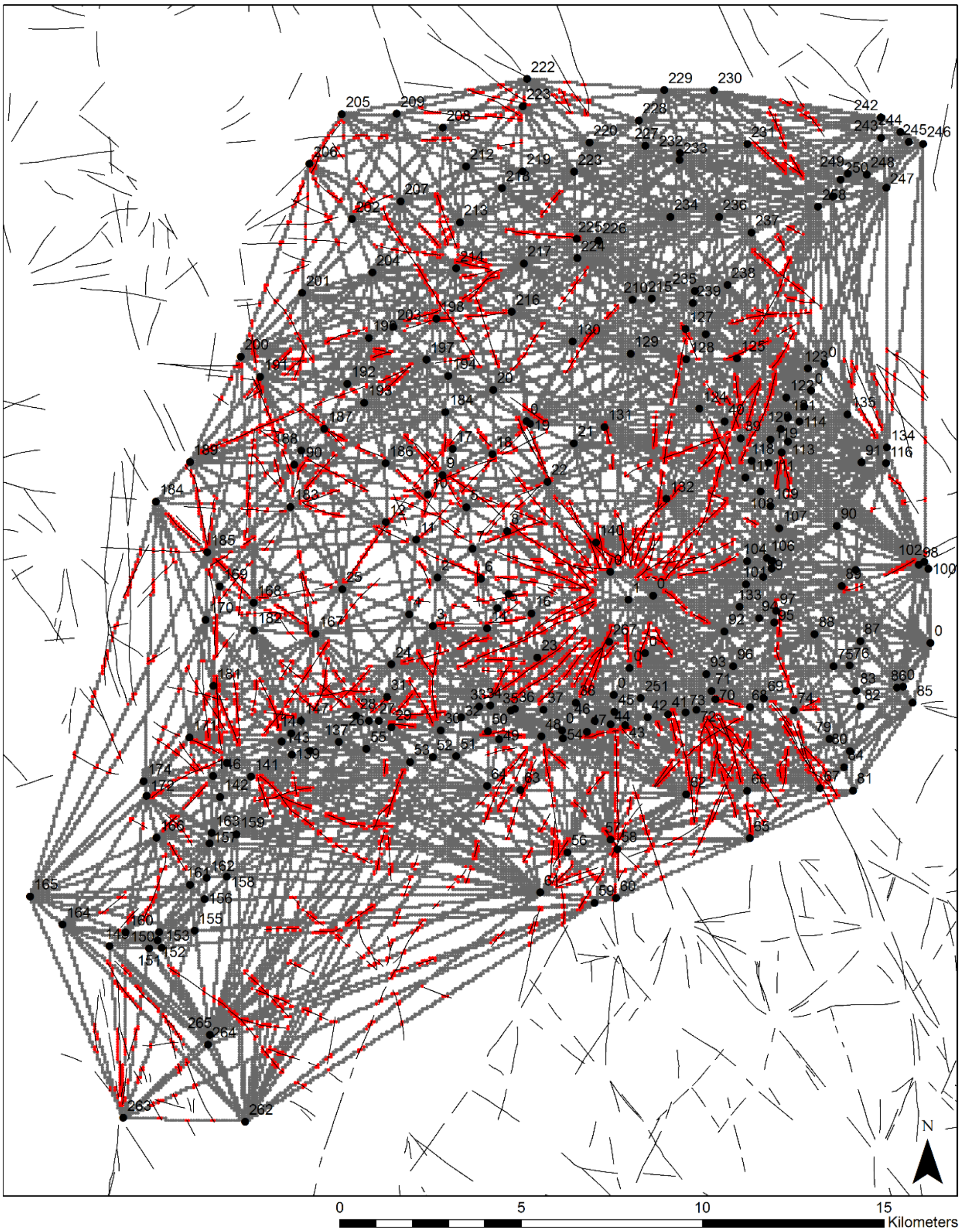


Figure 9.20 The shortest route model for the late fourth millennium B.C. in the Tell Brak survey areas. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. It was not possible to determine the statistical significance of this model.

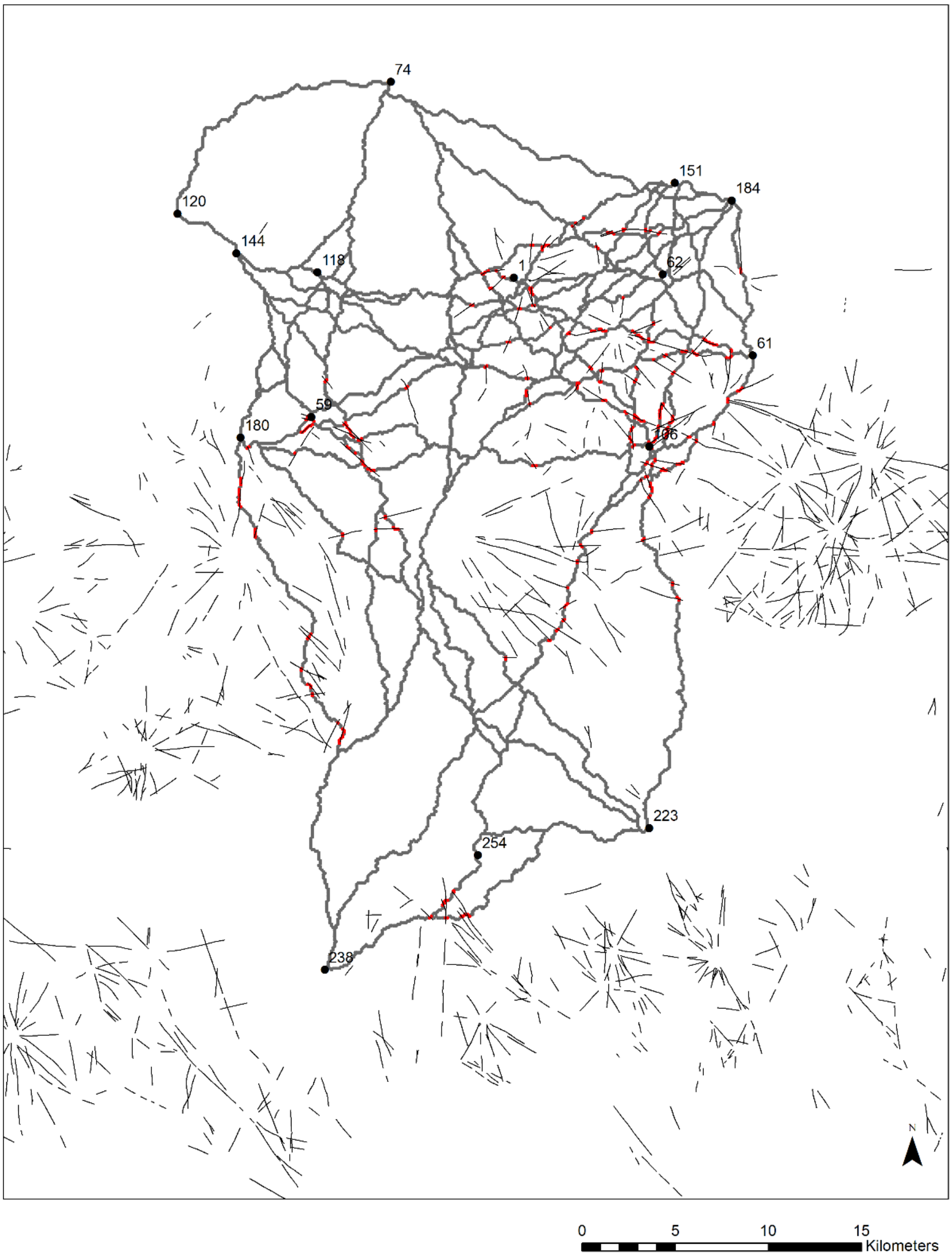


Figure 9.21 The easiest route model for the late fourth millennium B.C. in the Leilan Regional Survey area. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. This model is not statistically significant.

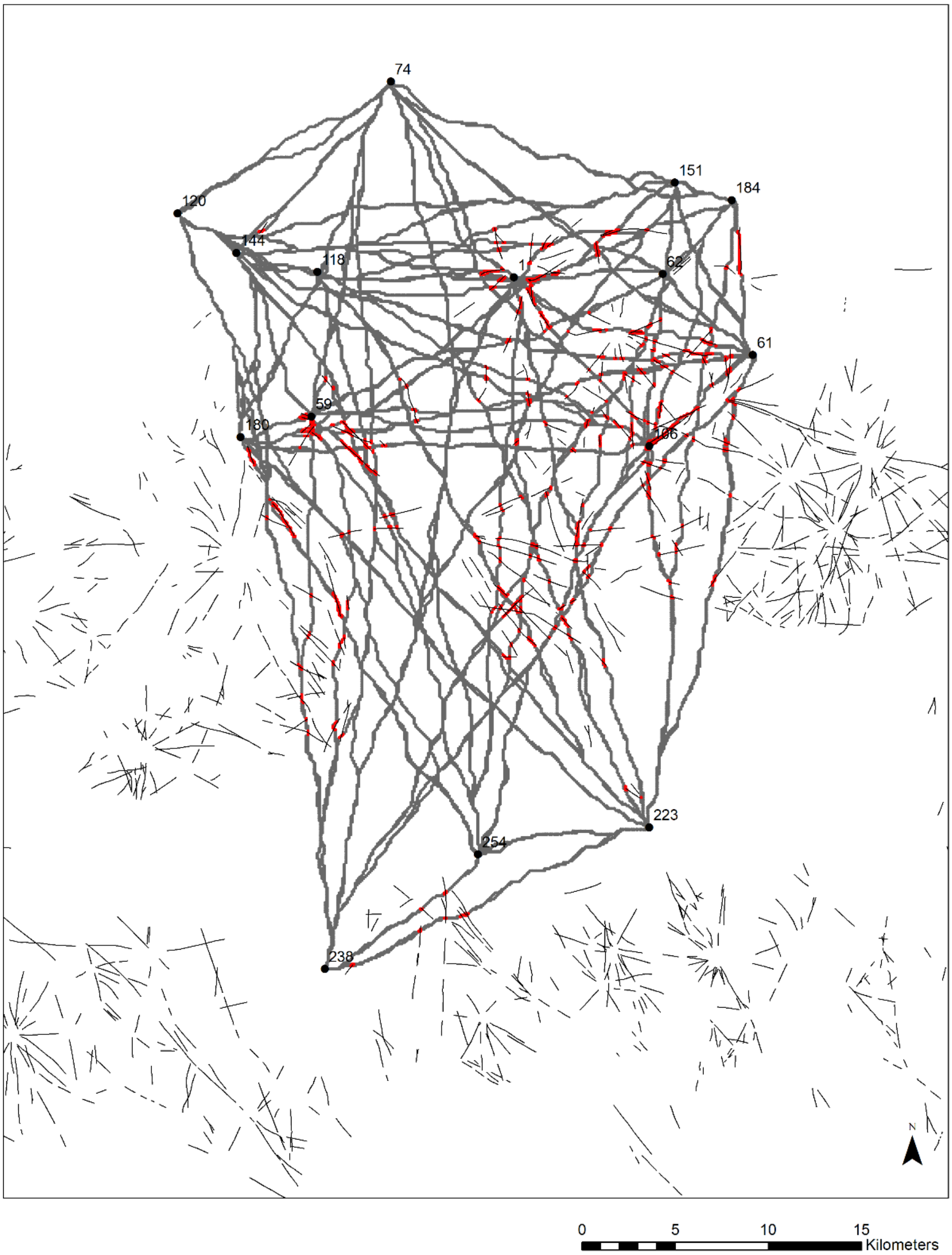


Figure 9.22 The fastest route model for the late fourth millennium B.C. in the Tell Brak survey areas. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. This model is statistically significant, overlapping the preserved hollow ways *more* than would be expected by random chance.

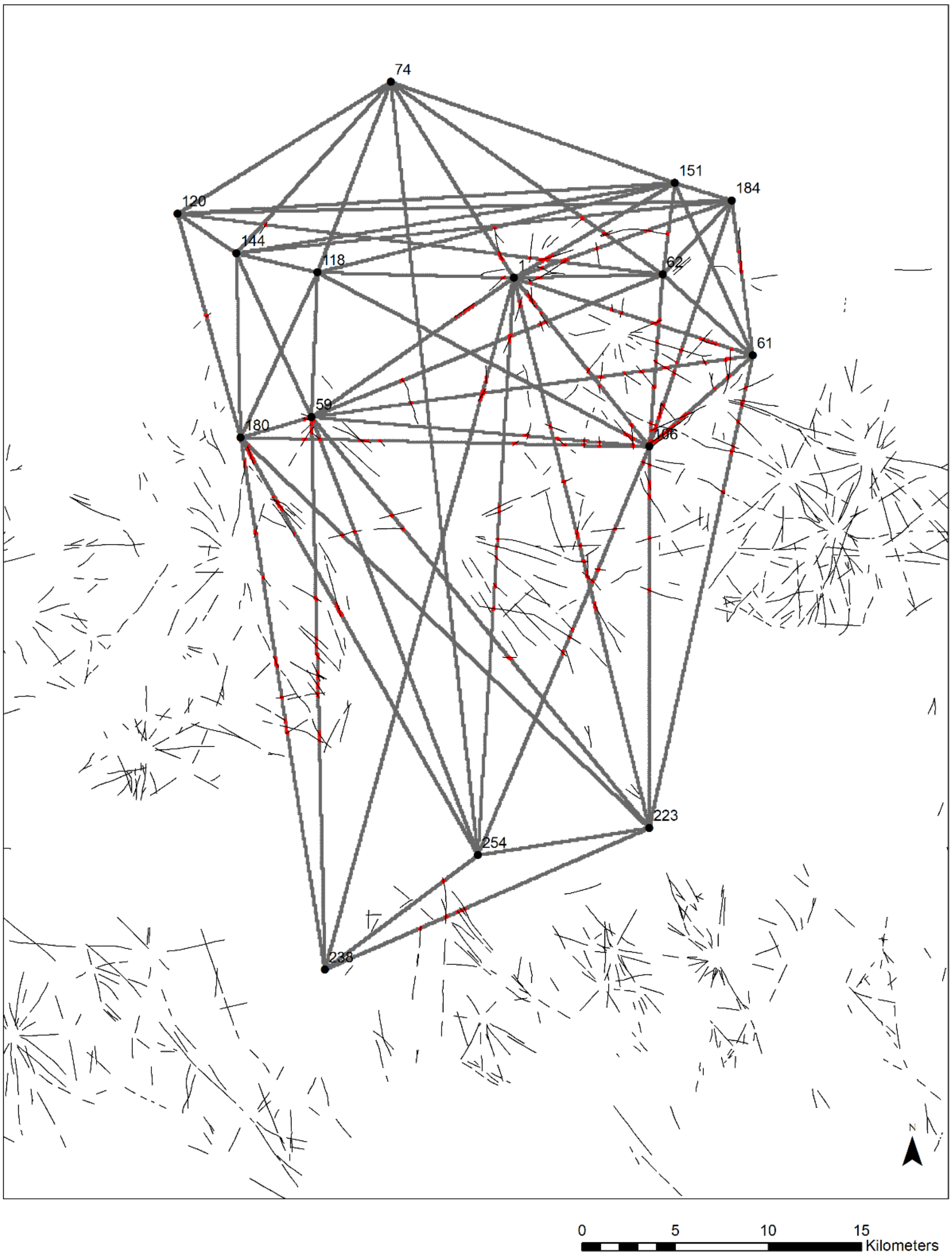


Figure 9.23 The shortest route model for the late fourth millennium B.C. in the Leilan Regional Survey area. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. This model is statistically significant, because it overlaps the preserved hollow ways *less* than would be expected by random chance.

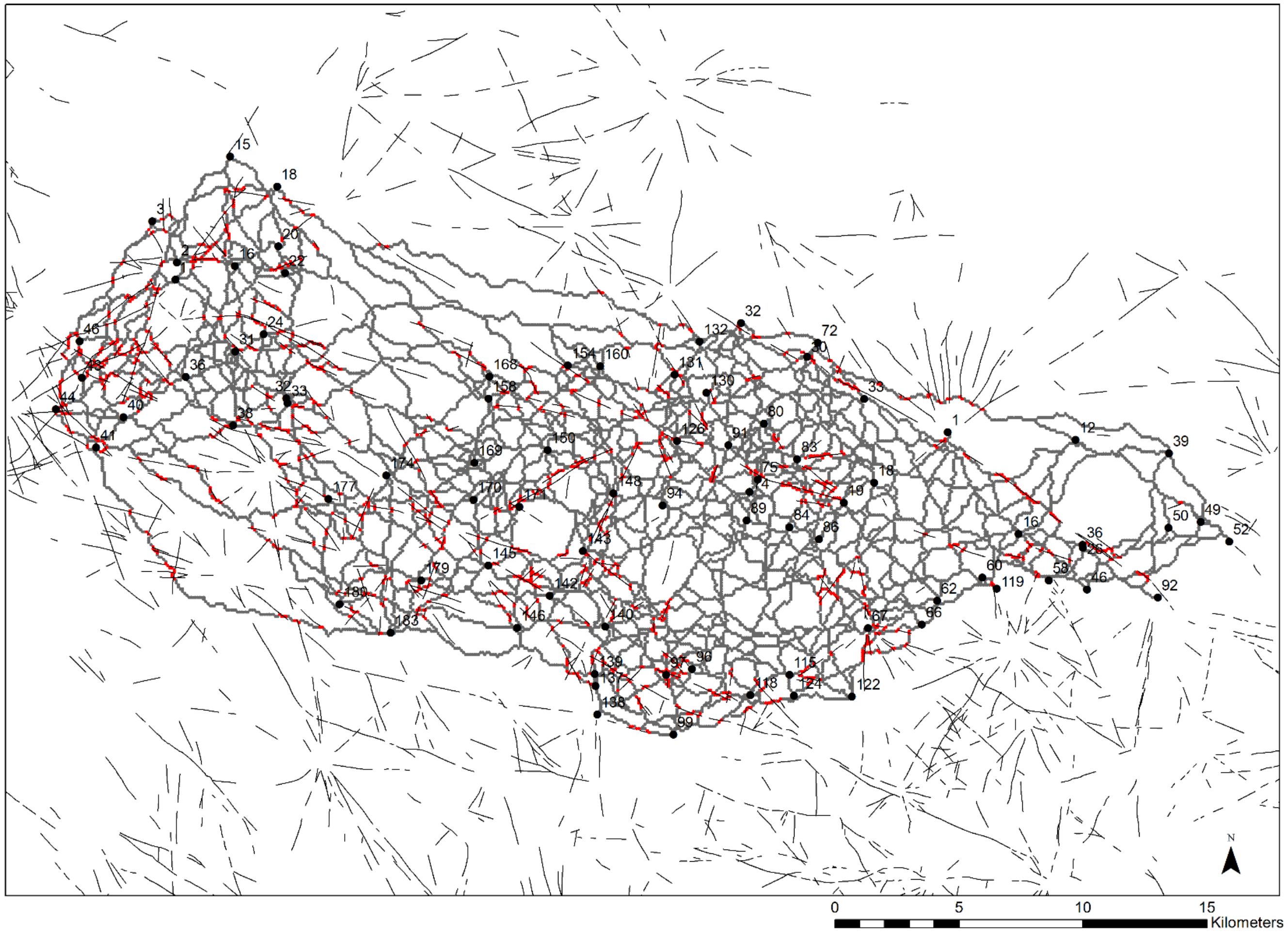


Figure 9.24 The easiest route model for the late fourth millennium B.C. in the Hamoukar and North Jazira survey areas. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. This model is not statistically significant.

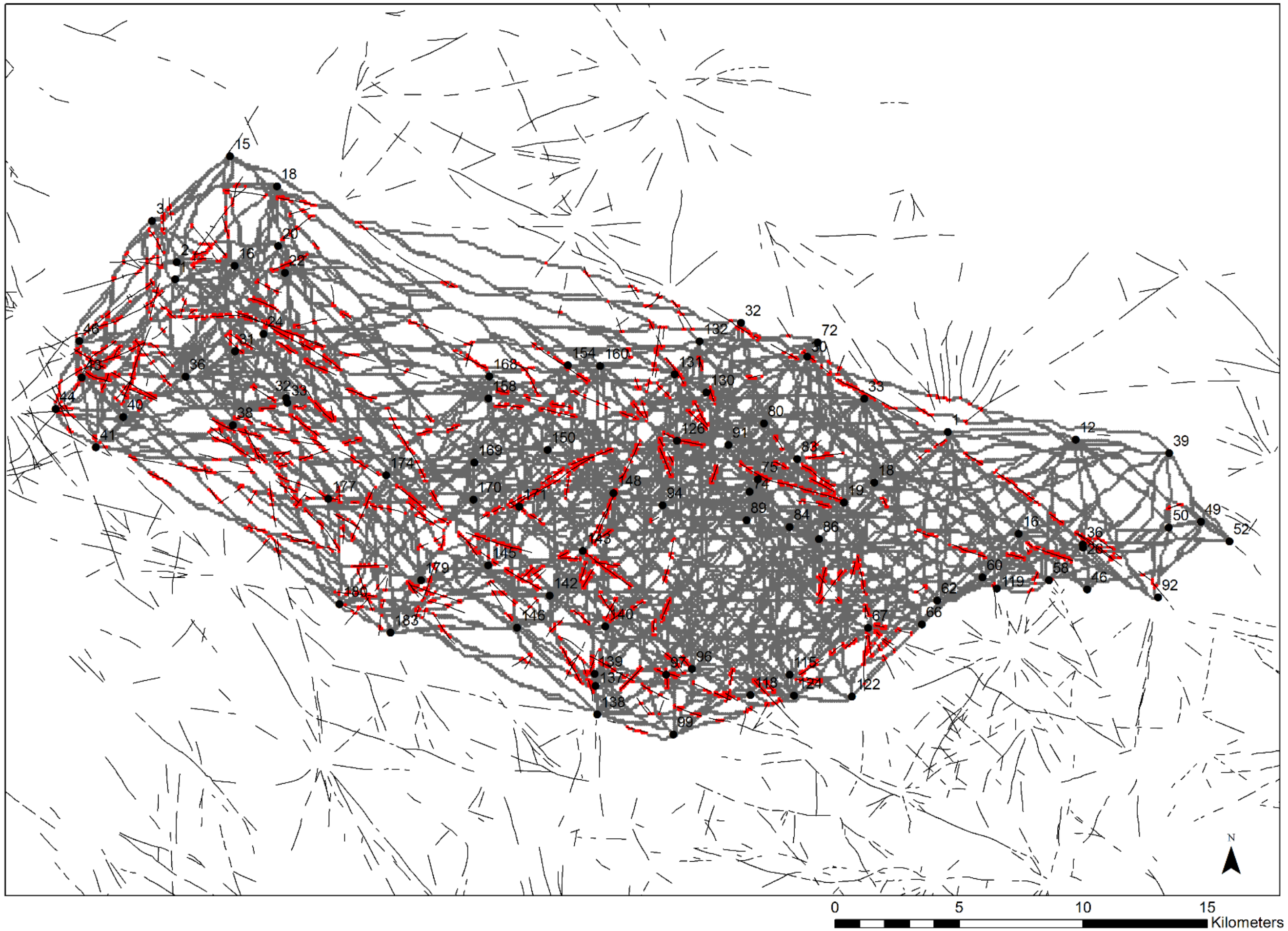


Figure 9.25 The fastest route model for the late fourth millennium B.C. in the Hamoukar and North Jazira survey areas. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. This model is statistically significant, because it overlaps the preserved hollow ways *less* than by random chance.

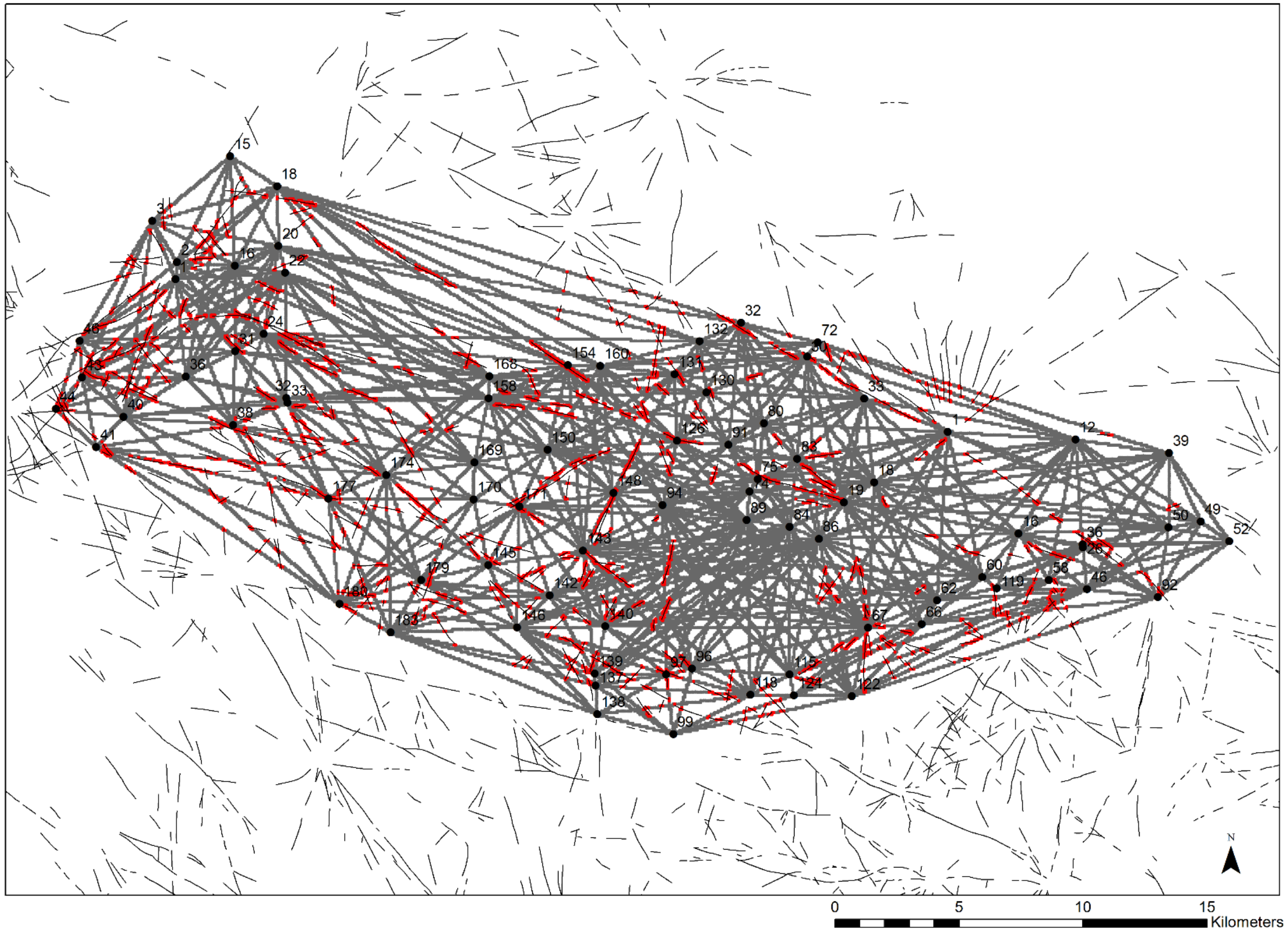


Figure 9.26 The shortest route model for the late fourth millennium B.C. in the Hamoukar and North Jazira survey areas. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. It was not possible to determine the statistical significance of this model.

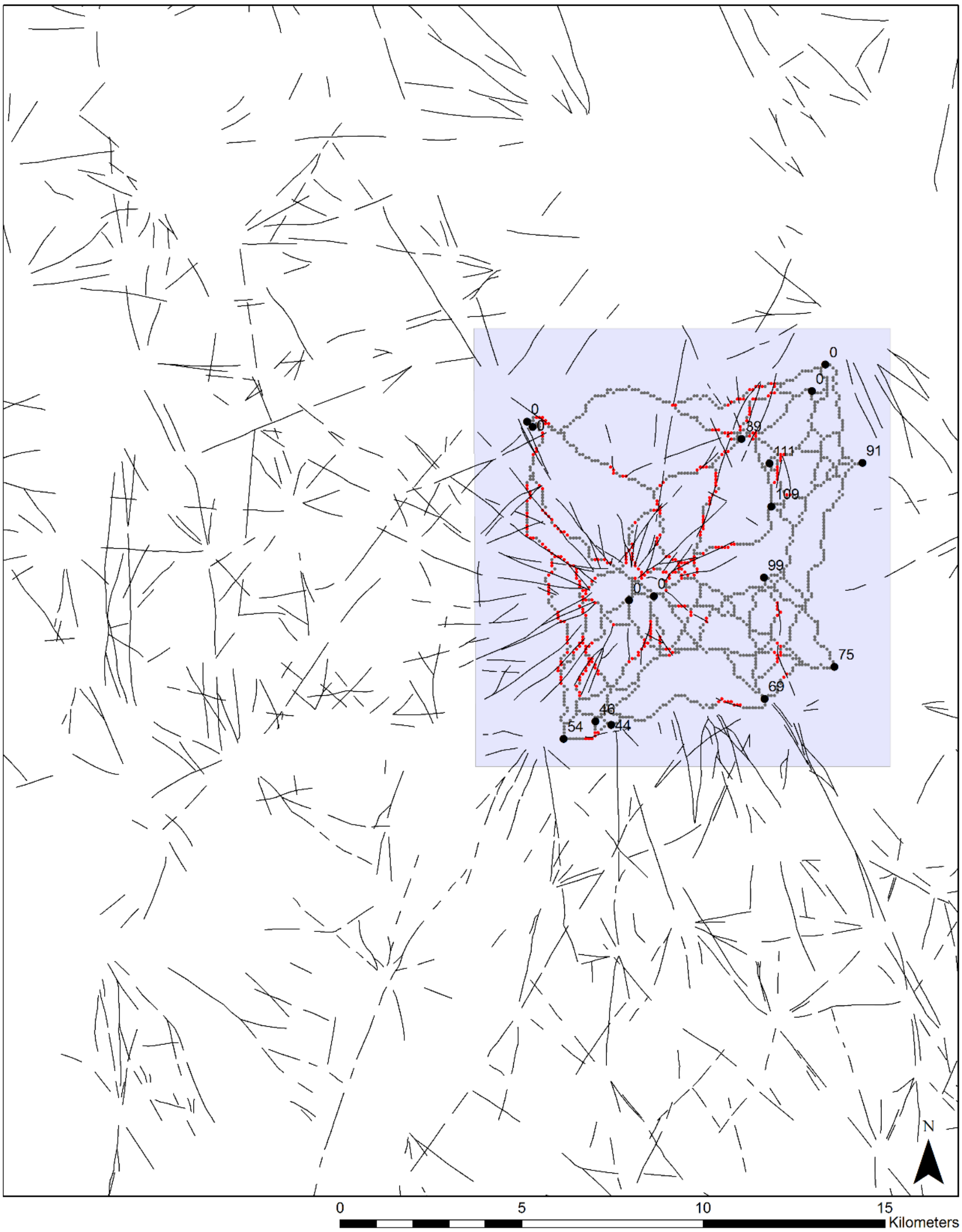


Figure 9.27 The easiest route model for the early third millennium B.C. in the Tell Brak survey area. The grey box shows the approximate survey area of the survey with published early third millennium B.C. results. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. The model is statistically significant, overlapping the preserved hollow ways *more* than would be expected by random chance.

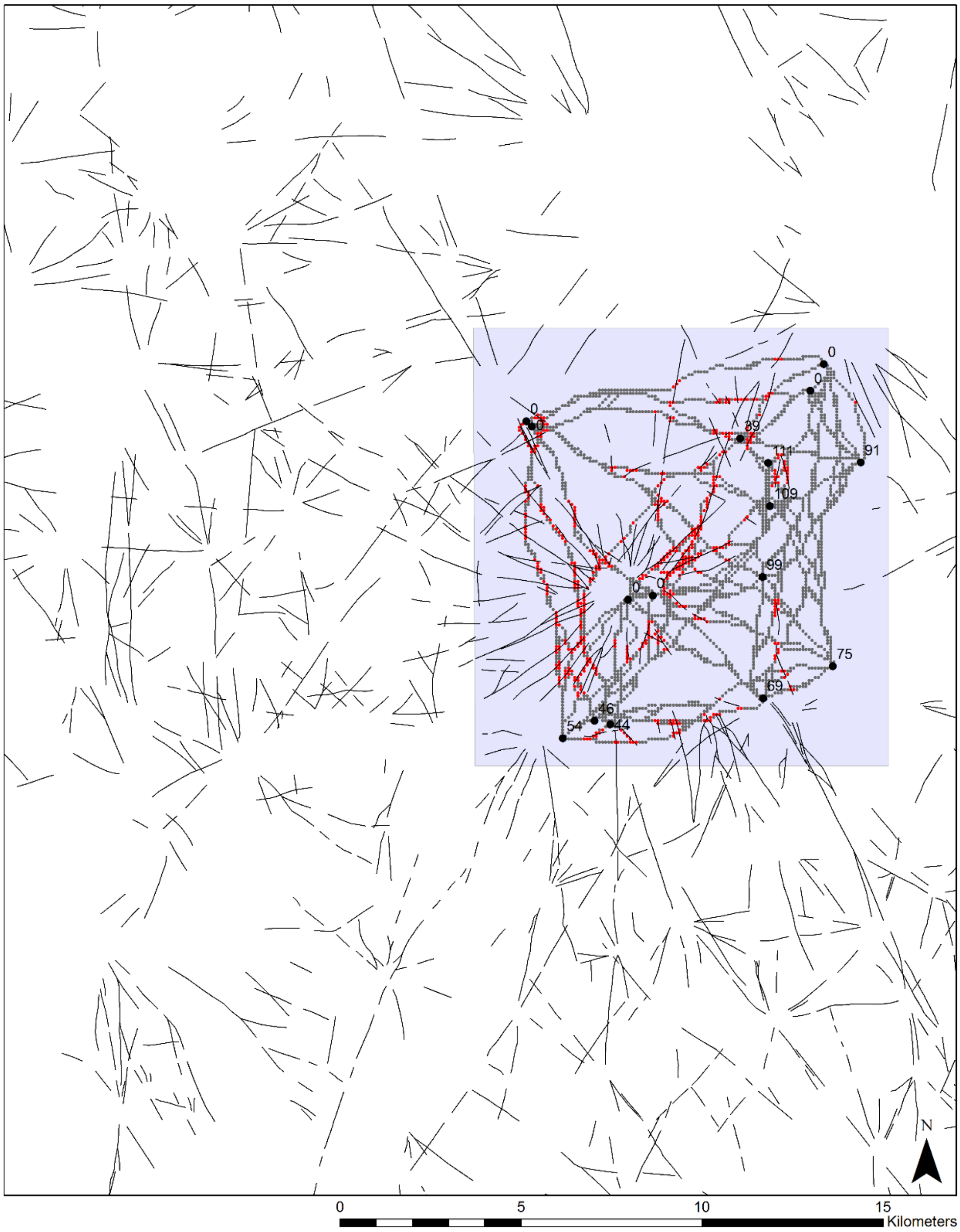


Figure 9.28 The fastest route model for the early third millennium B.C. in the Tell Brak survey area. The grey box shows the approximate survey area of the survey with published early third millennium B.C. results. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. The model is not statistically significant.

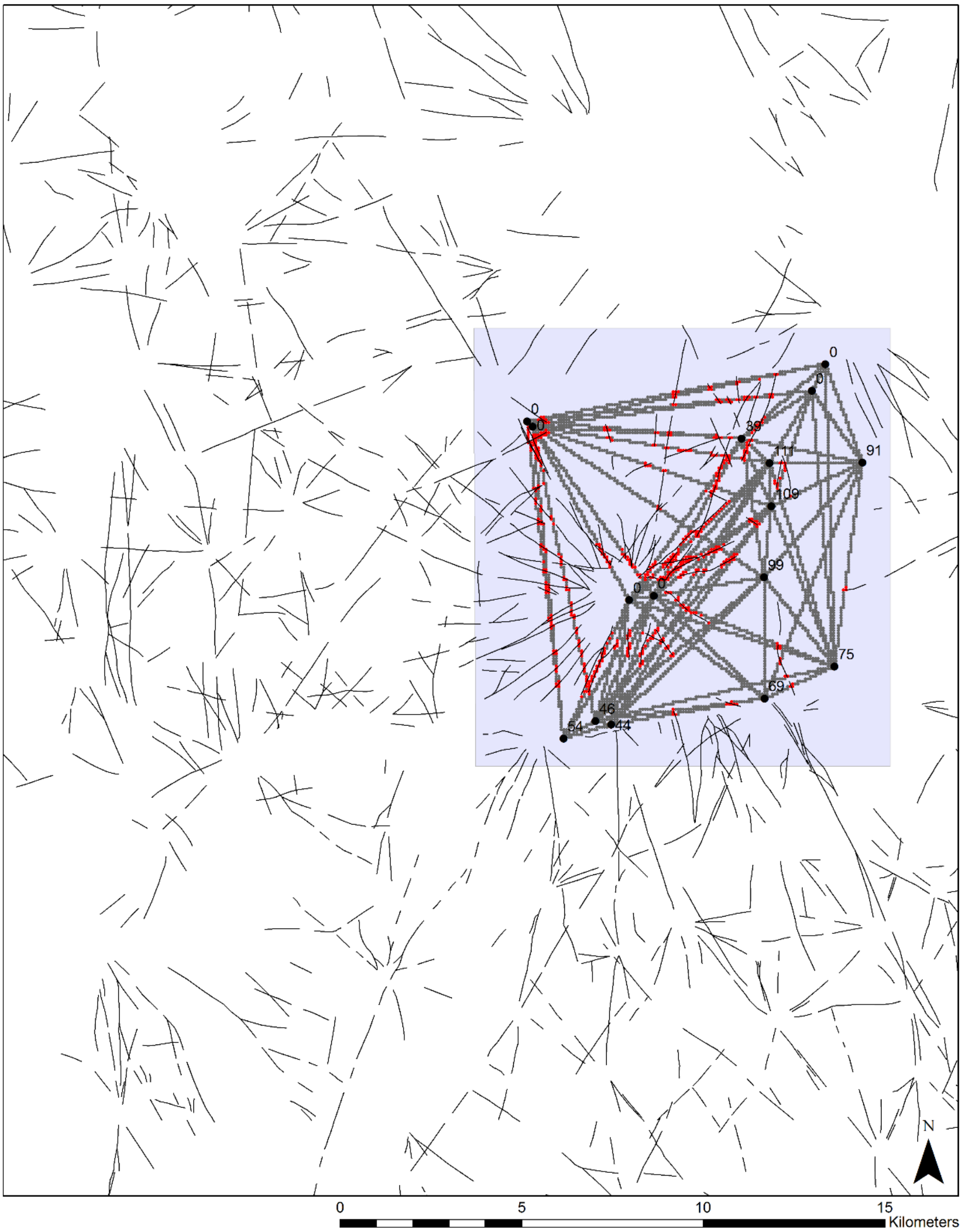


Figure 9.29 The shortest route model for the early third millennium B.C. in the Tell Brak survey area. The grey box shows the approximate survey area of the survey with published early third millennium B.C. results. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. The model is statistically significant, because it overlaps the preserved hollow ways *less* than would be expected by random chance.

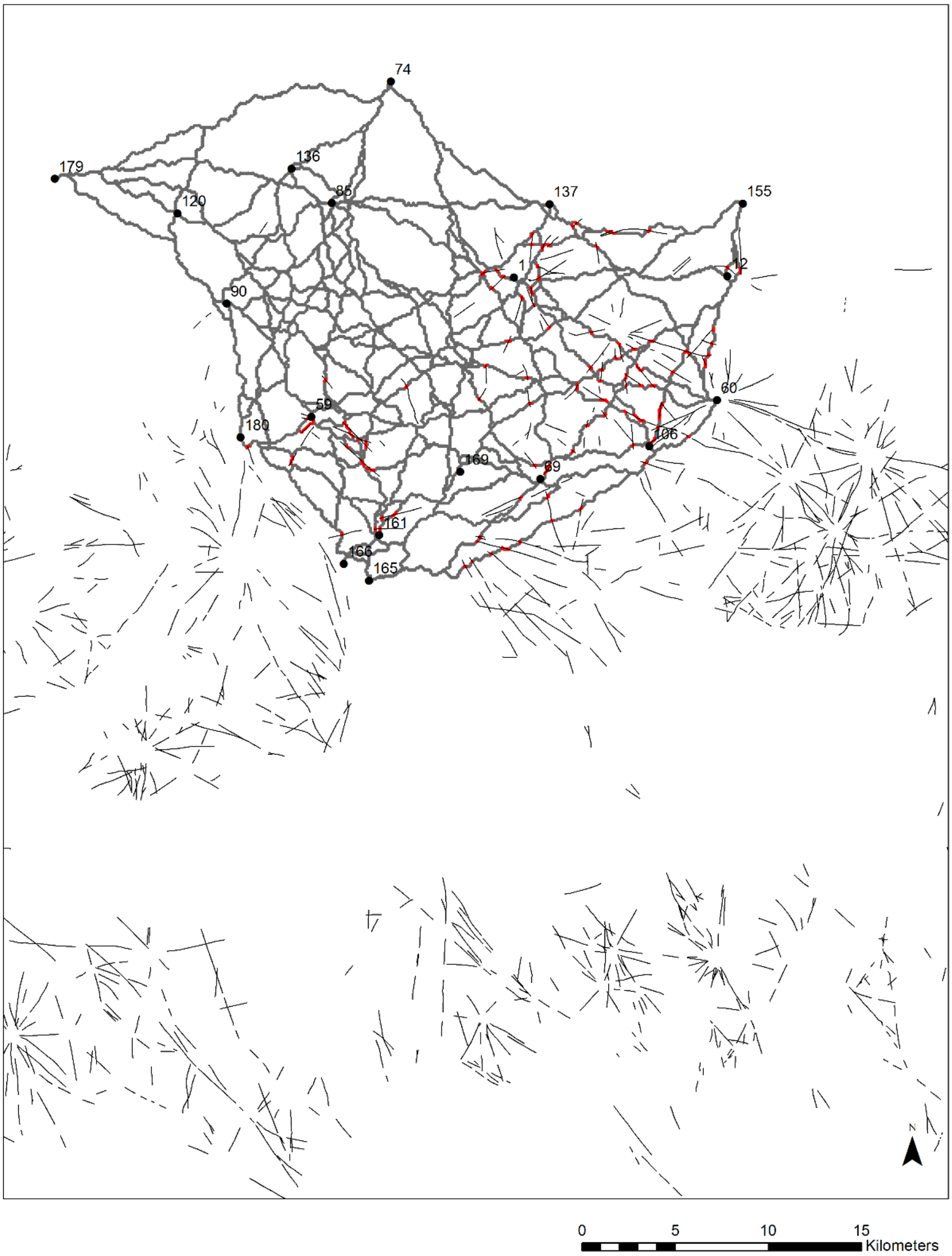


Figure 9.30 The easiest route model for the early third millennium B.C. in the Leilan Regional Survey area. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. The model is statistically significant, overlapping the preserved hollow ways *less* than would be expected by random chance.

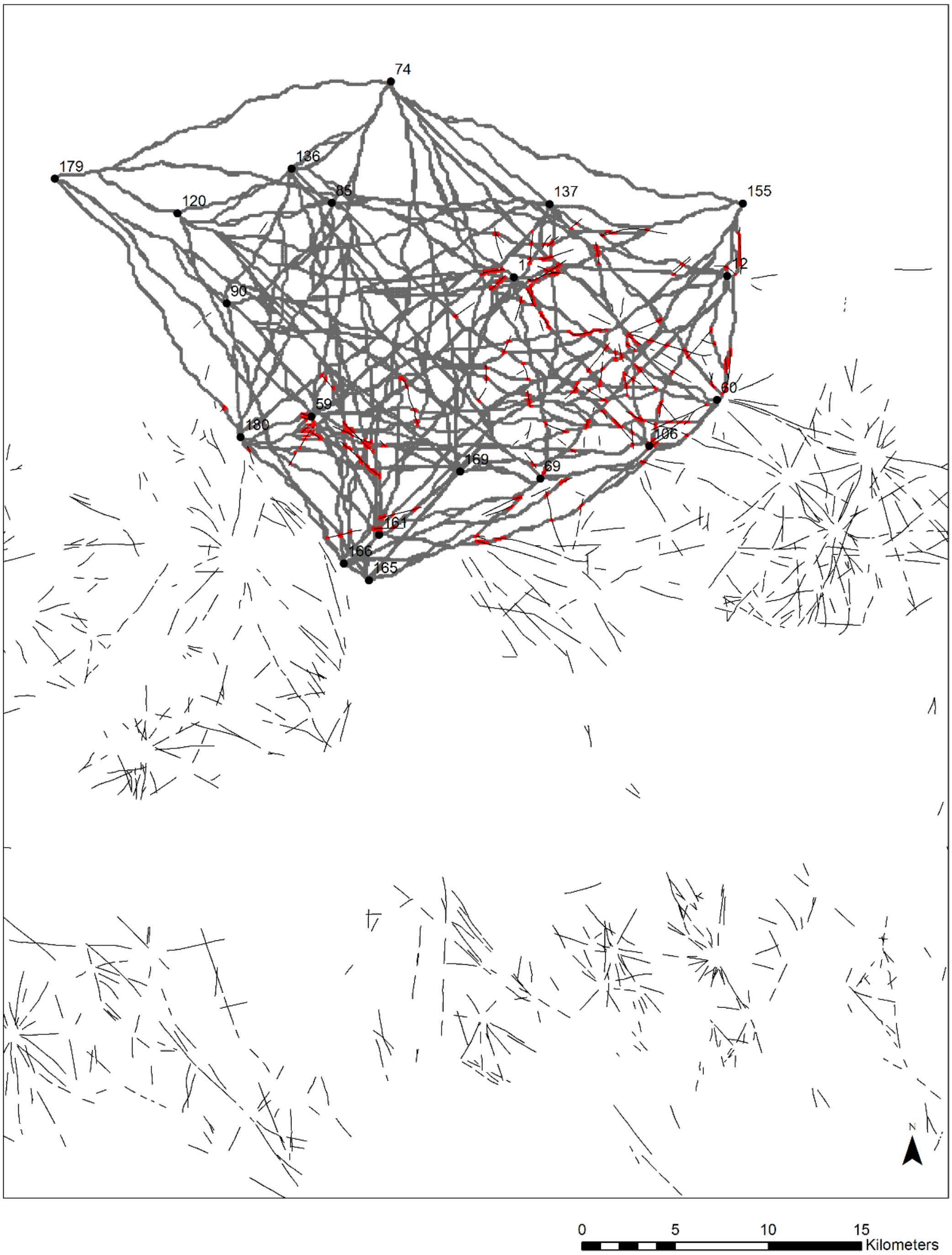


Figure 9.31 The fastest route model for the early third millennium B.C. in the Leilan Regional Survey area. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. The model is statistically significant, because it overlaps the preserved hollow ways *less* than would be expected by random chance.

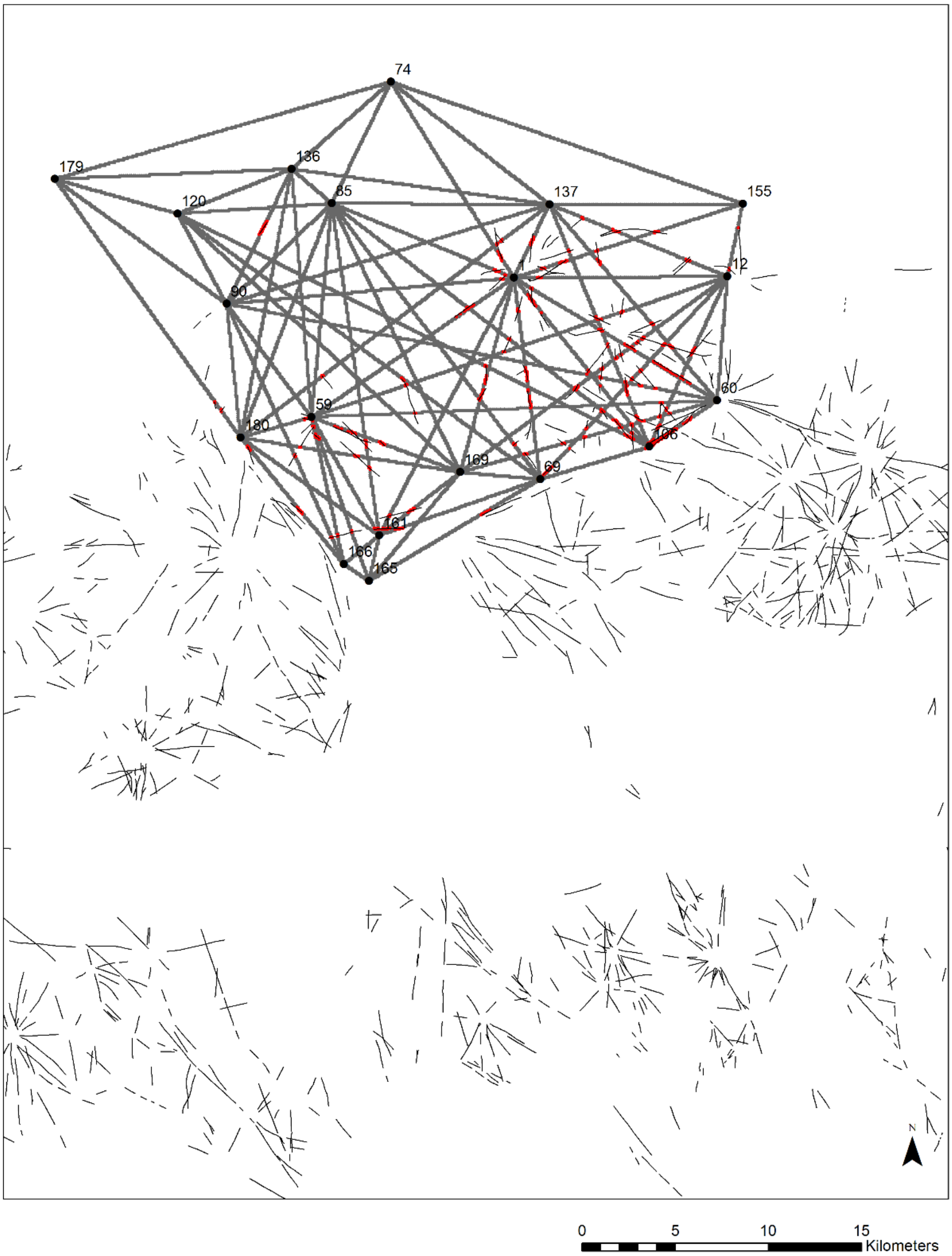


Figure 9.32 The shortest route model for the early third millennium B.C. in the Leilan Regional Survey area. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. The model is statistically significant, overlapping the preserved hollow ways *less* than would be expected by random chance.

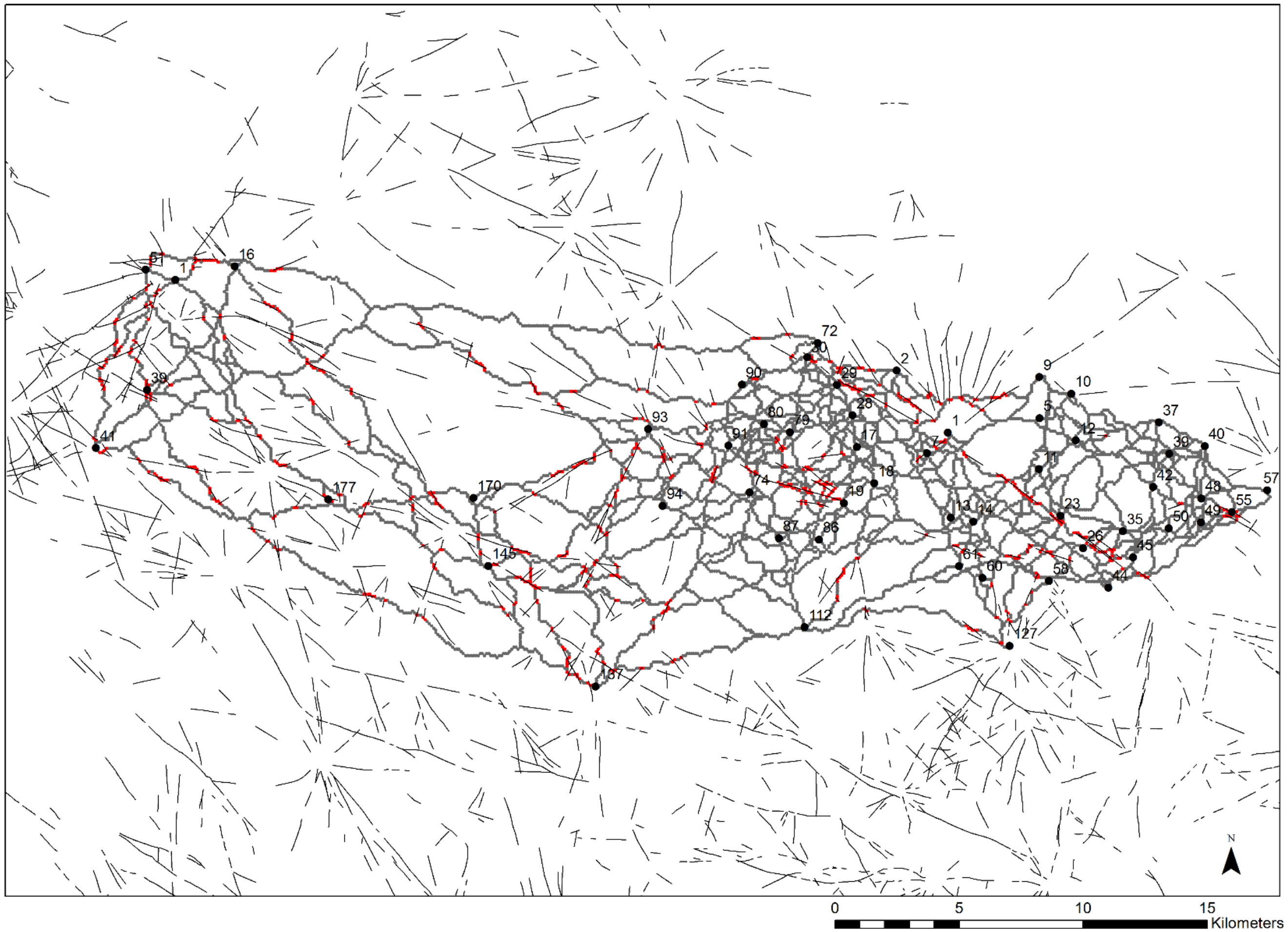


Figure 9.33 The easiest route model for the early third millennium B.C. in the Hamoukar and North Jazira survey areas. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. The model is statistically significant, overlapping the preserved hollow ways *less* than would be expected by random chance.

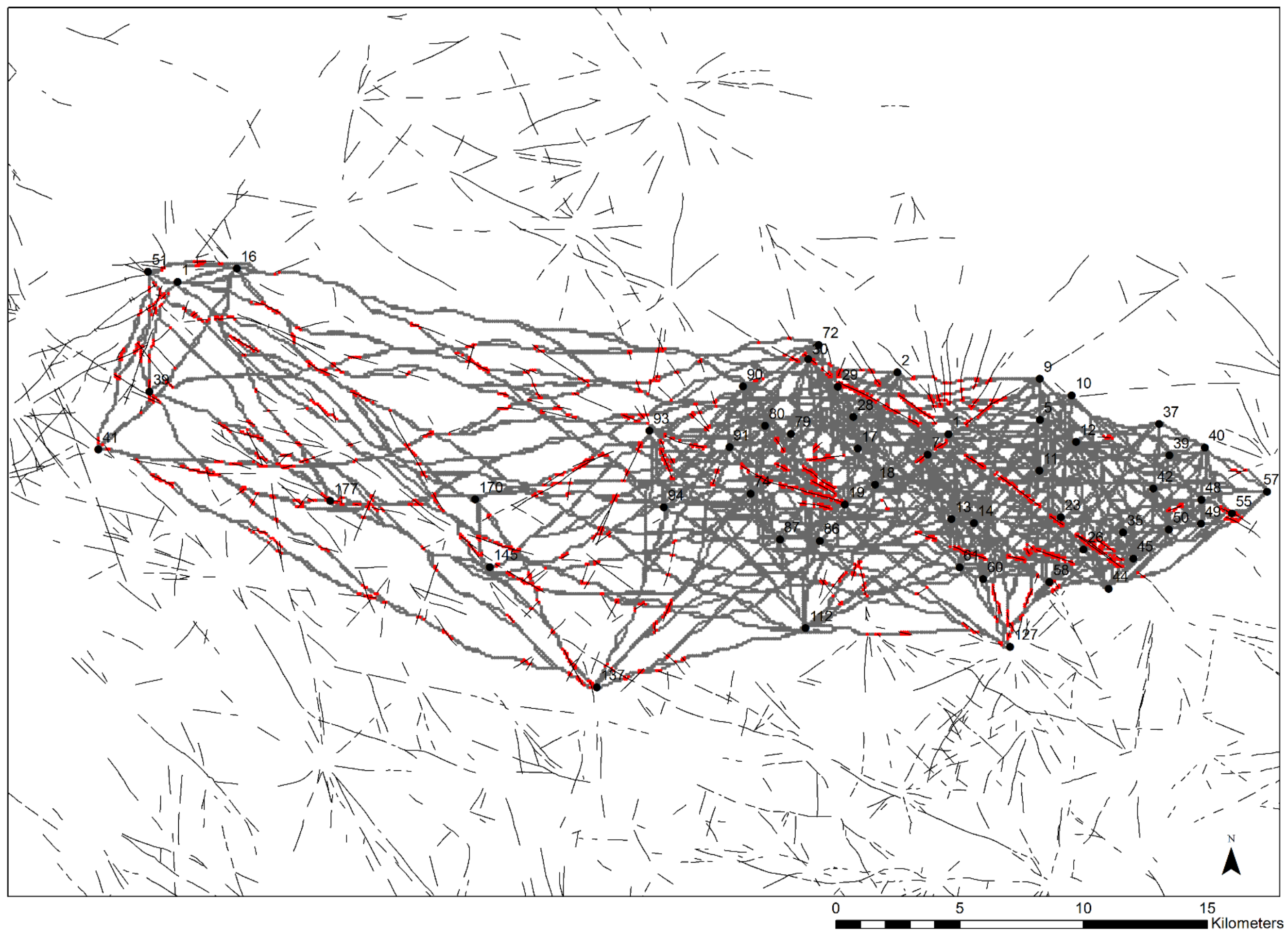


Figure 9.34 The fastest route model for the early third millennium B.C. in the Hamoukar and North Jazira survey areas. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. The model is statistically significant, overlapping the preserved hollow ways *less* than would be expected by random chance.

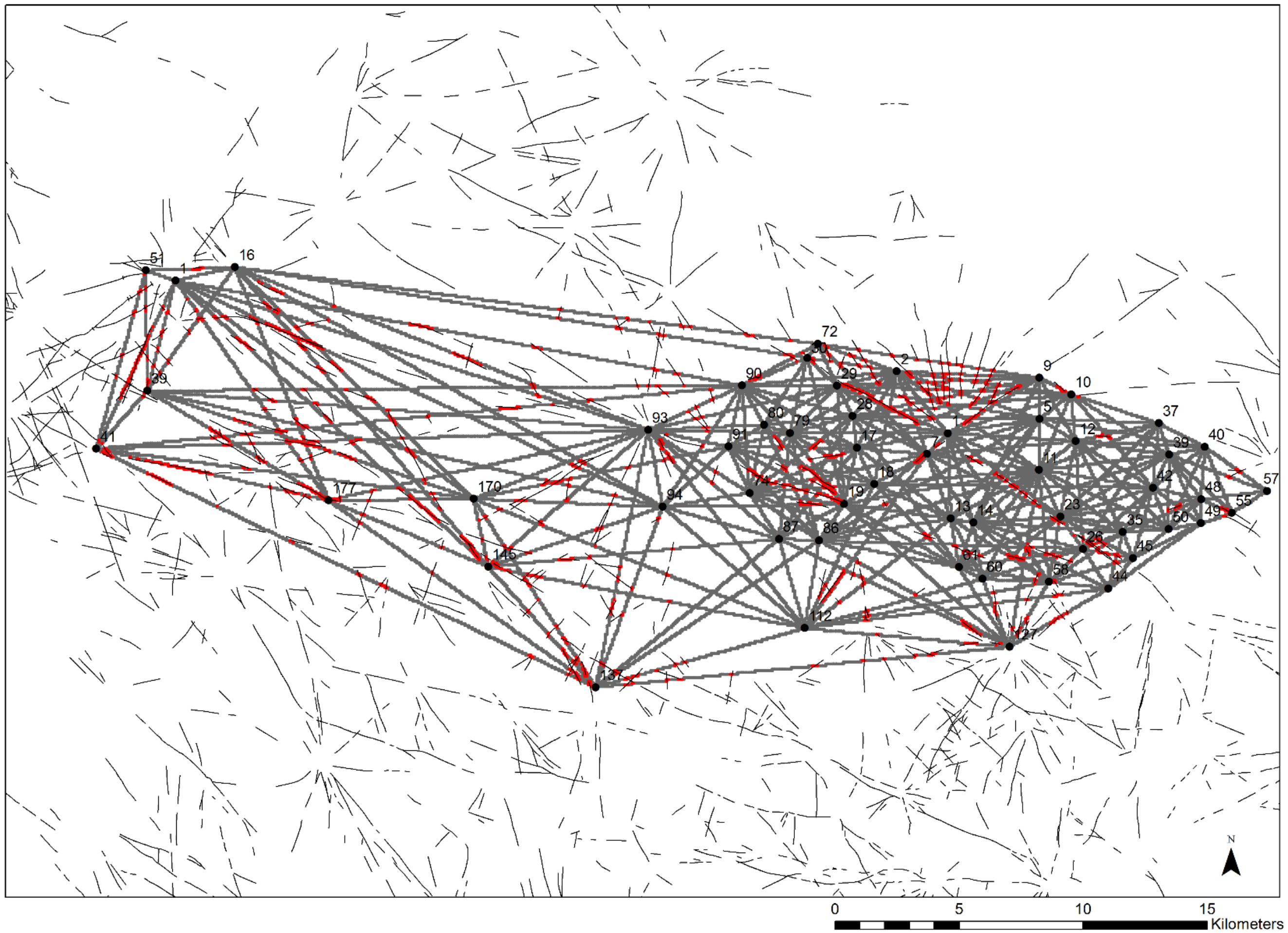


Figure 9.35 The easiest route model for the early third millennium B.C. in the Hamoukar and North Jazira survey areas. Portions of the model that overlap with preserved hollow ways segments are highlighted in red. The model is statistically significant, overlapping the preserved hollow ways less than would be expected by random chance.

the rate at which a model aligns with preserved hollow ways. Additionally, on such a map, where there is a very high density of routes, it is inevitable that the routes/route model are represented by a large number of pixels (or points once it is converted to a point shapefile). The random sample is created by using the point generator, but it seems that the random point generator in ArcMap 10.3 may have a bug. For example, for the late fourth millennium B.C. fastest route model in the area of Tell Brak it was specified that the random point generator in ArcMap 10.3 should create 180,898 points spaced a pixel's distance apart, but the program failed to produce more than more than 20,000 to 23,000 points (though it had already demonstrated that it is capable of generating higher number of points)[41]. The same problem occurred with the late fourth millennium B.C. shortest route models for the area of Tell Brak and the Hamoukar and North Jazira Survey areas. For this reason, it was not possible to analyse quantitatively the significance of these models. It is unclear what makes the tool generate much lower (and variable) numbers of points.

9.5 Discussion

No model across the three case study regions fully accounts for the preserved hollow ways that connect the sites inhabited in any of the three time periods examined. Yet there is excavation evidence that the initial infilling of the hollow ways in a geomorphological sense dates to the third millennium B.C. and evidence from association with sites that the routes the hollow ways record extend back in time to at least the early third millennium B.C. Nonetheless, the results improve our understanding of travel during the early fourth, late fourth, and early third millennia B.C. The statistically significant results that are better than random indicate variables that may have been behind route choice decisions alongside other variables. Meanwhile, the statistically significant results that are worse than random are clear indications that those variables were not important and can help inform future hypotheses.

[41] The tool itself states 'If the number of points is supplied as a long integer number, each feature in the constraining feature class will have that number of random points generated inside or along it' (ArcGIS 10.3 Tool Help 2016). There is no stated maximum limit, and the variable number of points produced by the tool suggests there is not an unstated maximum either.

For example, in the Hamoukar and North Jazira Survey areas during the early fourth millennium B.C., the shortest distance route model is statistically better than random, while fastest route model is statistically worse than random. It follows then that travel practices may have valued reducing the total distance travelled, but not saving time. It may also be that the difference in travel time between the fastest and shortest routes was not considered significant during the fourth and early third millennium B.C. (this possibility will be returned to in Chapter 10). The reverse is true in the Leilan Regional Survey Area during the late fourth millennium B.C. when the fastest route model is statistically better than random and the shortest route model is statistically worse than random. There, when the region was largely depopulated, saving time was potentially important (alongside other variables), while reducing the total distance travelled was not.

In the Tell Brak area, survey data is only published for the late fourth and early third millennia B.C.; but reducing physical exertion (statistically better than random) was potentially important to travellers in the area in both time periods.

In the early third millennium B.C., however, shortest route models are worse than random in all three case study areas, and both the easiest and fastest route models are also worse than random in the Leilan Regional Survey Area and the North Jazira Survey area. Whatever was important during the early third millennium B.C. in these areas resulted in journeys that were longer (in distance and time) and physically more difficult than might be expected.

Since there are no additional physical variables to be tested for the North Jazira, it is clear cultural factors were largely or entirely responsible for people's route choice decisions as they travelled between sites. One such cultural variable has already been examined by de Gruchy and Cunliffe (forthcoming) for the North Jazira Survey area during the early third millennium B.C.[42]

[42] In this joint chapter exploring the formation and preservation of hollow ways, I was responsible for the formation portion of the chapter (including the entire section dedicated to evaluating the need for travellers to seek permission from headmen). Emma Cunliffe was responsible for the portion focused on their preservation/destruction. Her work helped determine whether the absence of hollow ways in an area was simply due to their destruction or if something more archaeologically interesting was happening.

9.6 One More Variable: Seeking Permission from Headmen

Tony Wilkinson was interested in the possibility that travellers in the past may have been expected to seek permission from local headman to travel through their territory just as it is considered for modern archaeologists operating in some areas, such as Yemen, to gain permission from local headmen in addition to the central authorities before engaging in fieldwork. At Ebla, a treaty was found dated to 2400 B.C., which states '*without my permission, no one can travel through my country, if you travel, you will not fulfill your oath, only when I say so, may they travel*' (ARET XIII 5, translation in Ristvet 2011, 4). For these reasons, de Gruchy and Cunliffe (forthcoming) evaluated the possibility that this practice of seeking permission from headmen was present in the early third millennium B.C. as part of a wider paper on the formation and preservation of hollow ways in the North Jazira Survey area.

A different approach was taken to explore this cultural variable. Initially, the long distance routes were examined visually for spatial correlation with ranked sites, factoring taphonomic processes (de Gruchy and Cunliffe, forthcoming). This quickly revealed that travellers very consistently did not travel to small villages[43], strongly preferring instead to travel directly between larger villages and centres (**figure 9.36**). There was a single exception to this pattern – Site 90, a large 5 ha village (de Gruchy and Cunliffe forthcoming). No hollow ways connected this large village site to any surrounding site. After confirming that this apparent avoidance of Site 90 was not due to taphonomic processes, Thiessen polygons were drawn over the area to gain a broad understanding of territory. Significantly, the two parallel long distance routes that run southwest-northeast across the North Jazira Survey area on either side of Site 90 both veer to avoid the full area of the Thiessen Polygon associated with Site 90 (de Gruchy and Cunliffe, forthcoming).

[43] Out of 26 small villages in the original assessment shown in **figure 9.36** by de Gruchy and Cunliffe (forthcoming), four are located along the long distance routes through the region, perhaps five if site 26 located about half a kilometer from one of these routes is counted, with a further two hypothesized to have been along a paved road that may have also been a hollow way. Therefore, in this original assessment, less than a third of small villages are located on or near a long distance route. In the updated assessment shown in **figure 9.38**, six or seven small villages, if site 26 is counted, are along long distance hollow ways out of a total of 41 small villages, meaning more than 80% of small villages are not.

The association discovered between long distance routes and large villages and centres suggests that permission was not sought for every local headman, but only those located at larger sites. For some reason, however, people appear to have avoided visiting Site 90 and passing through its hinterland. Unfortunately, this site is only known from survey so it is impossible to hypothesize the reason behind this apparent behaviour.

9.6.1 Updated Results

The study by de Gruchy and Cunliffe (forthcoming) used the North Jazira Survey sites as published in Wilkinson and Tucker (1995) without any re-evaluation. To bring these results in line with the remainder of this thesis, the same methodology was applied to both the Hamoukar and North Jazira surveys, as a single case study, using the re-evaluated settlement data that is used throughout this thesis (**figure 9.36**). This re-periodization produced additional third millennium B.C. sites in the North Jazira Survey area (see Appendix B). Since these additional sites were all small villages under three hectares in size throughout their entire histories (Wilkinson and Tucker 1995, Appendix C), it was assumed they were under three hectares during the early third millennium B.C. as well. A second update was the application of nested Thiessen polygons to factor the settlement hierarchy in the region described in Chapter 4. These updated results are presented in **figures 9.37** and **9.38**.

This update reveals that, generally, the results of de Gruchy and Cunliffe (forthcoming) hold, but there are some additional important insights. One is that the long-distance route mapped in light brown connects small villages – contrary to the original observed trend. It should be remembered here that these small villages have already been noted as exceptional sites in Chapter 4: among them are the few sites remaining in the western half of the North Jazira Survey area, which is otherwise abandoned at the start of the third millennium B.C. (possibly for pastureland). It is possible that these villages either belong to a different exchange network or bridge two networks with different rules (as in *habitus*) of travel.

A second, additional insight revealed by combining the survey areas and applying nested Thiessen Polygons, first by grouping all centres (**figure 9.37**) and second by grouping only the large centres (**figure 9.38**). The nested Thiessen polygons produced by separating the large centres into their own class creates a boundary (not located at survey boundaries) that appears to correlate to two different settlement systems. This has important implications for the extent of power during the early third millennium B.C., which will be discussed further in Chapter 10.

Unfortunately, this study cannot be replicated in other survey areas until site size estimates are published, nor can it be replicated for the fourth millennium B.C. until new site size estimates are available.Nonetheless, the results of quantitative analysis in this chapter and the incorporation of routes into existing data regarding the protohistory of the North Jazira in chapter 4 have served to shed new light on the nature of the Uruk Expansion in the region and its lasting impact. This will now be discussed in chapter 10.

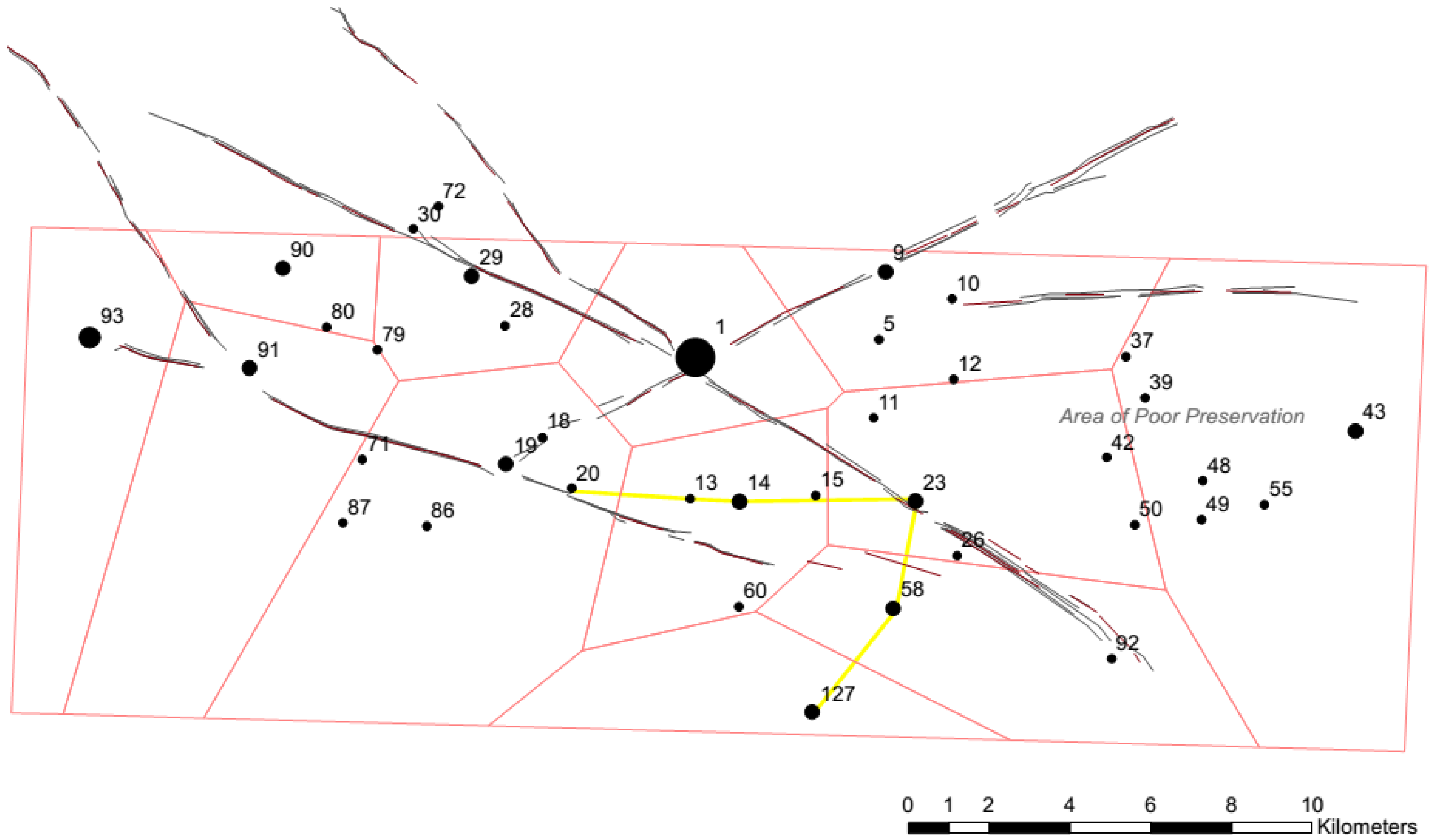


Figure 9.36 The publication by de Gruchy and Cunliffe (forthcoming) identified a pattern whereby long distance routes (shown as sketchy lines) connect only larger sites, ignoring the small villages. The sites are represented using proportionally sized black dots, the Thiessen Polygons are drawn in red, and the yellow lines indicate where de Gruchy and Cunliffe identified additional evidence for hollow ways. (This figure is based on de Gruchy and Cunliffe, forthcoming, fig. 15).

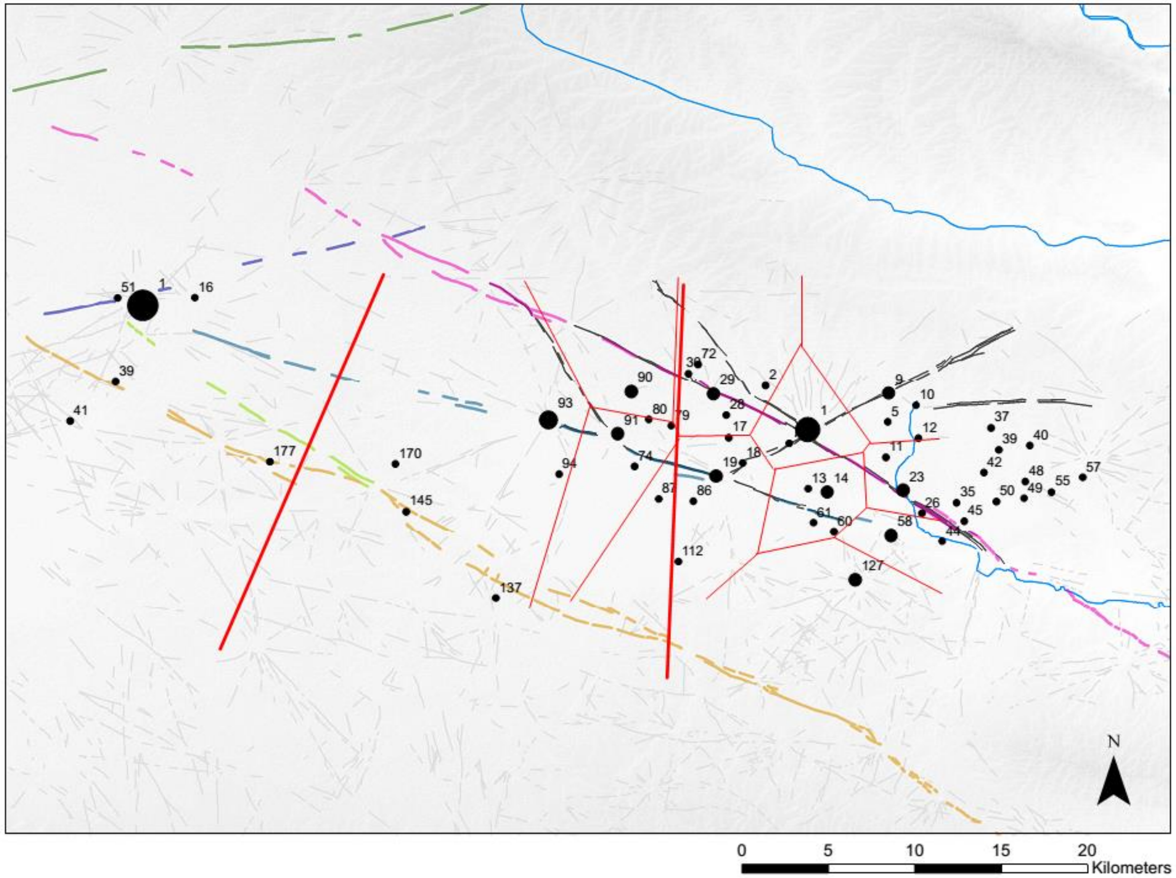


Figure 9.37 This figure displays an updated version of the work by de Gruchy and Cunliffe (forthcoming) shown in figure 9.33. Updates include: a re-evaluation of the sites dated to the early third millennium B.C, and the creation of nested polygons (centres = bold, large village = normal). Finally, the long-distance routes displayed in maps throughout chapter 4 have been added to the figure.

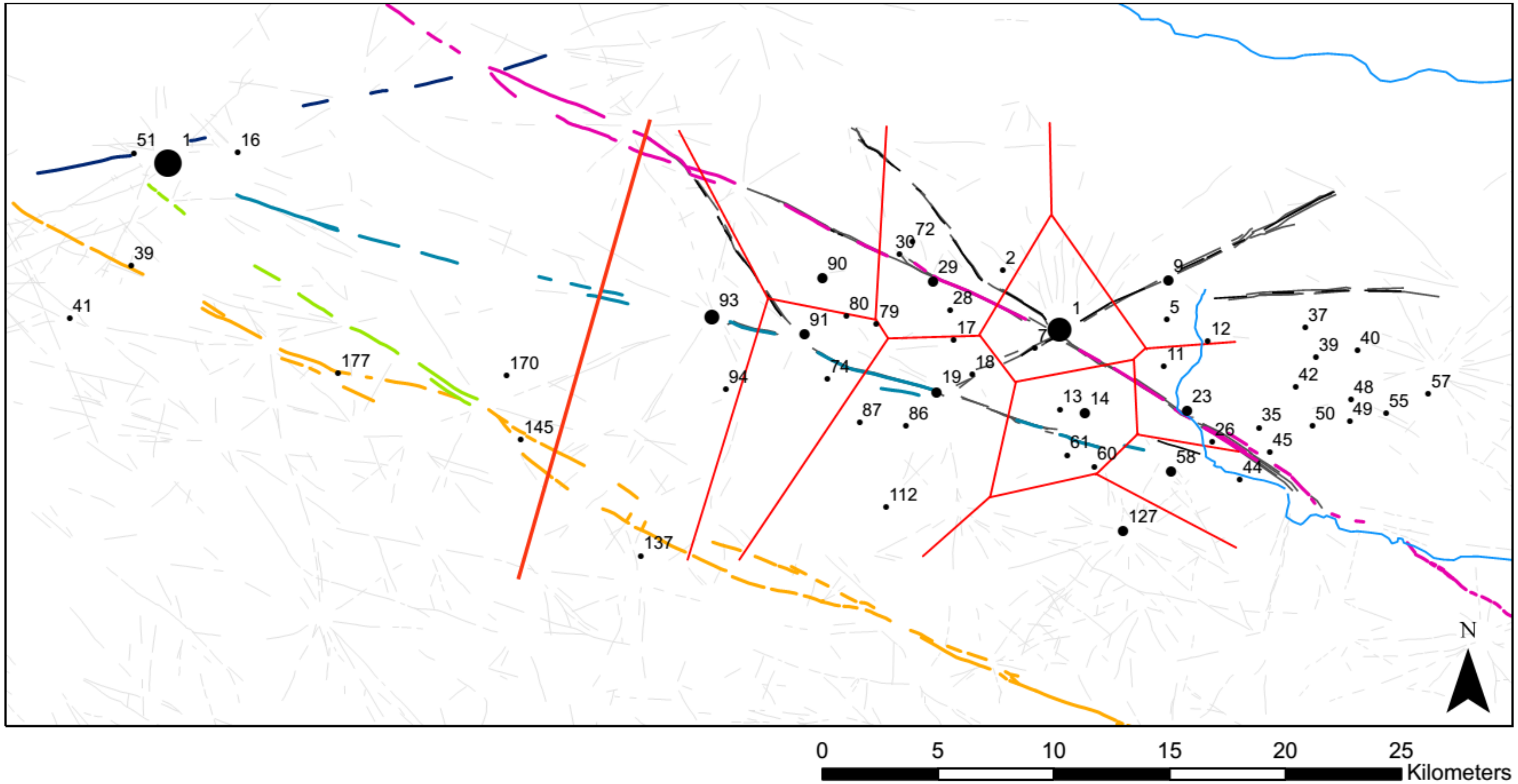


Figure 9.38 Nested Thiessen polygons between the small centre, NJS 93, and large villages (thinner red lines), and between the two large centres of the region: Tell Hamoukar and Tell al-Hawa (thicker red line).

Chapter 10: Discussion

The aim of this thesis has been, from the start, to use routes as a means of shedding new light on the nature of the Uruk Expansion – in particular, for the region of the North Jazira within Northern Mesopotamia. Having achieved this aim, the question remains: What can the routes tell us about the Uruk Expansion? The answers to this question fall under three themes:

1. Extent of power over extended territories
2. Route choice and travel practices
3. The Uruk Expansion as a polarizing force

The cumulative evidence presented here warrants a new assessment of the core-periphery models employed to understand the Uruk Expansion. It will be argued that, if a world system type core-periphery model is to be employed, then the most appropriate analogy is the core-periphery system described by Wallerstein (1974, 306-7) between 16th century Russia and Europe: one of multiple world economies with their own core and periphery areas engaged in exchange. This exchange may have generated revenue for the polities involved and 'reinforced the system of social prestige accumulation', but a split between Southern Mesopotamia and the North Jazira would not (and did not) cause a catastrophic collapse to the economy, affecting all socio-economic classes of individuals (as was the case with Poland, see Chapter 1) (Wallerstein 1974, 307).

10.1 Extent of Power

By the late fourth millennium B.C. centres in the North Jazira had gained the power to attract and retain large populations (Chapter 4), but it is questionable to what degree they had the ability to project that power over their hinterlands. Internally, the late fourth millennium B.C. centres of the North Jazira commanded workforces at least as large as those of Southern Mesopotamian cities (Algaze 2008), based on current estimates. Yet it is Southern Mesopotamian cities that project their power and influence far beyond their hinterlands. Normally, the relative size of centres would have implications for power, but it has already been shown that evidence points to very weak power from centres of similar size to Tell Brak, even in the mid-third millennium B.C. when city-states began to form in the North Jazira (Chapter 4). To begin this exploration of power, the reason(s) why urban centres in the North Jazira formed will be explored. Then, the ability of centres to project power will be assessed, and finally the emergence of polities in the North Jazira is discussed.

10.1.1 Urbanism: The Power to Attract, Retain, and Organise Large Populations

When and how urbanism took place varied across Mesopotamia (for a summary see Wilkinson et al. 2014, 46–50). For this reason, while centres in the North Jazira were at least the size of those in Southern Mesopotamia in the fourth millennium B.C., the nature of that urbanism would have been very different, although in both cases the growth of urbanism is attributed to routes and exchange networks.

As described by Algaze (2008), the growth of urbanism in Southern Mesopotamian is tied to the trade that occurred between centres/polities and the corresponding development of an economy organized around exchange. In explaining how Southern Mesopotamian urbanism began, the significance of the transportation network that connected Southern Mesopotamian cities located in different ecological regions is emphasised, as is the resulting economy based on the exchange of unique products (Algaze 2008, 40–92). Furthermore, Algaze (2008, 117-118) credited Tell Brak's location at 'a natural gravity-fed collection and bulk-breaking point for metals and other commodities procured from the Anatolian highlands' as the underlying reason for its growth into an urban site during the early fourth millennium B.C. However, there is no evidence in the routes or from the material culture of the North Jazira that Tell Brak was at such a 'bulk-breaking point'.

Similarly, Wilkinson (2000, 13) has attributed the (Bronze Age) growth of centres across the Jazira to their proximity along a hypothesised major east-west trade route and to exchange facilitated by pastoral nomadic groups.

Tell Brak's location along an important east-west route is noted by Oates et al. (2007). However, the combined research by Ur, Karsgaard, and Oates (2007, 2011) has shown that the primary cause for the growth of Tell Brak in the late fourth millennium B.C. was due to the merging of several semi-autonomous districts, which shared only limited dependency on the central administration (Oates et al. 2007; Ur, Karsgaard, and Oates 2007; Ur, Karsgaard, and Oates 2011). While the source of this limited dependency is not specified, it is suggested that urbanism at Tell Brak was based on both the distribution of prestige items and the ritual mobilisation of bulk goods like grain and wool (Oates et al. 2007, 598). The population and field area values presented in Chapter 4 support the mobilisation of bulk goods and, further, suggest that the limited dependency between districts at Tell Brak would have been based (at least in part) on the redistribution of food mobilised (ritually or otherwise) from the hinterland.

Nonetheless, Tell Brak is located approximately 3 km from the present location of the Wadi Jaghjagh route that continues downstream to the Khabur and Euphrates described by Algaze (2008, 117-118), and about 3 km north of the long distance route leading eastward to the area of the Wadi Radd marsh. Therefore, hollow ways do not provide evidence for Tell Brak's position at a bulk-breaking point for commodities from Anatolia, as described by Algaze (2008, 117), although there are hollow ways that preserve routes (of unknown age) running 'through the pass at the western end of Jebel Sinjar directly to the river crossings at Brak' (Oates et al. 2007, 586; this volume, figs. 4.4, 4.9, 4.10, and 4.14).

Furthermore, there are numerous sites located directly along the Wadi Jaghjagh and the overland route towards the Wadi Radd marsh that would have been in a much better position to control movement along these routes than Tell Brak (see **figures 4.9** and 4.10). Undoubtedly, at least a few of them were also inhabited in the earlier fourth millennium B.C. and fifth millennium B.C. when urbanism began at Tell Brak (Oates et al. 2007). If the catalyst for urbanism was positioning at a strategic control point along routes, then one of these sites should have become the urban centre, not Tell Brak. The cause for urbanism at Tell Brak was almost certainly not derived from its position relative to major long distance routes alone.

On the contrary, if there was a site that owed its urbanism to its position along route ways it is THS25/Tell Hamoukar. THS 25 was a large site created by the extensive low density habitation of a possible pastoralist population (Ur 2010, 147–48). It has already been argued in Chapter 4 that, if there were a pastoral population, they could have been responsible for the large quantities of obsidian recovered from THS25, which originated from Nemrut Dağ (Ur 2010; Khalidi, Gratuze, and Boucetta 2009; Lamya Khalidi and Gratuze 2010). It is believed that the inhabitants of THS25 relocated their settlement less than 2 km to the north and founded Tell Hamoukar towards the end of the LC 2 period (Ur 2010, 148). This slight shift in settlement location, positioned the inhabitants directly at the junction between three long distance routes, including the east-west route across the region that may have ultimately led up the Tigris to summer pastures (compare **figures 4.4** and **4.9**). While the initial settlement at Tell Hamoukar was smaller than that at THS 25, evidence for increased social stratification and conflict at the site occur almost immediately after foundation in the LC 3 period (Reichel 2004; Reichel 2006; Reichel 2007; Reichel 2011; Reichel 2012). Then, in the LC 4 and LC 5, the east-west route through Tell Hamoukar was abandoned and Tell Hamoukar reduced further in size. After the east-west route became active again in the early third millennium B.C., Tell Hamoukar experienced a 1500% increase in size (Chapter 4).

10.1.2 Projection of Power

It has been observed that by the late fourth millennium B.C. (LC 3-5), Tell Brak could not have sustained its population without the regular and reliable import of food from its hinterland (see Chapter 4). That Tell Brak maintained its size of 130 ha until the end of the fourth millennium suggests it had the necessary power/influence to regularly and reliably acquire those imports. In other words, it was the centre of a type of polity and had some level of power/influence across an extended territory. It is possible that other centres at this time, or even the centres of the early fourth millennium B.C. also had this power, but it cannot yet be demonstrated with current evidence.

The extent of power/influence held by these large villages and centres over their hinterlands, however, was probably limited. At Tell Brak, the food shortfall amounts to between 217 kg and 1,435 kg of grain[44] plus the full volume of all other crop

[44] Low estimate: population density = 100 people per ha, consumption = 250 kg grain per year, crop yield = 700 kg of grain per ha. High estimate: population density = 200 people per ha, consumption = 250 kg grain per year, crop yield = 500 kg of grain per ha.

products (lentils, peas, etc.) used by the population. Growing this amount of grain would only require between about 0.31 and 2.87 ha of land – an amount that would require each of the 25 sites located within a 5 km radius of Tell Brak (not including satellite tells like Tell Majnuna) to find as little as 0.012 ha of additional land beyond their own needs to grow surplus grain. While this 0.012 ha of additional land does not account for the known farming of additional crops (lentils, peas, etc.), it does serve to illustrate that the shortfall at Tell Brak could be supplied within a small territory.

Moving forward in time to the early third millennium B.C., it appears that all of the sites, even the large EJZ 2 period centres, could have been self-sufficient (see Chapter 4), but this does not mean they were. Evidence from the routes, in particular, suggests otherwise as the long distance routes appear to bypass the small villages (under 3 ha) in favour of the large villages (4-7 ha)[45] and centres (de Gruchy and Cunliffe, forthcoming). Additionally, NJS Site 90 (a large village) presents an anomaly to this overall pattern, but in an unusual way: two long distance routes not only bypass the large village, but perfectly defines the edges of the territory assigned to it by a Thiessen polygon. This suggests that even large villages held some amount of power over extended territories and possibly over smaller villages (under 3 ha). A traveller did not need to (or want to) travel to the small villages or worry about gaining permission from the heads of small villages to pass through their territories, it was sufficient to only visit large villages and centres.

This implies there were two networks of movement in the North Jazira during the fourth and early third millennia B.C. The first is a web of short distance connections between small villages (under 3 or 4 ha) and centres that facilitate exchange of agricultural and, probably, also pastoral products. Undoubtedly, there was also movement between neighbouring villages (large and small), even if the level of traffic did not produce hollow ways. Most people in the North Jazira would have probably only travelled along this network. Second, and separate from this village network, was a series of interregional long distance routes that connected centres and large villages like NJS 90 (Chapter 9). They were, however, primarily interregional routes. From at

[45] These are the same distinctive size categories of villages outlined in Chapter 4 (see especially, **figure 4.13**).

least the early fourth millennium B.C., their destinations were to locations outside the North Jazira: north to Anatolia, east towards the Tigris and the Tigridian Plains, south to Southern Mesopotamia via either the Tigris or the Khabur and Euphrates, and west towards the Balikh. Unlike Southern Mesopotamia where the network formed to connect centres/polities (Algaze 2008, 40–67), the network of routes that connected North Jaziran centres appear to have developed for the explicit purpose of reaching other regions. Their origins and destinations are rarely located at centres in the North Jazira. In one such rare case, Tell Hamoukar, it has already been shown that settlement was moved in order to be placed at the point where two long distance routes met a third; but the routes pre-date the location of the centre (**figures 4.4** and **4.9**). This is not a centre projecting power through trade connections, but one that is literally re-positioning itself within an existing system.

Further evidence to suggest that power/influence from North Jaziran centres over their hinterlands would have been weak comes from research into who would have produced ceramics in the Tell Leilan Regional Survey area during the third millennium B.C. (Sanders 2015). This study used fingerprint impressions on ceramic vessels from Tell Leilan and the village sites found in the Tell Leilan Regional Survey to determine whether male, female, or workers of both sexes were responsible for forming the vessels (Sanders 2015). The results demonstrated that alongside state formation in the mid-third millennium B.C., ceramic production shifted from an occupation for both men and women to one associated exclusively with men; but that this shift only occurred directly at Tell Leilan (Sanders 2015). The surrounding villages do not seem to have adopted this change, raising questions about the influence/power even a centre like Tell Leilan had over its hinterland as a polity in the mid-third millennium B.C. (Sanders 2015).

10.1.3 The Emergence of Polities (City-States?)

Given the above evidence for weak centres unable to project their power beyond a few kilometres, it is intriguing (and somewhat contradictory) that when nested Thiessen polygon are drawn over the Hamoukar and North Jazira survey areas during the early third millennium B.C., the border between Tell Hamoukar and Tell al-Hawa delineates two large and distinctively organized polities (**figure 9.38**). The first polity predicted contained a large centre, Tell Hamoukar 98-120 ha in area (EJZ 0-3a), surrounded only by small villages (under 3 ha) recorded by both the Hamoukar and North Jazira survey areas. The other polity predicted contained a large centre, Tell al-Hawa, only 42 ha in area (EJZ 0-3a), surrounded by all of the large villages (4-7 ha) recorded in either survey area and a single small centre (10 ha), which are in turn surrounded by small villages (under 3 ha). That the boundary between these distinct polities does not correlate with survey boundaries and that the Hamoukar Survey borrowed its methodology from the older North Jazira Survey, suggest that these results are not due to survey bias. Although, as shown here, survey coverage does make a difference. It would not have been possible to make this conclusion without combining the nearby Hamoukar and North Jazira surveys so that the case study area included two large centres. Firstly, both surveys were quite intensive (see chapter 3) and it would be expected that if any sites were missed that they would be small villages (under 3 ha), not large villages (4-7 ha) and particularly not centres. Additional small villages would not change the results of this analysis. Secondly, while there are several large tells beyond these surveys' boundaries (Lawrence 2012, 198–202, fig. 6.12), inclusion of these tells would only help further delineate the approximate boundaries of these proposed polities.

If the location of the Thiessen polygon boundary between Tell Hamoukar and Tell al-Hawa is correct (+/- 2 km), it would suggest the rulers based at Tell Hamoukar and Tell al-Hawa applied different strategies in how they attempted to exert power (however weak) over their hinterlands. It would be valuable, in the future, to excavate two or more of the large villages to investigate the possibility that whoever ruled Tell al-Hawa installed loyal governors in the large villages to extend power over the region and/or the long-distance routes within his territory. It would also be valuable to locate the early third millennium B. C. administrative buildings and/or residences of the rulers at both Tell al-Hawa and Tell Hamoukar.

10.2 Route Choice and Travel Practices

10.2.1 Who Travelled the Long Distance Routes?

The presence of two route networks has been described above in the context of power. One route network, connected neighbouring settlements, including small villages (under 3-4 ha) and would have been the route network used by most people in the region. The other was an interregional network of long-distance routes that only connected large villages (4-7 ha) and centres, with origins and destinations often outside the North Jazira region. Who would have travelled these routes? The answer changes over time.

During the LC 1-2 period, the most likely segment of the population to have been travelling long distance are the pastoralists. Pastoralism had already existed for over 1,000 years by the LC 1 period (Sherratt 1983), but pastoral nomadism is more controversial and rarely discussed for time periods before the Ebla and Mari texts of the second millennium B.C. Porter (2012, 65-163) provides a rare argument for their presence as early as the LC 3 period. It is only hesitatingly that the possibility of a seasonal pastoral population during the earlier LC 1 and 2 periods is offered and only in the context of THS 25 (Ur 2010, 147–49; Ur 2002a, 64; Wilkinson 2002, 101).

Nonetheless, the possibility exists and a description for how it could have functioned without pack animals has been provided in Chapter 4. If this is correct, if pastoralists did exist, then it was the adult men that travelled with their flocks of sheep and goats east through the region towards the Tigris and north for summer pasture, then down the Tigris and west through the region for winter (Chapter 4). Quantitative analysis of modelled routes (easiest, fastest, shortest, access to pasture, access to water, and so on) between THS25 (a hypothesized winter settlement location and consumption location of obsidian) and Nemrut Dağ (a hypothesized summer pasture location and source location for obsidian at THS25) could help shed light on the movement.

Further research is needed, however, to better understand why there appear to be multiple routes extending northwest from Nineveh, past Tell Hamoukar and Tell al-Hawa, and towards Tell Leilan during the early fourth millennium B.C. (LC 1-3). A new survey to refine the dates of sites found during the North Jazira Survey could help clarify whether the routes date to LC 1-2 or only to LC 3. At this time, it is unclear why such a connection might exist in LC 1-2, but there is already evidence for why this connection might exist in LC 3. In the LC 3 period, it is clear from Tell Brak and Tell Hamoukar that there is a segment of the North Jaziran population travelling to Southern Mesopotamia. This is evidenced by the emulation of a Southern

Mesopotamian building style: the mittelsaal or tripartite house. The tripartite house dated to the LC 3 period at Tell Brak (Area TW) shared a courtyard with the Feasting Hall (also of tripartite construction), while the tripartite houses at Tell Hamoukar from the LC 3 period all had their own walled courtyards containing small rooms for various activities, including cooking in large tannur ovens (Oates and Oates 1997; Oates 2002; Reichel 2004; Reichel 2006; Oates et al. 2007; Reichel 2007; Reichel 2011; Reichel 2012; Weber 2016). Based on the evidence from Tell Hamoukar, these tripartite houses at Tell Brak and Tell Hamoukar did not belong to local rulers, but a class of elite families who lived in the LC 3 equivalent of a gated community separate from lower socio-economic classes (Chapter 4). In this way, these elite at Tell Hamoukar chose to distinguish themselves and legitimize their status through the very thing that sets them apart from others: their knowledge and familiarity of foreign culture(s) that few (if any) other segments of the population would have had the luxury of travelling to.

Their large, exotic houses at the edges of the main mounds at both Tell Brak and Tell Hamoukar must have stood out. Inside, the contents remain local in style (Reichel 2004; Reichel 2006; Reichel 2007; Reichel 2011; Reichel 2012), but no one other than family and guests would see that. This segment of the population, with their familiarity of Southern Mesopotamian architecture, were probably not pastoralists who would require land for their flocks (unless it is to be argued there were already pasture institutions like those evidenced in the second millennium B.C., see Dercksen 2004). Rather, the most likely explanation is that these houses belong to local merchant families. The Sumerian word for merchant or businessman/agent (*damgar*) appears on early texts from the first half of the third millennium B.C. when it was already an established profession (Crawford 2013, 449; Tinney, Sjöberg, and Leichty 2006).

It has been argued before in a cross-cultural study by Helms (1988, 4) that it is both exotic materials *and* intangible knowledge of distant places that enable 'political advantage' – power. This relationship between knowledge of foreign cultures and power would place merchants at an advantage and what better way to legitimize themselves than through a shell of foreign architecture?

The association of tripartite houses with a merchant class is further supported by evidence from Tell Brak: at the LC 5 tripartite house in Area TX local stamp seals and southern-style seal impressions were found together and, in Area UA, local and southern style seal impressions were found together in a pit dated to LC 5 beneath a tripartite house (Emberling and McDonald 2003; Pittman 2003). Products acquired from Southern Mesopotamia were being brought back to these houses and opened (removing the seals) by multiple households of apparently equal rank either for consumption by the household or for redistribution or exchange with others.

In addition to travel to/from Southern Mesopotamia, contact continued across the North Jazira during the LC 3 period, evidenced by the new symbolism of both bears and lions at both Tell Brak and Tell Hamoukar, but this contact probably decreased over time as the middle portion of the region (Tell Leilan Regional Survey) became depopulated. Instead, it was the routes connecting resources in Anatolia with navigable waterways leading downstream to Southern Mesopotamia that remained in use through the LC 4 and LC 5 periods and it is near these routes that settlement increased.

The observed abandonment of east-west travel across the North Jazira indicates that Algaze (1993, fig. 46 B) was largely correct in his interpretation that the routes of the Uruk Expansion travelled north along the rivers, splitting around the Jazira. The only modification required is an additional arrow indicating parallel routes from Nineveh passed al-Hawa and Hamoukar towards Leilan and possibly (though there is no preservation) onwards into Anatolia (see Figure 10.1).

The travellers along the remaining routes would have almost certainly included merchants, but possibly others, too. In later time periods, potters were required to work as corveé labourers for institutional workshops (Wright 2013, 410). Provenance analysis of Southern Mesopotamian ceramics found at sites in Northern Mesopotamia and Iran have shown that the wares were made locally, rather than imported, suggesting the presence of potters trained in southern styles

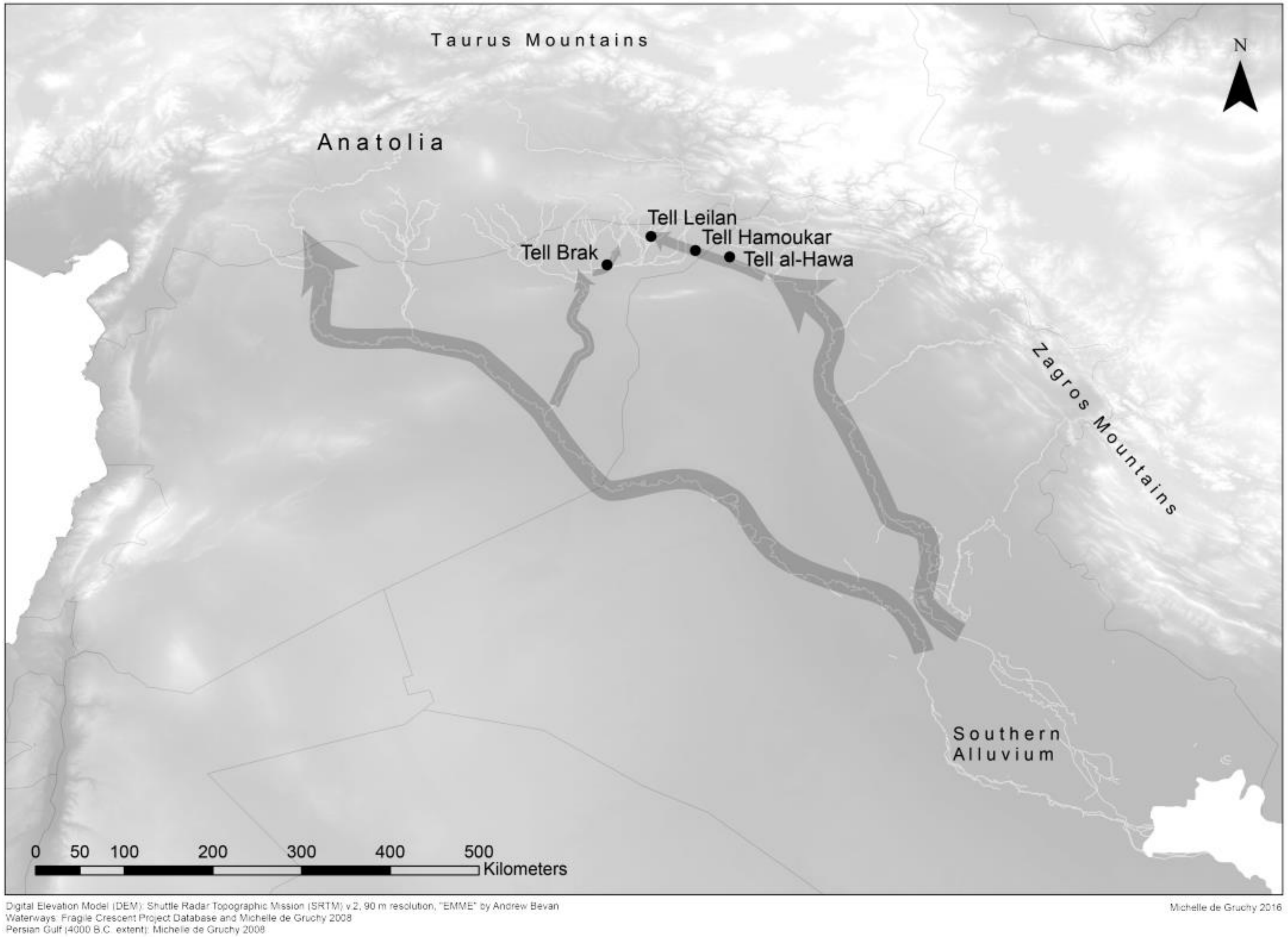


Figure 10.1 The direction of the Uruk Expansion into and through the North Jazira revised from Algaze (1993, fig. 46).

(Emberling and Minc 2016; Gopnik et al. 2016; Minc 2016; Minc and Emberling 2016; Mutin, Lamberg-Karlovsky, and Minc 2016; Sanjurjo-Sanchez et al. 2016). These may have been locals working from examples, but it could also be that potters were part of the retinue that accompanied merchants during the Uruk Expansion, or that they were independently mobile (Alden and Minc 2016; Wright 2016).

10.2.2 Comparison to Historic Old Assyrian Routes

A map by C. Michel published in Barjamovic (2008, map 1) displays the locations of historic, Old Assyrian route through the Jazira. It shows a route between Assur and Leilan (later called Samsi Adad) similar to that published by Hallo (1964) based on an Old Babylonian itinerary first published by Goetze (1953). Wilkinson (1990, 61) has previously noted that the route described in this itinerary is very similar to the preserved long distance hollow way that connects Tell Hamoukar and Tell Leilan, shown in light brown in **figures 4.4, 4.9, 4.10,** and **4.14**. The same Old Babylonian itinerary also describes a route similar to the east-west route across the Jazira preserved by hollow ways, with one exception: the route in the itinerary diverts north to Tell Leilan (Hallo 1964, fig. 3).

Finally, a route in the map by Michel is partially evidenced by hollow ways and can be seen extending south of the Wadi Radd towards the Wadi Radd marsh (Barjamovic 2008, map 1). It is possible that the route is not as well preserved as hollow ways further east for taphonomic reasons related to its proximity to the marsh. If so, then it is possible that this route (shown in orange in **figures 4.9, 4.10,** and **4.14**) could be part of the same route shown in **figures 4.9** and **4.10** in brown heading northeast towards the Tigris. The continuation of this route further east than the hollow ways evidence could explain the nearly linear arrangement of sites of entirely Southern Mesopotamian material that appear (then disappear) in the LC 4 period.

By the Old Assyrian/Old Babylonian periods, these routes would have been at least 2,000 years old and possibly much older. The connections they represent must have developed cultural significance as traditional routes with histories and travel stories attached to them. A full analysis of historic literature across time could reveal the nature of the significance attached to these routes (and others not attested to during the fourth and third millennia B.C.) over time.

10.2.3 The Variable(s) Underlying Route Choice

In the introduction, modern, western culture's preoccupation with time as a commodity and how that expresses itself in movement across the landscape was contrasted with the traditional, early/mid-20th century A.D. Hopi perspective of a connection between time and space (see also Chapter 6). We do not know how people residing in the North Jazira during the fourth through early third millennia B.C. perceived time, only how it was measured in Southern Mesopotamia, but the results from quantitative route analysis presented in Chapter 9 reveal that they most certainly did not perceive time as a valuable commodity to be saved.

It is likely that the system of timekeeping used in the North Jazira operated on similar scales to the system known from Southern Mesopotamia: reckoning in days and without using sub-divisions comparable to hours and minutes. It may be, then, that if time was accounted for in movement, it was only important on a scale of days (rather than hours or minutes). Sites, however, are rarely spaced more than an hour's walk from their nearest neighbours. Therefore, it is unlikely that time played a role in the shapes of the hollow ways/routes between pairs of sites. Rather, if reducing time was important, this variable would be expressed in the itinerary of sites chosen along longer journeys across the region or to/from other regions. However, as the analysis indicates, other variables drove route choice decisions between neighbouring sites.

For the Tell Brak survey area, ease may have been one of these variables, despite a general lack of topographic variation (see Chapter 9, table 9.1); but the maps (figure 9.18, 9.27) illustrate that, at best, it was only one among many considerations in route choice and this raises an important point: *People may optimize their travel factoring multiple variables at the same time.*

Branting (2012, 214-216) described that 'Problem 3' of least cost pathways is that 'least cost pathways often assume that a person would choose the optimal path rather than a merely satisficing or even non-satisficing one.' He argued that people are not always optimal and states that 'an important distinction should be made in least cost analysis between optimizing, or finding the absolute best path according to the criteria employed, and satisficing, or finding a path that would meet the need(s) behind the movement of the individual' (Branting 2012, 315). He provided the example of having a meeting in an hours' time at a location only 20 minutes away, enabling him to choose any number of paths that will get him to his meeting on time, including one that allows him to stop by his favourite coffee shop and another that allows him to complete a necessary errand, a third that enables him to do both, and a fourth through a park with many trees that he finds relaxing. Taking these alternatives routes, rather than simply a fastest route, he categorized as examples of satisficing. I would argue that it is not.

As described in Chapter 6, Herbert Simon defined the word satisficing as both '[looking] for a course of action that is satisfactory or "good enough"' and making 'choices without first examining all possible behaviour alternatives and without ascertaining that these *are* in fact all the alternatives' (1965, xxv-xxvi). He argued that people are not always optimal and stated that they '…*satisfice* because they have not the wits to *maximize'* (Simon 1957, xxiv). What Branting describes is not a lack of wits to examine all his alternatives and maximize his journey. He is not taking the second or third or tenth fastest route when he is in a hurry, because he cannot determine the fastest route. Rather, the examples presented illustrate that he is choosing an optimal route based on multiple variables. After all, arriving on time for a meeting *with* a great cup of coffee is surely *better* than simply arriving at the meeting on time.

Returning to the people travelling in the area around Tell Brak during the late fourth through early third millennia B.C., they (like Branting going to his meeting) may have sought routes that reduced slope and minimized difficult land cover (easiest) while simultaneously achieving other requisite goals. Whatever these other goals were, they were unlikely to involve saving time and certainly did not involve reducing distance, since the shortest route model performs so poorly that it is statistically significant. Boat travel has not been incorporated into the models and it is probable that boats did travel down the Wadi Jaghjagh to the Khabur in the vicinity of Tell Brak during the fourth millennium B.C., however, these are simply additional routes and would not affect the overall shapes of overland connections between sites (determined by the route choice decisions of travellers) observed in preserved hollow ways.[46] Likewise, access to water, another important physical variable, is insignificant since a traveller is rarely more than 15 minutes' walk from the nearest settlement. Nor would the use of donkeys as pack animals add any physical limitations (for example, access to pasture or fodder) in such a dense region of settlement. It follows, then, that whatever the other variables were that drove route choice decisions in the vicinity of Tell Brak, they were cultural – not physical – and at least one of them significantly increased the length of journeys.

Cultural variables must have played an even larger role in the areas of the Tell Leilan Regional Survey, and the Hamoukar and North Jazira surveys during the early third millennium B.C., where all the tested physical variables are worse than would be expected from random chance. One of these cultural variables at play in the North Jazira Survey area was the exclusion of small villages from the long distance route network, but more hypotheses and models should be tested.

This importance of cultural variables (rather than physical variables) in travel and route choice is not very surprising given ethnographic literature like Bourdieu's (1977) observations of the correct way to walk in the Kabylia region of Algeria (see Chapter 1), Widlok's (2008) study of wayfinding and navigation among the Hai//om in Namibia, and Lewis' (1976) study of the same among the Pintupi in Australia (see Chapter 6). Nor is this the first archaeological study to highlight the importance of culture in past travel: many of the examples mentioned in the introduction come from the American volume, *Landscapes of Movement: Trails, Paths, and Roads in Anthropological Perspective* and further examples like that described from the Arenal area of Costa Rica of 'When the Construction of Meaning Preceded the Meaning of Construction' can be found in another American book *The Anthropology of Paths and Trails*. For the North Jazira, moving forward will inevitably involve considering who was travelling long distance routes.

[46] Although, the presence of water routes could have reduced traffic or even prevented the formation of any parallel overland routes.

10.3 The Uruk Expansion as a Polarizing Force

Rova (1996) observed that while Northern Mesopotamia can be classed as a ceramic region with shared traditions, from at least the early fourth millennium B.C. (LC 2-3), this ceramic region can be divided into three ceramic provinces. Province A is located west of the area covered in this volume. Province B is located over the Balikh River and Khabur triangle, including Tell Brak and Tell Leilan (Rova 1996, 15, Fig. 2). Province C extends over the Taurus and Zagros mountain foothills and the Tigridian plains (Rova 1996, 15, Fig.2). Tell Hamoukar and Tell al-Hawa are located between Provinces B and C (as drawn in Rova 1996, Fig.2). In the early third millennium B.C., the Near East can be divided into five ceramic provinces. Of relevance here are Province B containing Tell Brak and Tell Leilan and Province A, located within Province B, whose western border is drawn less than 5 km from the Hamoukar and North Jazira Survey areas (Rova 1996, 19–20, Fig.4). Rova commented that the borders of Province A 'are still somewhat vague', but published results from surveys have demonstrated that the province (defined by painted, ribbed, and early incised Ninevite V pottery) includes the Hamoukar and North Jazira survey areas (Wilkinson and Tucker 1995, 49; Rova 1996, 19; Ur 2010, 249–50). Moving forward in time again into the later early third millennium ('late Ninevite 5'), Province A expands such that Province B is a subarea within Province A (Rova 1996, 23, Fig.5). Tell Brak at this time was contained within an area of overlap between Provinces A, B, and C (C is mainly defined by the distribution of Metallic Ware). Meanwhile, Tell Leilan, Tell Hamoukar, and Tell al-Hawa are all located within the overlapping area of Provinces A and B (Rova 1996, 23, Fig.5). The exceptional time period, for which Rova was unable to generate ceramic provinces, is the late fourth millennium B.C. at the time of the Uruk Expansion (Rova 1996, 17). Instead, she remarks that 'the most interesting feature of this phase is the lack of homogeneity between neighbouring sites' (Rova 1996, 17).

Ceramics are only a useful starting point for examining cultural connections. In Chapter 4, it has already been shown how the major east-west route is abandoned (temporarily) in the late fourth millennium B.C. (see Chapter 4). A study examining the provenance of bitumen excavated from sites and contexts across Northern Mesopotamia has also detected changes in route locations (Schwartz and Hollander

2006). Fortunately, the sites excavated to *in situ* fourth millennium B.C. levels (Tell Brak, THS 25, and Tell Hamoukar) are located on opposite sides of the region, making it possible to assess connections through other objects, architecture, and features.

One such object of interest is the eye idol or hut symbol. Many were found during excavations at both Tell Brak and THS 25/Tell Hamoukar (Ur, Khalidi, and Quntar 2011, 154–55; McGuire Gibson et al. 2002; Mallowan 1947, 32; McMahon et al. 2007, 153–54). The eye idols at Tell Brak tend to be made of stone and have been found in association with the Eye Temple (named after them) and in Area TW where multiroom public buildings that served as workshops have been excavated (Mallowan 1947, 32; McMahon et al. 2007, 153–54). At THS 25, eye idols were also found associated with multiroom public buildings that served as workshops, but the eye idols found at THS 25 and Tell Hamoukar tend to be made of bone (Ur, Khalidi, and Quntar 2011, 254–55; McGuire Gibson et al. 2002). (Unfortunately, excavations at both THS 25 and Tell Hamoukar have yet to uncover any temples dated to LC 1-3.) Like ceramics at the time, the eye idols appear to be a shared tradition across the region, but with subregional differences: stone eye idols at Tell Brak in Ceramic Province B, bone eye idols at THS 25 and Tell Hamoukar in the space between Ceramic Provinces B and C.

The public buildings with workshop spaces are another common feature between Tell Brak and THS 25 during the early fourth millennium B.C. The multiroom public buildings found at both sites both showed evidence for use as workshops and for feasting, indicated in both cases by large ovens (3-4 m in diameter) and large quantities of animal bones, and (as just noted), both contained eye idols (Ur, Khalidi, and Quntar 2011, 155; Al Quntar and Abu Jayyab 2016, 89–90; Lamya Khalidi 2016, 71, 75; McMahon et al. 2007, 153–54).

In the LC 3 period at both Tell Brak and Tell Hamoukar, the lion and the bear become important symbols used in the same ways at both sites (McGuire Gibson 2002, 53; Reichel 2004, 85; Mallowan 1947, 41–42; McMahon 2009; Weber 2016). Bears are depicted engaging in human behaviour and, unlike lions, have been found at both sites on stamp seals and as figurines (McGuire Gibson 2002, 53; Reichel 2004, 85; Mallowan 1947; McMahon 2009; Weber 2016). Lions were traditionally symbols of kingship in Mesopotamia (McMahon 2009; Weber 2016, 127–28), but in the LC 3 it may have been more loosely associated with elite members of society. At Tell Hamoukar, one of the LC 3 tripartite building complexes (B) contained a dump in which 160 of the sealings came from the same stamp seal with an image of six lions (Reichel 2007, 63–64), perhaps it was the personal seal of the home owner. At Tell Brak, bear figurines and lion sealings have been found in the Grey Brick Stratum under the Eye Temple and in Area TW where a tripartite building was situated during LC 3 (Mallowan 1947, 41–42; McMahon 2009; Weber 2016). Additionally, evidence for the use of bear and lion pelts has been found in the tripartite building in Area TW at Tell Brak (Weber 2016, 131).

Clearly, given the many similarities, there were ties connecting the North Jazira east-west during the early fourth millennium B.C. (LC 1-3). This is further supported by evidence (through association to sites) that the long distance route running east-west across the region from Tell Hamoukar past Tell Leilan and continuing westwards north of Tell Brak was in use during the early fourth millennium B.C. (see **figure 4.2a**).

It has already been shown in Chapter 4 that there is no evidence for the continued use of this east-west route in the late fourth millennium B.C. (LC 3-5). No sites west of Tell Hamoukar, dated to the late fourth millennium B.C., are situated along it (see **figure 4.7a**). At the same time, evidence from material culture, architecture, and features of the region fail to prove a continued connection (rather than continuity of earlier traditions and parallel connections to Southern Mesopotamia) between Tell Brak in the west and Tell Hamoukar in the east.

After the Uruk Expansion ended and ties between Anatolia and Southern Mesopotamia weakened, the route network changes once again, in many ways returning to its previous form; but with some important changes. The climate was gradually drying and, in the North Jazira Survey, settlement was abandoned where land would have been more suitable for pasture in drier years (in/near the Zone of Uncertainty) with exception of only a few small villages located along the route connecting Nineveh to Tell Leilan (Wilkinson and Tucker 1995). Likewise, small agricultural villages with oversized grain storage facilities are spaced along the mid-Khabur. In both cases, these sites may have acted as exchange points with pastoralist communities located within the Zone of Uncertainty, south of the North Jazira, and as way points along exchange routes with Southern Mesopotamia (see Chapter 4). Current evidence does not rule out reduced exchange between the North Jazira and Southern Mesopotamia during the early third millennium B.C. – only the disappearance of distinct Southern Mesopotamian communities in northern regions through assimilation or return to Southern Mesopotamian polities.

There is no doubt that donkeys were domesticated by the early third millennium B.C. and model wagons found in Area TC at Tell Brak and Tell Mozan (see Chapter 5) prove that wheeled vehicles have also been invented. There is also evidence for the investment in infrastructure associated with long distance travel both at Tell Mozan where there were centrally planned roads and at Tell Hamoukar THS 51 appears to have been a site that controlled movement in and out of the western gate (Ur 2010, 204).

In the early third millennium, the routes may have returned to their pre-Uruk Expansion form, and once again Rova (1996) is able to define ceramic provinces, but evidence from excavation described in Chapter 4 does not show the same degree of similarities observed before the Uruk Expansion. Tell Brak and Tell Mozan both construct a monumental oval building, similar to the oval structures found at Godin Tepe and Khafajah that were built during the late fourth millennium B.C. (Quenet 2011, 31; Meyer 2011, 132; Pfälzner 2011, 179–80; Rothman and Badler 2011; Delougaz 1940). Tell Leilan and Tell Mozan both construct inner and outer city walls (Meyer 2011, 132, 135; Pfälzner 2011, 140–43; Quenet 2011, 35). Tell Brak, Tell Mozan, and Tell Leilan all construct large temples and palatial buildings (Meyer 2011, 132, 135; Pfälzner 2011, 170, 179–80; Quenet 2011, 31, 35). Tell Leilan and Tell Hamoukar expand dramatically partially due to increasing populations and partially by creating acropolises for their public buildings and pushing residents out into lower cities (Meyer 2011, 133; Ur 2010, 105–6, 167). The emergent picture is one in which Tell Brak and Tell Mozan are located in one cultural sphere and Tell Hamoukar (likely along with Tell al-Hawa) are in another with Tell Leilan in between the two spheres, in accordance with Rova's (1996) ceramic provinces.

10.4 The Uruk Expansion and World Systems Theory: An Update

Algaze (1989, 1993) was correct to recognize that world systems theory provides a useful framework through which to investigate research questions about core-periphery relations. However, a more careful and subtle approach is required. There are similarities that can be drawn between 16th century European world economies and the Uruk Expansion that make it tempting to apply the theory; but in applying world systems theory (including as many as of its nuances as possible), it is demonstrated that the region was not connected as a world system. Southern Mesopotamia was not a core surrounded by a periphery comprised of Northern Mesopotamia, Anatolia, and the Zagros Mountains. Rather, if world systems theory is to be applied, then there are many cores with many peripheries forming many world economies (not world systems) during the late fourth millennium B.C. This model fits well with Wright's (2005) argument for polycentricity – multiple centres within a region or 'heartland' interacting and competing with each other – but on a different scale with multiple competing cores across regions. Furthermore, where Wright (2005) identifies two core areas or 'heartlands' within Mesopotamia (and additional cores in the surrounding highlands), the evidence presented here predicts many more, smaller world economies with two present in just the North Jazira region of Northern Mesopotamia.

10.4.1 Economic Industries

Wallerstein (1974, 304) described how Poland's economy during the 16th century was centred on the export of cereals, especially wheat, through the Baltic to Western Europe. By contrast, Russia also traded with Europe, but had a more diverse economy that included agriculture domestically, but also furs, metals (including silver), arms, and luxury items (including art). It was the latter items: fur, metals, arms, and luxury items that were exported to Western Europe.

In the North Jazira, the numerous small villages, which could not have supported many (if any) specialists (see Chapter 4) attest to the importance of agriculture in the economy throughout the fourth and early third millennia B.C. Nonetheless, the near-abandonment of the Leilan Regional Survey Area suggests that while agriculture remained an important part of the economy, evidenced by an increase in the number of small villages in the Tell Hamoukar and North Jazira survey areas, agriculture was not the only important economic sector.

Pastoralism is also traditionally an important part of the economy of the region and would have also been an important part of the North Jaziran economy during the fourth and early third millennium B.C., especially once a textile industry emerged in the LC 2 period – evidenced by the appearance of weaving workshops (Oates et al. 2007; McCorriston 1997). The near-abandonment of the Leilan Regional Survey Area opened hundreds of square kilometres of pastureland. It is possible that pastoralists, like those who may have lived at THS25, moved into this new space, creating a new spatial separation between pastoralists and agriculturalists, which continued into the third millennium B.C. when pastoralists may have become concentrated in the Zone of Uncertainty (Wilkinson 2000b; Wilkinson et al. 2014).

Finally, it is likely that the manufacture of objects was also part of the economy of the region. The growth at Tell Brak from 55 to 130 ha supported at least 5,000, but more likely nearly 10,000, specialists and administrators when the agricultural field area is factored (see Chapter 4). Without many natural resources to extract in the area, it is likely they were engaged in the manufacture of finished products made from raw materials like stone, metal, and wood that were brought down the Wadi Jaghjagh from Anatolia, as well as, perhaps textiles made from local sources of wool and linen (Al Quntar and Abu Jayyab 2016, 89–91; Khalidi 2016, 71–75; McMahon et al. 2007; J. Oates et al. 2007, 591–92). Likewise, al-Andalus, Tell Leilan, Tell Hamoukar, THS 40, and Tell al-Hawa would have supported thousands more specialists and administrators across the region (Chapter 4).

The narrative of the Uruk Expansion has always been one of the city states of Southern Mesopotamia expanding outwards to resources rich areas with metals, stone, and timber; and to control points along the routes along which these materials flowed into the south (see Algaze 2014). If this is correct, it is not the agricultural or pastoral products that form a staple part of the North Jaziran economy that would have been of interest to Southern Mesopotamians. Rather, it was the materials flowing down the Wadi Jaghjagh to the Khabur and the Euphrates, the materials transported along the routes passed Tell Leilan, Tell Hamoukar, and Tell al-Hawa towards Nineveh and the Tigris, and any finished products (stone tools, metal objects, wooden objects, bone objects, woollen textiles, linen textiles) manufactured in the centres of the region that would have been of interest to Southern Mesopotamians. In this regard, the North Jazira during the late fourth millennium B.C. more closely resembles the example by Wallerstein (1974) of 16th century A.D. Russia (which traded in preciosities) than 16th century A.D. Poland (which was singularly focused on grain export).[47]

10.4.2 Obstacles to Trade Removed

The singular focus of the economy on cereals, alone, is not what made Poland a periphery to Western Europe, as described by Wallerstein (1974, 304-307). It was also the removal of trade barriers. In the North Jazira, there would have been no analogous trade barriers to remove (or enforce), since it is a region at a time before nation states or even city states. Hard borders were not invented yet. Nonetheless, it has long been noted how the physical presence of Southern Mesopotamians tends to be found at strategic route locations that would have enabled control over the flow of materials and objects into Southern Mesopotamia (Algaze 1993, 41–45; Stein 1999b, 82–101; Algaze 2001, 39–45; Stein 2001, 268; Aubet 2013, 167–81; Algaze 2014, 68–73; but see also Schwartz 2001, 256–61). The motivations for establishing themselves at these strategic points were, according to Algaze (2014, 73), 'to secure access to the critical lines of communication through which coveted resources were obtainable and, equally important, to deny their local southern rivals such access.' The same strategy is also behind the workings of a trade diaspora model (Stein 1999b, 47). However, the most oft-cited example of such a site in the North Jazira, Tell Brak, is located about 3 km from the routes it is supposed to be strategically located along with numerous sites positioned closer. Surely, as described above, any of these other sites would have been preferable to Tell Brak if the only motivation was the control of routes. Instead, a distinguishing factor of Tell Brak is its rank as a centre with thousands of specialists producing finished tools, textiles, ceramics, and other objects. Perhaps it was access to these finished products and its existing position as a large

[47] This may change in later periods. For example, Weiss (2013) has argued that in the late third millennium B.C., the region was subject to Akkadian 'agro-imperialism' with grain exported in large quantities south to Akkad.

centre of political power in the area (see Chapter 9 – One More Variable), combined with Tell Brak's proximity to major routes that attracted Southern Mesopotamians.

10.4.3 Reinforcement of Prestige

Contact with the south undoubtedly helped reinforce and legitimize increasingly social, economic, and political divisions occurring within centres. This is most clearly seen in the adoption of foreign architecture (tripartite houses) by local elite communities starting in the LC 3 period at Tell Hamoukar and Tell Brak. Visible to all, architecture is an excellent means for showing off knowledge of exotic/foreign cultures, even to those too lowly to enter the same spaces. The tripartite house at Area TW near the edge of the main mound at Tell Brak and at the edge of the mound at Tell Hamoukar in Area B would have been visible to anyone working in the surrounding fields or simply passing by. That these same LC 3 tripartite buildings were filled with local material culture demonstrates that it was the outward display that was important.

10.4.4 Benefactors of Profit from Interregional Trade

Before delving into who in the North Jazira would have benefited from the exchange with Southern Mesopotamia, it is important to discuss what profit would have looked like during the late fourth millennium B.C. This is because surplus would have been substantially different during the fourth millennium B.C. than now or even during the 16th century A.D., since a symbolic abstraction of wealth like coinage or another form of currency, did not exist yet (Powell 1996).

In the Old Assyrian period, silver was an important material for storage of wealth and merchants aimed to convert their profits into silver (Veenhof 1999, 55), but it was not a symbolic abstraction of wealth analogous to coinage. Furthermore, even the use of silver as a commodity used for storing wealth seems to have only begun around the mid-third millennium B.C. when it was used alongside grain, oil, wool, and possibly axes[48] (Powell 1996, 229, 238; Gelb 1965). It seems likely that these other commodities (grain and wool, especially, but also possibly axes and oil) served a

[48] The suggestion that axes may have acted as a commodity for storing wealth is evidenced primarily by the shared Sumerian word for shekel and axe (*gin*) and symbol for shekel, which may represent a stylized picture of an axe (Powell 1996, 238).

similar function during the fourth millennium B.C. and here there is an important observation to be made: most of these products are perishable.

It is Van Driel (1999, 29) who observed that 'Some of the money equivalents, notably barley, which also constituted the main defence against famine, cannot be hoarded for unlimited periods: last year's grain already loses part of its value after the new harvest and texts differentiate between new and old.' Furthermore, barley and other grain rations would eventually decay. For this reason, while grain may have been a unit of payment, ultimately it is fundamentally different from currency today that can be hoarded or inherited.

In short, late fourth millennium B.C. profit (except possibly for axes and textiles) had to be consumed or else it went to waste. Furthermore, grain, oil, and wool, the rations of the paid worker (Gelb 1965), would have been necessities of everyday life. Most settlements in the region were small agricultural villages where household production and the dozen or so administrators and specialists each village would have provided for many of the needs of the village. It was in the centres of the region (THS 40, Tell Leilan, Tell Hamoukar, Tell al-Hawa, al-Andalus, and especially Tell Brak) where specialist workers paid via rations were available in numbers sufficient to provide surplus production of products (stone tools and objects, metal tools and objects, textiles, ceramics) for an interregional trade network.

About 26-30% of the population each centre would have been specialists and administrators (see Chapter 4) who relied upon others (including each other) for their needs from food to clothing to the tools required both at home and for their jobs (looms for weavers, drills for beadmakers, etc.). The exception was Tell Brak where nearly 40% of the population may have been specialists and administrators.

These individuals, their suppliers, their administrators, and any third-party distributors (merchants) would have been potential benefactors from any increased production derived from the interregional trade through the North Jazira. As suppliers of the textile industry, it follows that pastoralists would have been among the potential benefactors of the Uruk Expansion and the additional pasture created by the large-scale of the Leilan Regional Survey area would have provided an opportunity for expansion. Other suppliers, however, particularly those for the stone and metal industries, would have been situated outside the North Jazira in Anatolia (Khalidi, Gratuze, and Boucetta 2009; Frahm 2014; Algaze 1993; Wilkinson 2014).

Overall, the emergent picture is one in which only a minority of the North Jaziran population (specialists, administrators, elite, but also pastoralists) would have been impacted by the Uruk Expansion and its end. In this regard, the North Jazira resembles Wallerstein's example of Russia more closely than his example of Poland (1974, 304-5). There is no evidence that the economy of the North Jazira became entirely (or nearly entirely) dependent on export to outside regions. This is further supported by observing what happened after the Uruk expansion ended.

10.4.5 The Nature of Contraction Post-Uruk Expansion

Wallerstein distinguished Russia from Poland by describing that 'if a blockade had occurred equivalent to that of Gustavus Adolphus of the Vistula in 1626, the impact on Russia's internal economy would have been far less than on Poland's' (1974, 307). If the economy of the North Jazira had become a true periphery of Southern Mesopotamia, as Poland had with Western Europe during the 16th century, then it would be expected that the region would have experienced collapse when trade abruptly ended.

On the contrary, Rothman (2001, 369) has argued that there was no collapse in the Iraqi Jazira (evidenced by the North Jazira Survey). For the broader North Jazira region, it has been shown in Chapter 4 that the end of the Uruk Expansion led to the resettlement of the Leilan Regional Survey area and evidence for the reestablishment of the northern east-west route across the region, suggestive of renewed contact between the area of Tell Brak and the area of Tell Hamoukar and Tell al-Hawa. Additionally, increased settlement hierarchy from four tiers during the late fourth millennium B.C. to five during the early third millennium B.C. indicates that the region continued to experience increases in political complexity. At the same time, spatial analysis has shown a small increase in total settled area, produced by a drop in the total area occupied by smaller sites that were counterbalanced by increases in

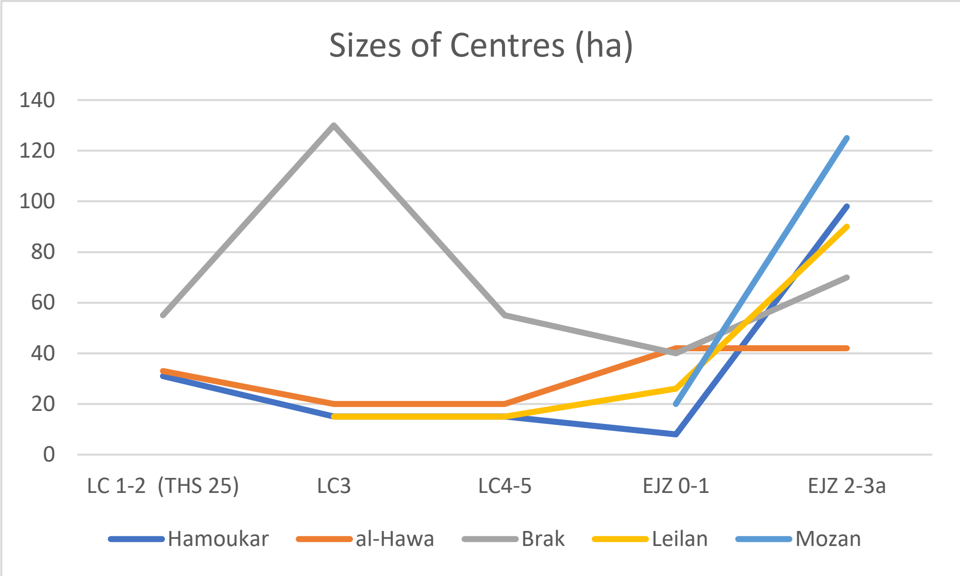


Figure 10.2 The sizes of centres in the North Jazira over time. Tell Brak declined in size at the start of the early third millennium B.C. (EJZ 0-1), but remains one of the largest centres of the region until EJZ 2.

settlement areas of Tell al-Hawa, Tell Hamoukar, and other larger sites in the North Jazira survey area (Lawrence 2012, figs. 6.19 and 6.21).

Across the region, the only site to experience a collapse was Tell Brak, which shrank from 130 ha in the LC 3 period to 55 ha in LC4-5, then to only 40 ha at the start of the third millennium B.C. Nonetheless, Tell Brak remained one of the two largest centres in the region during EJZ 0-1; similar in size to Tell al-Hawa, which had grown from 20 ha in the late fourth millennium B.C. to 42 ha in the early third millennium B.C. (see Tables 4.5 and 4.6). It was only in the EJZ 2 period, when the growth at Tell Brak(163% or 175%) was outpaced by faster growth at other centres (Tell Mozan – 625%, Tell Leilan – 346%, and Tell Hamoukar 1500% or 3077%) that Tell Brak lost its status as a large centre of the region (**figure 10.2**).

10.4.6 Russia, not Poland

If the Uruk Expansion will continue to be framed in terms of world systems theory, then it is important to recognize that:

1. It does not belong to a world system, but a world economy
2. It is more analogous to Russia than Poland

3. This implies the North Jazira is its own world economy with its own core(s) and peripheries

The implication that the North Jazira is its own world economy is not far-fetched. If searching for cores, two can be identified: one core centred on Tell Brak and the other containing Tell Hamoukar and Tell al-Hawa. The area covered by the Leilan Regional Survey area between the two cores would be the periphery, which depopulated (collapsed, even) during the Uruk Expansion when the cores redirected their interests on the trade between Southern Mesopotamia and Anatolia. The Zone of Uncertainty and the mid-Khabur could be additional peripheries to this North Jazira world economy. Yet there is something unsatisfactory about this and not just because it violates one of the observed patterns of world economies: that they tend to be limited in size to between 40 and 60 days travel (Wallerstein 1974, 16–17).

Even with these refinements, the use of world economies as descriptors for the systems in place is oversimplified and fails to recognize core differences between the more distant past of the late fourth millennium B.C. and the less distant past of the 16^{th}-20^{th} centuries A.D.: the presence/absence of nation states (or even just states or defined borders); the presence/absence of a currency or coinage (or any form of symbolic representation of wealth); the presence/absence of banking, finance sectors, and credit; the presence/absence of a market economic system (this is not the same as villages or centres having a market place, see Wallerstein, 1974, 18), to name a few major differences.

10.5 Summary

This chapter has established that physical variables did not play a role in travel practices during the fourth and early third millennium B.C., the Uruk Expansion polarised the region physically and culturally, and that the North Jazira was not a periphery of Southern Mesopotamia. Furthermore, it has identified some of the people who would have travelled the routes (an elite merchant class and possibly pastoralist groups on seasonal migration). Chapter 11 highlights the implications of this research and outlines some future directions.

Chapter 11: Conclusion

The aim of this thesis was to introduce quantitative methods for analysing preserved routes and, through these methods, shed new light on the nature of the Uruk Expansion in the North Jazira region of Northern Mesopotamia.

By critically examining some variables that may have been important to travellers using quantitative route analysis and examining changes in route structure over time, new evidence has emerged about past route choices and travel practice, as well as, the extent of power held by centres during the fourth and early third millennia B.C. However, this work has also raised important implications for route analysis generally, especially predictive route analysis.

11.1 Shedding New Light on the Uruk Expansion

In the flat landscape of the North Jazira, physical variables (easiest, fastest, shortest) were not the primary variables behind route choice decisions and travel preferences. I suspect this is true for other areas outside of steep mountainous terrain. Furthermore, as settlement became more hierarchical over the fourth millennium B.C., small villages became removed from the long distance route network. This may have been because the routes travelers preferred travelling between larger sites or because sites located along routes tended to become the larger sites. Evidence, however, suggests the former is more likely (see Chapter 4).

Meanwhile, polities formed during the late fourth millennium B.C. and continued into the early third millennium B.C., governed by centres that were limited in their ability to project power over their hinterlands. However, this does not mean centres did not try to project power. In the Hamoukar and North Jazira Survey areas, Thiessen Polygons indicate different settlement patterns associated with the two large centres in the region (Tell Hamoukar and Tell al-Hawa). It is possible that this is tied to two different strategies for projecting power. Tell Hamoukar became very large (about twice the size of Tell al-Hawa) and ruled over a territory of small villages (under 3 ha), while the rulers at Tell al-Hawa may have distributed power by sending trusted friends and family to control small territories of small villages (under 3 ha) from large villages (4-7 ha) within the polity/state.

Together, the new evidence from diachronic and quantitative route analysis (Chapters 4 and 9) alongside examination of existing evidence from survey and excavation (Chapter 4) has enabled a re-evaluation of the nature of the Uruk Expansion and the application of World Systems Theory. There is no evidence that the North Jaziran economy (primarily agricultural and pastoral) became dependent on exports to a Southern Mesopotamian core, as would be expected if it were a periphery within a world system. Nor did the North Jazira experience a collapse following the Uruk Expansion that affected all segments of its population (as occurred in 16th century Poland). Instead, the region continued to grow and develop. This is not to say that the region was unaffected by the Uruk Expansion, but that if World Systems Theory is to be applied, then there are multiple cores. One core in Southern Mesopotamia, a second core centred on Tell Brak, and a third core with Tell Hamoukar and Tell al-Hawa. The Uruk Expansion, therefore, was a phenomenon between cores and the expense on the periphery (for example, the Tell Leilan region) came immediately, during the phenomenon itself, not after. This is not, however, what World Systems Theory would expect.

The nature of the Uruk Expansion in the North Jazira was not one of a Southern Mesopotamian core colonizing a relatively underdeveloped periphery (Algaze 1993), or even a developed periphery (Algaze 2005; Algaze 2008). It was a phenomenon of movement and interaction, that led to an immense increase in traffic flow between Anatolia and Southern Mesopotamia. This acted as a polarizing force to the North Jazira, located between the two regions. Settlement was pulled towards the traffic flows, opening pastureland in the middle of the region. While the Uruk Expansion did not lead to collapse, its lasting effect on the North Jazira was division: division between the west (Tell Brak) and east (Tell Hamoukar/THS 25), and possibly division between agriculturalists and pastoralists into separate territories.

11.2 Implications for Route Analysis

11.2.1 When Routes are Unknown

The frequent lack of significance or worse than random significance of physical variables like ease and time demonstrated in this volume, raises some serious concerns for the practice of predictive route modelling in studies that seek to understand movement in locations where routes are not preserved. Current practice of 'predicting' routes using least cost paths based on physical variables like ease (for example, ArcMap's least cost path) or time (for example, Tobler's hiking function or GRASS's R.Walk tool based on Naismith's rule) could be yielding results that are worse at predicting the actual route people took than if the researchers draw a random line on the map. This is alarming, but it does not mean that all investigations into movement should cease in cases where routes are not known – only that the use of corridors may be more appropriate. Instead of specifying specific lines of travel, a corridor approach like that developed by Toby Wilkinson (2014) can identify general locations and directions of movement and aid in understanding dynamics across a landscape.

11.2.2 When Routes are Known: Quantitative Route Analysis

Nonetheless, where routes are preserved in the landscape or known through historic documentation, this has shown the unrealised potential of routes for learning about past cultures – and not just in the North Jazira. Routes of different ages are preserved or known from historical documentation around the world and all hold cultural information, and quantitative route analysis opens the possibility for unlocking this information through critical analysis.

By comparing the full lengths of linear features to models without reliance on sampling points, quantitative route analysis enables all preserved routes to contribute more than simply confirming of an A to B connection. The construction of random models allows for the assessment of whether the rate at which a model overlaps a preserved route is significant. This is important because sometimes, as has been seen in the models examined in this volume, a model can have a relatively high overlap rate (20 or more percent), but does not perform better than any random model and/or is made up of many crossings rather than true alignments. The hypotheses this method can assess is only bounded by the limits of what a researcher can model.

11.3 Future Directions

11.3.1 Exploring Cultural Variables

Having considered physical variables and eliminated their relevance in all except three cases, the next step is to construct hypotheses of cultural variables that can be tested. The range of possibilities, especially when ideology is factored in, is enormous, so careful examination of the culture will be required to identify likely travel preferences.

11.3.2 Calibrated Route Prediction

In chapter 7, the idea of calibrated route prediction was raised. In short, the idea is that once the important route choice variables had been discovered for many cultures and time periods, it could be possible to borrow from analogous cultures to predict the locations of routes in regions where no routes are preserved. This would be an improvement over the current practice of easiest or fastest routes.

11.3.4 Expansion of Land Cover Reconstruction

The first direction, however, that I hope to take this research in is expanding the spatial and temporal coverage of the land cover reconstructions presented in this volume and in de Gruchy et al. (2016). As, described in chapter 8, maps of the natural land cover are a pre-requisite for quality route models, since it may play a more significant role in how easy/difficult and how quickly a person can travel through the landscape than slope, particularly in flatter terrains. Reconstructing land cover based on archaeobotanical remains is a worthy pursuit in its own right. While there have been many studies investigating the connection between climate and various major events in the past like the origins/adoption of agriculture, the climate is not entirely responsible for environmental conditions on the ground (de Gruchy, Deckers, and Riehl 2016; Maher, Banning, and Chazan 2011). People and animals play a significant role in shaping the environment, too (Laland, Matthews, and Feldman 2016; Laland, Odling-Smee, and Feldman 2000). Furthermore, a large proportion of the Middle East lacks climate proxy data sources (Clarke et al. 2016; de Gruchy, Deckers, and Riehl 2016). It would be interesting to compare and contrast the results from land cover reconstruction based on dated archaeobotanical remains with the expectations from climate data, and to combine this data with settlement data to learn more about human-environmental interaction over time across the entire Middle East.

11.3.5 Terrain Coefficients: Larger Sample Populations and More Terrains

While reconstructing the land cover is a prerequisite for good route models, land cover can only be incorporated into route models through terrain coefficients. At this time the range of terrain coefficients is extremely limited and all are based on small samples (de Gruchy, Caswell, and Edwards 2017). Moving forward, it will be necessary to calculate energy-based and velocity-/time-based terrain coefficients for a more diverse range of terrain/land cover types, including all natural land cover types present in the Middle East.

11.3.6 A Whole World of Routes to Investigate

This thesis has described how routes store information about past cultures and shown how to extract that information from them. The methodology for reconstructing land cover from dated archaeobotanical remains in Chapter 8 can be applied anywhere. The methodology for calculating terrain coefficients described later in Chapter 8 can be applied anywhere to generate terrain coefficients for local land cover types. The method for quantitative route analysis described in Chapter 7 can be used on any preserved or known route. There are thousands of ancient routes across Northern Mesopotamia preserved in CORONA imagery and many more prehistoric and known historic routes around the world.

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Routes of the Uruk Expansion

Volume 3 of 3

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Ph.D. Thesis
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Appendix A: Diagnostic Ceramic Types

The following ceramic typology is based on the Wilkinson and Tucker (1995) typology used to date sites both in the North Jazira Survey (*ibid*.) and the Tell Beydar Survey (Wilkinson 2000a, 32), and the Tell Hamoukar Survey typology by Jason Ur (2002, 2010). The type numbers provided below in bold relate directly to the type numbers of Appendix A in *Settlement Development in the North Jazira, Iraq* (Wilkinson and Tucker 1995). Diagnostic types not listed in the typology for these surveys are not added. This is due to the necessity of using ceramic forms to reassess the age of the sites rather than a re-examination of the ceramics directly. References to external parallels are provided.

Types from Wilkinson and Tucker (1995) were compared with the more recent typology by Jason Ur for the Hamoukar survey (Ur 2002b; Ur 2010) and reorganized into the three time period categories of this project: Early Fourth Millennium B.C. (LC 1-3), Late Fourth Millennium B.C. (LC 3-5), and Early Third Millennium B.C. (EJZ 0-3a).

The typology by Jason Ur for the Hamoukar survey is based on the typology by Wilkinson and Tucker for the North Jazira Survey (Ur 2010, 214–15), which in turn is based on the typology by Warwick Ball from the excavation of al-Hawa (Wilkinson and Tucker 1995). In this light, the typology for Hamoukar by Jason Ur is the most recent update of this typology series that began with Warwick Ball at al-Hawa. Jason Ur's version of the typology draws on evidence from Tell Brak, Tepe Gawra, Hacinebi, Leilan, Grai Resh, and other sites (Ur 2002, 2010).

After comparing the types presented in Wilkinson and Tucker (1995) with those of Jason Ur (2002, 2010), the types were cross-checked against the more recent results for the Jazireh by the Associated Regional Chronologies for the Ancient Near East (ARCANE) project for the third millennium (Rova 2011).

Early Fourth Millennium B.C. Types (LC 2-3)

Type 7 – Coarse Shallow Bowl

(Ur 2002b, 32–33, NaN no. 17)

(Ur 2010, 216)

(image: Ur 2010, Fig. B.10, 1)

Type 8 – Hole-mouthed Jar

(Ur 2010, 216)

(image: Ur 2010, Fig. B.10, 5)

Type 10 – Double Rimmed Jar

(Ur 2002b, 32–33, NaN no. 11)

(Ur 2010, 216)

(image: Ur 2010, Fig. B.10, 10)

No Image

Type 11 – Brown-washed Ware [can be LC 1]

(Ur 2002b, 32–33, NaN no. 1)

(Ur 2010, 216)

Type 12 – Internally Hollowed-rim Jar

(Ur 2002b, 34–35, NaN no.14)

(Ur 2010, 216)

(image: Ur 2010, Fig. B.11, 16)

Type 13 – Flaring Rim Jar [can be LC 1]

(Ur 2010, 216)

(image: Ur 2010, Fig. B.10, 14)

Type 16 – Fine Beaker

(Ur 2002b, 32–33, NaN no.9)

(Ur 2010, 216)

(image: Ur 2010, Fig. B.11, 4)

No Image

Type 17 – Deep Bowl [can be LC 1]

(Ur 2010, 216)

Type 21 – Bowl with Internally-thickened Rim

[can be LC 1]

(Ur 2002b, 32–33, NaN no.13)

(Ur 2010, 216)

(image: Ur 2010, Fig. B.11, 19)

Late Fourth Millennium B.C. Types (LC 3-5)

Type 6 – Bevelled-rim Bowl [Southern Type]

(Ur 2002b, 34–35, Fig.11 11 and 12)

(Ur 2010, 217)

(image: Ur 2010, Fig. B.15, 1)

Type 14 – Internally Grooved Rim Jar

(Ur 2010, 216)

(image: Ur 2010, Fig. B.13, 7)

Type 15 – Carinated Ridged Bowl

(Ur 2010, 216)

(image: Ur 2010, Fig. B.13, 19)

Type 18A – Nose Lug [Southern Type]

(Ur 2010, 217)

(image: Ur 2010, Fig. B.15, 8)

Type 55 – Double Mouth Jar

(Ur 2010, 217)

Type 106 – Ceramic Ring Scraper

(Ur 2010, 217)

(image: Ur 2010, Fig. B.13, 31)

No Image

Type 120 – Broad Strap Handle [Southern Type]

(Ur 2010, 217)

No Image

Type 138 – Late Chalcolithic Grey Ware

(Ur 2010, 216)

No Image

Type 149 – Flared-rim Cooking Pot

(Ur 2010, 217)

Type 150 – Grooved-rim Beaker

(Ur 2010, 216)

(image: Ur 2010, Fig. B.13, 20)

Type 151 – Undercut-rim Jar [Southern Type]

(Ur 2010, 217)

(image: Ur 2010, Fig. B.15, 15)

Type 152 – Inturned Rim Bowl

(Ur 2010, 216)

(image: Ur 2010, Fig. B.13, 12)

Type 153 – Carinated Bowl (Casserole)

(Ur 2010, 216)

(image: Ur 2010, Fig. B.13, 18)

Early Third Millennium B.C. Types (EJZ 0-3a)

Type 22 – Incised Grey Fineware

(Elena Rova 2011, 52 and 69 Type 30)

(Ur 2010, 217)

(image: Ur 2010, Fig. B.17, 1)

Type 23 – Excised Grey Fineware

(Elena Rova 2011, 57 and 70-71 Type 47)

(Ur 2010, 217)

(image: Ur 2010, Fig. B.17, 2)

Type 24 – Pedestal Base

(Rova 2011, 67–68 Types 19 and 20, 71–72 Types 53 and 54)

(Ur 2010, 217)

(image: Ur 2010, Fig. B.17, 8)

Type 25 – Vertical Gouged Fine Ware

(Ur 2010, 217)

(image: Ur 2010, Fig. B.17, 6)

No Image

Type 26 – Ribbed Fine Ware

(Ur 2010, 217)

No Image

Type 27 – Painted Ware

(Elena Rova 2011, 52, NaN-17-23)

(Ur 2010, 217)

Type 28 – Pointed or Parabolic Fine Ware Base

(Ur 2010, 217)

(image: Ur 2010, Fig. B.17, 11)

Type 133 – Fine Ware Beaded Rim Bowl

(Ur 2010, 217)

(image: Ur 2010, Fig. B.17, 14)

Appendix B: Sites by Period

The Tell Leilan Regional Survey results for the Late Chalcolithic and early third millennium B.C. (Ninevite V) are published in a 'preliminary analysis' by Weiss (2003) of both the 1995 and 1997 results, on the Leilan Regional Survey Project website (location for period IIIb survey results), in an article based on an M.A. thesis examining the Late Chalcolithic material from the 1995 survey by Brustolon and Rova (2007), and in an article examining the third millennium material from the 1995 survey making use of Rova's then-unpublished sequence for the Jazireh and chronological information from the ARCANE project by Arrivabeni (2010). There are many discrepancies between the preliminary analysis and the later examinations of the 1995 survey material and it is not clear whether the additional sites identified by Weiss (2003) refer to material from the 1997 survey or if the more limited site lists from Brustolon and Rova (2007) and Arrivabeni (2010) are the result of changes in the ceramic sequence from the ARCANE project and more detailed examination. For this reason and to avoid a Type 1 error, the classifications by Brustolon and Rova (2007) and Arrivabeni (2010) based on only the 1995 material are used.

Site #	Weiss (2003) and website (IIIb only)	Brustolon and Rova (2007)	Arrivabeni (2010)	This Volume
1	Period IV (ca. 3400-3000 B.C.) Southern Uruk and LC 5 IIIa, IIIb, IIIc, IIId	LC 1-2 Early LC 3 Late LC 3 to LC 4 Late LC 4 to LC 5		Early 4th Late 4th Early 3rd
3	Period IV (ca. 3400-3000 B.C.) Southern Uruk and LC 5			
9		LC 1-2		Early 4th
11		LC 1-2		Early 4th
12	IIIb, IIIc, IIId		EJZ 1 EJZ 2	Early 3rd
13	IIIb, IIIc, IIId			
14	Period IV (ca. 3400-3000 B.C.) Southern Uruk IIIb, IIIc, IIId			
15	IIIb, IIIc, IIId			
16	Period IV (ca. 3400-3000 B.C.) Southern Uruk and LC 5 IIIb, IIIc, IIId			

17	Period IV (ca. 3400-3000 B.C.) Southern Uruk IIIb, IIIc, IIId			
18	Period IV (ca. 3400-3000 B.C.) Southern Uruk IIId			
20	IIIb, IIIc, IIId			
22	Period IV (ca. 3400-3000 B.C.) Southern Uruk	Early LC 3		Early 4th
34	IIIb, IIIc, IIId			
35	Period IV (ca. 3400-3000 B.C.) Southern Uruk IIIb, IIIc, IIId			
37	Period IV (ca. 3400-3000 B.C.) Southern Uruk and LC 5			
44	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
47	IIIb, IIIc, IIId			
49	Period IV (ca. 3400-3000 B.C.) Southern Uruk IIIc			
51	Period IV (ca. 3400-3000 B.C.) Southern Uruk IIIb, IIIc, IIId			
52	IIIb, IIIc, IIId			
54	IIIc			
55	IIIa, IIIb, IIIc, IIId			
59	Period IV (ca. 3400-3000 B.C.) Southern Uruk and LC 5 IIIa, IIIb, IIIc	LC 1-2 Early LC 3 Late LC 3 to LC 4 Late LC 4 to LC 5	EJZ 1 EJZ 2	Early 4th Late 4th Early 3rd
60	IIIb, IIIc, IIId	LC 1-2	EJZ 1 EJZ 2	Early 4th Early 3rd
61		LC 1-2 Late LC 3 to LC 4 Late LC 4 to LC 5		Early 4th Late 4th
62	Period IV (ca. 3400-3000 B.C.) Southern Uruk	LC 1-2 Late LC 3 to LC 4		Early 4th Late 4th
63	Period IV (ca. 3400-3000 B.C.)			

	Southern Uruk			
66		LC 1-2 Early LC 3		Early 4th
69		LC 1-2	EJZ 2	Early 4th Early 3rd
71	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
74	Period IV (ca. 3400-3000 B.C.) Southern Uruk IIIb, IIIc, IIId	LC 1-2 Late LC 3 to LC 4	EJZ 1 EJZ 2	Early 4th Late 4th Early 3rd
79	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
85		Early LC 3	EJZ 2	Early 4th Early 3rd
90	IIIc, IIId		EJZ 1 EJZ 2	Early 3rd
92		Early LC 3		Early 4th
96	IIIa, IIIb, IIIc			
101	Period IV (ca. 3400-3000 B.C.) Southern Uruk IIIb, IIIc	LC 1-2		Early 4th
106	IIIb, IIIc, IIId	Late LC 3 to LC 4	EJZ 2	Late 4th Early 3rd
112	IIIb, IIIc, IIId			
118		LC 1-2 Late LC 3 to LC 4		Early 4th Late 4th
120	IIIb, IIIc, IIId	Early LC 3 Late LC 3 to LC 4	EJZ 1 EJZ 2	Early 4th Late 4th Early 3rd
123	Period IV (ca. 3400-3000 B.C.) Southern Uruk and LC 5 IIIb, IIIc	LC 1-2 Early LC 3		Early 4th
124		Early LC 3		Early 4th
133	IIIb, IIIc, IIId			
136	IIIb, IIIc		EJZ 1 EJZ 2	Early 3rd
137	IIIb, IIIc		EJZ 1 EJZ 2	Early 4th Early 3rd
144		Late LC 3 to LC 4		Late 4th
147	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
148	Period IV (ca. 3400-3000 B.C.)	LC 1-2 Early LC 3		Early 4th

	Southern Uruk and LC 5			
151		Early LC 3 Late LC 3 to LC 4		Early 4th Late 4th
155	IIIc		EJZ 1	Early 3rd
161			EJZ 2	Early 3rd
165	IIIb, IIIc, IIId		EJZ 2	Early 3rd
166	Period IV (ca. 3400-3000 B.C.) Southern Uruk	LC 1-2 Early LC 3	EJZ 1	Early 4th Early 3rd
169	IIIc, IIId		EJZ 1 EJZ 2	Early 3rd
179		LC 1-2 Early LC 3	EJZ 2	Early 4th Early 3rd
180	IIIb, IIIc, IIId	Early LC 3 Late LC 3 to LC 4 Late LC 4 to LC 5	EJZ 2	Early 4th Late 4th Early 3rd
184	Period IV (ca. 3400-3000 B.C.) Southern Uruk	Late LC 4 to LC 5		Late 4th
186	IIId			
187	IIIb, IIIc			
189	Period IV (ca. 3400-3000 B.C.) Southern Uruk IIIa, IIIb, IIIc, IIId			
196	IIIb, IIIc			
197	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
198	IIId			
200	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
201	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
203	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
204	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
206	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
209	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
212	Period IV (ca. 3400-3000 B.C.)	LC 1-2 Early LC 3		Early 4th

	Southern Uruk			
219	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
220	Period IV (ca. 3400-3000 B.C.) Southern Uruk IIIc, IIId			
221	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
223	Period IV (ca. 3400-3000 B.C.) Southern Uruk and LC 5	Late LC 3 to LC 4 Late LC 4 to LC 5		Late 4^{th}
226	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
228	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
238	Period IV (ca. 3400-3000 B.C.) Southern Uruk and LC 5	Late LC 4 to LC 5		Late 4^{th}
245	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
246	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
250	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
254	Period IV (ca. 3400-3000 B.C.) Southern Uruk and LC 5	Late LC 4 to LC 5		Late 4^{th}
257	Period IV (ca. 3400-3000 B.C.) Southern Uruk IIId			
264	Period IV (ca. 3400-3000 B.C.) Southern Uruk IIId			
273	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
276	Period IV (ca. 3400-3000 B.C.)			

	Southern Uruk			
282	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
301	Period IV (ca. 3400-3000 B.C.) Southern Uruk			
322	Period IV (ca. 3400-3000 B.C.) Southern Uruk			

Re-periodization of the sites in the North Jazira Survey was achieved using the diagnostic ceramic typology presented in Appendix A and the original ceramic forms from the field, which were updated during a re-examination of the ceramics in the early/mid-1990s by Alan Lupton ahead of his publication, *Stability and Change, Socio-political Development in North Mesopotamia and South-East Anatolia 4000-2700 B.C.* (pers. comm. Tony Wilkinson). The site size estimates are taken from Wilkinson and Tucker (1995, Appendix C), but only for the early 3rd millennium B.C. (Ninevite V). While the third millennium B.C. diagnostic ceramic types (and, therefore, sites) remain the same, the fourth millennium B.C. diagnostic ceramic types have been refined considerably since the survey. The site sizes for these sites in Wilkinson and Tucker (1995, Appendix C) are based on sherd scatters for types now known to span from the terminal Ubaid into the third millennium B.C. (see Appendix A, this volume).

Site #	Ceramic Type (Quantity + Possible?)	Site Size (Early 3rd)	Notes
2	Early 4th: - Late 4th: - **Early 3rd:** 22(1)		
5	**Early 4th:** 13(1) Late 4th: - **Early 3rd:** 22(1), 24(3), 26(2), 133(1)		
7	Early 4th: - Late 4th: - **Early 3rd:** 28(1)		

9	Early 4th: - Late 4th: - **Early 3rd:** 22(1), 23(2), 27(3)		
10	Early 4th: - Late 4th: - **Early 3rd:** 23(3), 25(1)		
11	Early 4th: - Late 4th: - **Early 3rd:** 23(3), 133(1)		
12	Early 4th: - **Late 4th:** 15(1), 138(1) **Early 3rd:** 22(3), 23(6), 24(5), 25(7), 26(1), 27(3), 28(4), 133(1)		
13	Early 4th: - Late 4th: - **Early 3rd:** 22(5), 23(3), 24(6), 25(3), 26(3), 27(2), 28(2), 133(7)		
14	**Early 4th:** 8(1), 13(1) Late 4th: - **Early 3rd:** 22(5), 23(3), 24(3), 25(4), 27(2), 28(3), 133(2)		1 possible type 13 or type 153
16	**Early 4th:** 13(2) **Late 4th:** 6(1), 106(1) Early 3rd: -		
17	Early 4th: - Late 4th: - **Early 3rd:** 24(1?)		
18	Early 4th: - **Late 4th:** 55(1?) **Early 3rd:** 22(3), 23(2), 24(4), 25(3), 26(5), 27(1+3?), 28(1)		
19	**Early 4th:** 8(1), 11(6), 12(1), 16(2), 21(?) **Late 4th:** 6(2) **Early 3rd:** 22(7), 23(4), 24(7), 25(1), 26(4), 27(7), 28(1), 133(13)		
23	**Early 4th:** 13(1) Late 4th: - **Early 3rd:** 22(3), 23(7), 24(1), 25(2), 26(1), 27(1), 28(1)		

26	**Early 4th:** 13(1) **Late 4th:** 18A(1) **Early 3rd:** 22(2), 23(3), 24(3), 27(1+2?)		
28	Early 4th: - Late 4th: - **Early 3rd:** 24(1), 26(1), 133(1?)		
29	Early 4th: - Late 4th: - **Early 3rd:** 23(2), 24(9), 25(2), 26(1), 27(1), 28(4), 133(1)		
30	Early 4th: - **Late 4th:** 6(1) **Early 3rd:** 23(2), 24(4), 26(3), 27(2), 28(1)		
32	Early 4th: - **Late 4th:** 138(1) Early 3rd: -		
33	Early 4th: - **Late 4th:** 55(1) Early 3rd: -		
35	Early 4th: - Late 4th: - **Early 3rd:** 26(1)		
36	**Early 4th:** 8(1), 10(1), 12(1), 13(7), 17(1), 21(20) **Late 4th:** 138(3) Early 3rd: -		Considered part of Site 26, not its own site as originally thought (Wilkinson and Tucker 1995, 127)
37	**Early 4th:** 21(2) Late 4th: - **Early 3rd:** 23(1), 24(1?)		
39	**Early 4th:** 7(1), 17(3) **Late 4th:** 6(12), 15(1), 120(2) **Early 3rd:** 23(1), 24(2), 27(2), 28(3+1?)		+1 either type 13 or type 15
40	Early 4th: - Late 4th: - **Early 3rd:** 28(1)		

42	Early 4th: - Late 4th: - **Early 3rd:** 24(3?), 28(1)		
44	Early 4th: - Late 4th: - **Early 3rd:** 24(1)		
45	**Early 4th:** 7(2), 8(3), 10(1), 11(1), 12(1), 13(8), 17(2), 21(6+1?) Late 4th: - **Early 3rd:** 22(1), 23(1)		
46	**Early 4th:** 8(4), 10(5), 11(3), 12(6), 13(7), 17(4), 21(9) **Late 4th:** 55(1), 106(2), 138(5) Early 3rd: -		Some bags from sites 46 and 48 were mixed. The bags from site 46 that were not mixed (shown left) suggest that the site dates to the fourth millennium B.C., while the bags not mixed from site 48 suggest the site dates to the early third millennium B.C. Based on this pattern, the following sherds likely also come from site 46: **Early 4th:** 8(12), 10(7), 11(9), 13(6), 17(4), 21(28) **Late 4th:** 138(1)
48	Early 4th: - Late 4th: - **Early 3rd:** 22(4), 23(3), 25(2), 26(2), 27(1), 133(1)		Some bags from sites 46 and 48 were mixed. The bags from site 46 that were not mixed suggest that the site dates to the fourth millennium B.C., while the bags not mixed from site 48 (shown left) suggest the site dates to the early third millennium B.C. Based on this pattern, the following sherds likely also come from site 48: **Early 3rd:** 24(2+1?), 27(1), 28(1)
49	**Early 4th:** 8(4), 10(3), 11(21), 12(7), 13(9+10?), 17(4), 21(13) **Late 4th:** 6(1), 138(4?) **Early 3rd:** 22(4), 23(11), 24(5), 25(1), 26(8), 27(5)		+ 8 sherds Ninevite V grey fine ware, possibly type 22 or 23?
50	**Early 4th:** 17(1) **Late 4th:** 138 (4?) **Early 3rd:** 22(2), 23(10), 24(5), 25(1), 26(2), 28(1), 133(1)		+ 2 sherds Ninevite V grey ware, possibly type 22 or 23?
52	**Early 4th:** 8(2) **Late 4th:** 14(1+1?), 138(8) Early 3rd: -		

55	Early 4th: - Late 4th: - **Early 3rd:** 24(1), 133(1)		
57	Early 4th: - Late 4th: - **Early 3rd:** 24(1), 26(1)		
58	**Early 4th:** 8(3), 10(1), 12(1), 13(2), 17(2), 21(4) **Late 4th:** 138(3) **Early 3rd:** 22(9), 23(12), 24(2+4?), 25(3), 26(5), 27(9), 28(5), 133(5)		
60	**Early 4th:** 8(6), 10(1), 11(4), 12(1), 13(15), 16(1), 17(13), 21(7) **Late 4th:** 6(1), 14(5), 106(1), 138(12) **Early 3rd:** 22(2+1?), 23(5), 24(3), 26(6), 27(6), 28(3), 133(3)		
61	Early 4th: - Late 4th: - **Early 3rd:** 28(1)		
62	**Early 4th:** 8(2), 21(3) **Late 4th:** 138(7) Early 3rd: -		
66	**Early 4th:** 12(2), 13(15), 17(2) **Late 4th:** 55(2) Early 3rd: -		
67	**Early 4th:** 8(4), 10(1), 11(2), 13(1), 17(7+1?), 21(2) **Late 4th:** 55(1) Early 3rd: -		
72	**Early 4th:** 8(4), 10(1), 13(3), 17(2+1?), 21(2) **Late 4th:** 138(6) **Early 3rd:** 24(1), 133(1)		
74	**Early 4th:** 8(4), 10(1), 13(3), 17(2+1?), 21(2) **Late 4th:** 138(6) **Early 3rd:** 24(1), 133(1)		
75	**Early 4th:** 7(2), 13(5),17(5), 21(4) **Late 4th:** 6(19), 120(2), 138(1) Early 3rd: -		

76	**Early 4th:** 8(2), 21(3) Late 4th: - Early 3rd: -		
79	Early 4th: - Late 4th: - **Early 3rd:** 24(1)		
80	**Early 4th:** 8(5), 10(1), 11(7), 17(1), 21(1) **Late 4th:** 55(1), 138(1) **Early 3rd:** 24(1)		
82	**Early 4th:** 7(1), 8(1), 11(7), 13(3), 21(4) Late 4th: - Early 3rd: -		
83	Early 4th: - **Late 4th:** 6(1) Early 3rd: -		
84	Early 4th: - **Late 4th:** 6(6), 106(1) Early 3rd: -		
85	**Early 4th:** 7(1), 8(1), 10(1), 11(7), 13(2), 17(3), 21(1?) Late 4th: - Early 3rd: -		
86	**Early 4th:** 13(1), 17(1) **Late 4th:** 6(38+9?), 15(3), 18A(1), 120(2) **Early 3rd:** 21(1+1?), 22(6+2?), 23(11), 24(11+1?), 25(1), 26(5), 27(5), 28(10), 133(17)		
87	**Early 4th:** 21(1) Late 4th: - **Early 3rd:** 22(9), 23(8), 24(5), 25(2), 26(1), 27(1), 28(1), 133(3)		
89	**Early 4th:** 8(1), 13(5), 11(2), 17(2) **Late 4th:** 6(66), 18A(1) Early 3rd: -		

90	Early 4th: - Late 4th: - **Early 3rd:** 22(3), 23(2), 24(4), 133(1)		
91	Early 4th: - **Late 4th:** 138(3) **Early 3rd:** 22(2), 23(1), 24(1)		
92	Early 4th: - **Late 4th:** 138(2) **Early 3rd:** 22(10), 23(16), 24(6), 25(2), 26(2), 27(2), 133(4)		
93	Early 4th: - Late 4th: - **Early 3rd:** 23(2), 24(2), 26(2), 27(3), 133(3)		
94	**Early 4th:** 8(3), 12(4+3?), 13(5+1?), 21(1) **Late 4th:** 55(1), 138(11+1?) **Early 3rd:** 27(1)		
96	**Early 4th:** 21(1) **Late 4th:** 106(1) Early 3rd: -		
97	Early 4th: - **Late 4th:** 138(1) Early 3rd: -		
99	**Early 4th:** 7(1), 8(2), 11(1), 12(2), 13(5+1?), 17(3), 21(5) **Late 4th:** 6(33+1?), 106(1), 138(3) Early 3rd: -		+1 cross between Type 13 and an undercut rim
112	Early 4th: - Late 4th: - **Early 3rd:** 24(1?)		
113	**Early 4th:** 21(1?) Late 4th: - Early 3rd: -		
115	**Early 4th:** 12(1), 17(2) **Late 4th:** 6(3) Early 3rd: -		

118	**Early 4th:** 8(6), 10(3), 11(3), 12(5), 13(11+2?), 16(1), 17(20), 21(5) **Late 4th:** 6(7), 120(1), 138(24) Early 3rd: -		
119	**Early 4th:** 12(5), 13(3), 21(3) **Late 4th:** 6(1), 106(1), 138(2) Early 3rd: -		
122	**Early 4th:** 8(26), 10(2), 11(20), 12(20), 13(17), 21(24) **Late 4th:** 14(1), 138(40) Early 3rd: -		+2 variants of Type 138
123	**Early 4th:** 11(1), 12(4) Late 4th: - Early 3rd: -		
124	**Early 4th:** 7(1+4?), 8(10), 10(5+3?), 11(11), 12(16), 13(12), 16(7), 17(2+2?), 21(32) **Late 4th:** 138(2) Early 3rd: -		
126	**Early 4th:** 12(2) **Late 4th:** 138(3) Early 3rd: -		
127	Early 4th: - Late 4th: - **Early 3rd:** 22(2), 23(5), 25(1)		
130	**Early 4th:** 12(1) **Late 4th:** 138(4) Early 3rd: -		
131	**Early 4th:** 8(1), 13(1) **Late 4th:** 138(1) Early 3rd: -		
132	**Early 4th:** 8(1), 21(3) **Late 4th:** 138(1) Early 3rd: -		
134	**Early 4th:** 8(1) Late 4th: - Early 3rd: -		
137	**Early 4th:** 7(2), 8(1), 11(9+1?), 12(4), 13(9+3?), 17(2), 21(5) **Late 4th:** 6(2), 138(8)		

	Early 3rd: 23(1)		
138	**Early 4th:** 13(1) **Late 4th:** 6(1) Early 3rd: -		
139	**Early 4th:** 17(2) **Late 4th:** 6(20), 18A(1) Early 3rd: -		
140	**Early 4th:** 8(1), 10(1), 12(1), 17(2), 21(2) **Late 4th:** 138(4) Early 3rd: -		
142	**Early 4th:** 12(3) **Late 4th:** 138(1) Early 3rd: -		
143	**Early 4th:** 12(6+1?), 13(4), 17(5), 21(4) **Late 4th:** 6(6), 14(1), 138(8) Early 3rd: -		
145	**Early 4th:** 7(1), 8(1), 12(3), 13(1?), 17(1) **Late 4th:** 6(2), 14(2), 138(3) **Early 3rd:** 27(2)		
146	**Early 4th:** 8(1), 13(3) **Late 4th:** 15(1), 106(1), 138(5) Early 3rd: -		+1 like Type 138
148	**Early 4th:** 8(7), 11(1), 13(1), 17(6), 21(4) **Late 4th:** 14(2), 106(1), 138(7) Early 3rd: -		
150	**Early 4th:** 7(4), 8(7), 11(5), 12(1), 13(17), 17(3), 21(6) **Late 4th:** 14(6+1?), 138(12) Early 3rd: -		
153	**Early 4th:** 8(2), 21(1) Late 4th: - Early 3rd: -		
154	**Early 4th:** 8(3), 13(2) **Late 4th:** 14(2), 138(7) Early 3rd: -		

158	**Early 4th:** 8(1), 11(1), 12(2), 13(1), 21(2) **Late 4th:** 14(1), 138(1) Early 3rd: -		
160	**Early 4th:** 8(1), 12(1), 21(2) **Late 4th:** 6(1) Early 4th: -		
168	**Early 4th:** 7(4), 11(1), 12(1), 17(2) **Late 4th:** 15(1) Early 3rd: -		
169	Early 4th: - **Late 4th:** 138(7+1?) Early 3rd: -		
170	**Early 4th:** 8(2), 12(5) **Late 4th:** 6(4) **Early 3rd:** 27(3)		
171	**Early 4th:** 7(1), 12(4), 13(2), 21(3) **Late 4th:** 138(4) Early 3rd: -		
172	**Early 4th:** 12(6), 13(1), 21(3) Late 4th: - Early 3rd: -		
173	**Early 4th:** 7(1), 8(1), 12(10), 13(2), 21(4) Late 4th: - Early 3rd: -		
174	**Early 4th:** 8(2), 11(1), 12(7), 13(3), 21(6) **Late 4th:** 15(1), 138(4) Early 3rd: -		
177	**Early 4th:** 11(2), 12(1), 14(2), 17(2), 21(1) **Late 4th:** 55(1), 138(6) **Early 3rd:** 27(2), 133(1)		
179	**Early 4th:** 8(3), 13(4) **Late 4th:** 138(3) Early 3rd: -		+ 1 Uruk hole mouth greyware (Type 8 or Type 138?) + 2 Uruk shallow bowls (Type 7?)

180	Early 4th: - **Late 4th:** 138(3) Early 3rd: -		
181	**Early 4th:** 7(1) Late 4th: - Early 3rd: -		
183	**Early 4th:** 8(3), 12(2), 13(2), 17(2), 21(6) **Late 4th:** 14(1), 138(12) Early 3rd: -		

Appendix C: Plant Taxa Data

Adonis sp.

(3rd and 4th Millennia B.C.)

Elevation: 0 to 3000m

Slope: 0+ degrees

Mountain Plain, Depression, Foothills, Gorges, Hills, Lower Mountain Slopes, Mountains, Northern and Southern Mountain Slopes, Mountainside, River Valleys, Valleys

Soil/Matrix:

Among Rocks, Calcareous Substrate, Clay, Clay Silt, Conglomerate Clay, Gravel, Gypsaceous, Loam, Loess Substrate, Mudrock, Rocky, Sandy, Serpentine, Stony Soil

Habitats:

Near River, Batha, "Corn" Fields, Desert, Disturbed Steppe, Fallow Fields, Fields, Recently Burned, Raised Places in Salty Floodplain, Riverbeds, Steppe, *Triticum* Fields, Uncultivated Land, Wadi Beds, Woodland

All Locations:

Among Rocks Near River, Batha, Calcareous Substrate, Clay in Mountain Plain, Clay Silt, Conglomerate Clay, "Corn" Fields, Desert, Desert Depressions, Disturbed Steppe, Fallow Fields, Fields, Foothills, Gorges, Gravel, Gypsaceous Hills, Loam, Loess Substrate, Lower Mountain Slopes, Mountains, Mudrock, Near River, Northern Mountain Slopes, On Recently Burned Mountainside, Raised Places in Salty Floodplain, River Valleys, Riverbeds, Rocky Desert, Rocky Places, Rocky Slopes, Sandy Desert, Sandy Soil, Serpentine Mountains, Southern Mountain Slope, Steppe, Steppic Plains, Steppic Hills, Stony Soil, *Triticum* Fields, Uncultivated Land, Valleys, Wadi Beds, Woods

Aegilops sp.

(3rd and 4th Millennia B.C.)

Elevation: near Sea Level to 1900m

Slope: 0+ degrees

Hills, Hill Sides, Slopes, Steep Slopes, Depressions, River Banks, Banks in Hills, Plains, Hill Slopes, Lower Mountain Slopes, Gullies, Dunes, Irrigation Bunds, Mountains, Roadside Banks, Cliffs, Rock Ledges, Mountain Slopes, Slopes

Soil/Matrix:

Boulders, Calcareous Soil/Substrata, Compact Sand, Conglomerate, Limestone, Stony Ground, Sandy Gravel, Gravel, Gypsaceous Ground, Eroded Clay, Humid Alluvial Soil, Igneous Substrata, Limestone, Nubian Sandstone, Basalt, Rocky Limestone, Rocky Ground, Saline Soil, Sandstone, Sandy Areas, Sandy Clay/Sandy Clay Soil, Sandy Ground, Sandy Places, Sandy Soils, Sand Pockets on Rocky Ledges, Shale, Shale Substrata, Silty Ground, Stony Limestone, Stony Ground

Habitats:

Adobe Ruins, Banks of Irrigation Canals, Batha, Boulder Scree, Coppiced Oak/Coppiced Oak Forest, Denuded Oak Forest, Cereal Fields, Corn Fields, Cultivated Land, Degraded Forest, Degraded Macchie, Degraded Oak Forest, Cleared Oak Forest, Desert, Disturbed Cultivated Land, Disturbed Land, Disturbed Places, Disturbed Steppe, Dry Cracked Mud River Bank, Dry Grass, Dry Grass Steppe, Earthy Side of a Dry Runnel, Edge of "Corn" Fields, Fallow Fields, Fields, Field Margins, Grassy Places, Grassy Steppe, Irrigated Steppe, Irrigation Bunds, Littoral Dunes, Littoral Plains, Low Dunes, Luxurious Grassy Steppe, Margins of Oaks Forest, Moist Steppe, Muddy River Banks, Oak Forest, Oak Scrub, Open Coastal Pine Forest, Open Meadow, Open Oak Scrub, Open Pine-Oak Woodland, Pine Woodland, Roadsides, Sand Dunes, Coasts, Desert, Scree, Seashore, Steppe, Upland Steppe, Vineyards, Wadis, Waste Places, Waysides, Weed of Cultivation, Wheat Fields

All Locations:

Adobe Ruins, Arid Hills, Banks of Irrigation Canals, Batha, Boulder Scree, Calcareous Hill Sides, Calcareous Soil, Calcareous Substrata, Cereal Fields, Compact Sand, Conglomerate, Conglomerate Hills, Coppiced or Denuded Oak Forest on Limestone Slopes, Coppiced Oak, Coppiced Oak Forest on Limestone, Corn Fields, Cultivated Land, Degraded Forest on Limestone, Degraded Macchie, Degraded Oak Forest on Steep Limestone Slopes, Denuded Oak Forest, Denuded or Cleared Oak Forest on Stony Hill Sides, Denuded Stony Hill Sides, Desert Depressions on Sandy Gravel, Desert Depressions on Gravel, Disturbed Cultivated Land, Disturbed Land, Disturbed Places, Disturbed Steppe, Dry Cracked Mud River Bank on Plains, Dry Grass Banks in Hills, Dry Grassy Steppic Hills and Plains, Dry Gypsaceous Slopes, Dry Hill Sides, Dry Hill Slopes, Dry Open Hillsides, Dry Stony Slopes, Earthy Side of a Dry Runnel, Edge of "Corn" Fields, Eroded Clay, Eroded Hills, Fallow Fields, Fields, Field Margins, Grassy Clay Hill Sides, Grassy Places, Grassy Steppe Land on Lower Mountain Slopes, Grassy Steppic Slopes, Gravelly Places, Gullies, Hills, Humid Alluvial Soil, Igneous Substrata, Irrigated Steppe, Irrigation Bunds, Limestone, Limestone Cliffs, Littoral Dunes, Littoral Plains, Low Dunes, Luxurious Grassy Steppe, Margins of Oak Forest, Moist Steppe, Mountains, Muddy River Banks, Nubian Sandstone Hills, Oak Forest, Oak Forest on Limestone, Oak Scrub, Oak Scrub on Limestone, Open Coastal Pine Forest, Open Meadow on Basalt, Open Oak Scrub, Open Pine-Oak Woodland, Pine Woodland, Plains, Roadside Banks, Roadsides, Rocky Limestone Hills, Rocky Limestone Slopes, Rocky Plains, Saline Soil, Sand Dunes, Sandstone, Sandstone Hill Sides, Sandy Areas, Sandy Clay/Sandy Clay Soil, Sandy Coasts, Sandy Desert, Sandy Fields, Sandy Foothills, Sandy Ground, Sandy Places, Sandy Slopes, Sandy Soils, Scree, Seashore, Shady Limestone Cliff, Shady Rock Ledges, Shady Sand Pockets on Rocky Ledges, Shale Hill Sides, Shale Substrata, Silty Depressions, Silty Desert Depressions, Steep Limestone Slopes, Steppe, Stony Limestone Slopes, Stony Ground, Stony Hill Slopes, Stony Hillsides, Stony Mountain Slopes, Stony Slopes, Upland Steppes, Vineyards, Wadis, Waste Places, Waysides, Weed of Cultivation, Wheat Fields

Ajuga sp.

(4th Millennium B.C.?)

Elevation: 0 to 3660m

Slope: 0+ degrees

Mountain Cliffs, Mountains, Slopes, Banks, Mountain Slope, Crevices, Gorges, Gullies, Sloping and Vertical Rocks facing South and West, Southern Mountain Slope, Valleys

Soil/Matrix:

Calcareous Ground, Clay, Clayey Conglomerate, Limestone Rocks, Rocks, Gravelly Ground, Limestone, Rocky Limestone, Rocky Places, Stony Places

Habitats:

At the Confluence of Rivers, At the Confluence of Rivers in a Gorge, Bushes, By Lake, By River, By Salt Lake, Steppe, Desert, Fallow Fields, Forest, Grazing Land, Scree, Open Habitats, Pasture, Scrub, Wadis, Vineyards, Waste Ground, Wet Places

All Locations:

At the Confluence of Rivers, At the Confluence of Rivers in a Calcareous Gorge, Bushes, By Lake, By River, By Salt Lake, Calcareous Mountain Cliffs, Calcareous Mountains, Calcareous Slopes, Calcareous Steppe, Clay, Clay Banks, Clayey Conglomerate Mountain Slope, Crevices, Crevices of Limestone Rocks, Crevices of Rocks, Desert, Fallow Fields, Forest, Gorges, Gravelly Ground, Grazing Land, Limestone Gullies, Limestone Rocks, Limestone Screes, Mountains, Open Habitats, Pasture, Rocks, Rocky Limestone Slopes, Rocky Slopes, Rocky Steppe, Screes, Scrub, Sloped Steppe, Sloping and Vertical Limestone Rocks facing South and West, Southern Mountain Slope, Steppe, Stony Places, Stony Slopes, Stony Wadis, Valleys, Vineyards, Waste Ground, Wet Places

Androsace maxima

(4th Millennium B.C.)

Elevation: 300 to 2400m

Slope: 0+ degrees

Gorges, Hills, Southern Slope, Valleys

Soil/Matrix:

Clay, Gravel, Igneous Rocks, Limestone Rocks, Pebbles, Sand

Habitats:

Batha, Steppe, Cultivated Fields, Fallow Fields, Fields, Open Pine Woodland, Scree, Steppe, Waste Fields

All Locations:

Batha, Clay Steppe, Cultivated Fields, Fallow Fields, Fields, Gorges, Gravel Steppe, Hills, Igneous Rocks, Limestone Rocks, Open Pine Woodland, Pebbles, Sand Steppe, Scree, Southern Slope, Steppe, Valleys, Waste Fields

Arenaria sp.

(4th Millennium B.C.)

Elevation: 0-3600m

Slope: 0+ degrees

Gorges, Mountains, Mountain Slopes, Northern Mountain Slopes, Plateaus, River Valleys, Northern/ Southern/ Western Slopes, Valleys

Soil/Matrix:

Among Rocks, Calcareous Rocks, Calcareous Substrate, Dry Light Soils, Granite Substrate, Gravel, Rocks, Rocky Places, Sand, Sandy Places, Siliceous Substrate, Stony

Habitats:

Batha, Beech Forest, At Streams, By Spring/Well, Cultivated Ground, Fields, Field Margins, Forest Woodland Districts, Grass, Juniper Forest/Woodland, Oak Forest/Woodland, Open Communities, Open Hornbeam Woodland, Open Oak Forest/Woodland, Pine Forest/Woodland, Riverbeds, At Lake, Lakesides, Meadows, Seashore, Steppe, Woodland

All Locations:

Among Rocks, At Streams, Batha, Beech Forest, By Spring/Well, Calcareous Gorges, Calcareous Rocks, Calcareous Substrate, Cultivated Ground, Dry Light Soils, Fields, Field Margins, Forest/Woodland Districts, Granite Substrate, Grass Above Tree Line, Gravel, Juniper Forest/Woodland, Lakesides, Mountains, Mountain Slopes, Northern Mountain Slopes, Oak Forest/Woodland, Oak Forest/Woodland in Valleys, Open Hornbeam Woodland, Open Communities on Mountains, Open Oak Forest/Woodland, Pine Forest/Woodland, Plateaus, River Valleys, Riverbeds, Rocks, Rocky Northern Slopes, Rocky Places, Sand at Lake, Sandy Places, Sandy Seashore, Siliceous Substrate, Southern Slopes, Steppe, Stony Meadows, Stony Slopes, Valleys, Western Slopes, Woodland

Arnebia linearfolia

(3rd and 4th Millennia B.C.)

Elevation: 800m

Slope:

Hills, Mountains, Valleys, Volcanoes

Soil/Matrix:

Stony

Habitats:

Deserts

All Locations:

Deserts, Hills, Mountains, Stony Hills, Valleys, Volcanoes

Artemisia sp.

(4th Millennium B.C.)

Elevation: Low Altitudes

Slope: 0-60 degrees

Hills

Soil/Matrix:

Desert Soils, Loess, Sandy Places, Senonian Hills

Habitats:

Desert, Fields, Gray Steppe, Open Habitats, Steppe, Waste Places

All Locations:

Desert Soils, Dry Places, Fields, Gray Steppe, Loess, Open Habitats, Sandy Places, Senonian Hills, Steppe, Waste Places

Astragalus sp.

(4th Millennium B.C.)

Elevation: 50 to 4300m

Slope: 0+ degrees

Slopes, Banks, Hill Sides, Plains, Foothills, Gorges, Cliffs, Hills, Depressions, Mountainsides, Mountain Slopes, East Facing (Mountain) Slopes, Slopes, Mountains, Rolling Plains, Valleys

Soil/Matrix:

Basalt-strewn Plains, Calcareous Areas/Ground/Soil, Calcareous Clay, Calcareous Loam, Calcareous Scree, Calcareous Scree on Limestone, Chalky Scree, Chalky Soil, Clay, Compact Sand, Compact Sandy Gravel, Conglomerate, Degraded Barren Conglomerate, Gravel, Gravelly Soils, Gypsaceous Limestone, Gypsaceous Sand, Gypsaceous Soil, Gypsiferous Pebble-strewn, Gypsiferous, Gypsum, Igneous Rock, Limestone, Limestone Scree, Loam, Loose Sandy Soil, Metamorphic Rock, On Alluvium, On Conglomerate, On Gravel, On Gravelly Soil, On Igneous Rock, On Limestone, On Sand, On Sandy Clay, On Sandy Gravel, On Serpentine, On Very Dry Shale and Other Formations, Pebble-strewn, Red Marls, Rocky Basalt-strewn, Rocky Ledges, Rocky Limestone, Rocky Sandstone, Saline Alluvium, Saline Silt, Sand, Sandstone, Sandy Clay, Sandy Eroded Soil, Sandy Gravel, Sandy Places, Sandy Places on Hard Pebble-strewn Gypsiferous Ground, Sandy Soils, Serpentine, Shale, Shale Sandstone, Silt, Silty Gravel-strewn, Silty Places, Silty Soils, Slightly Saline Soil, Stony Calcareous Ground, Stony Clay, Stony Ground/Places, Stony Red Soil, Stony Soil

Habitats:

Alpine/Alpine Regions, Alpine Meadows, Alpine Summit, Among Remnants of Oak Forest, Among Shrubs, Arable Fields, Barley Fields, Barren Fields, Barren Hill Sides, Barren Places, Clearings in Oak Forest, Coppiced Oak, Coppiced Oak Scrub, “Corn” Fields, Cultivated Fields, Cultivated Ground, Cultivated Hill-Forest by a Stream, Cultivated Hill Sides, Cultivated Places, Denuded Oak Forest, Depressions Where Rain Water Accumulates and Gradually Evaporates, Desert Depressions where

Rainwater is Gathering and Gradually Evaporating, Deserts, Desert Places, Desert Plains, Desert Wadis, Destroyed Forest (Grassland), Disturbed Ground, Disturbed Habitats, Dry Alpine, Dry Barren Places, Dry Fields, Dry Grassy Steppe, Dry Gravel by Roadside, Dry Habitats, Dry Places, Dry Plains, Dry Steppe, Dry Steppic Plains, Dry Subalpine Regions, Dry Subalpine Regions, Dry Wadi Beds, Dunes, Edges of Cultivation, Fallow Fields, Felled Forest, Field Borders, Field Margins, Fields, Forest, Grassy Places, In Dry Watercourses, In a Ravine, In Wadis, Macchie, Marly Banks, Meadows, Moist Steppe, Near Melting/Melted Snow, Neglected Fields, Oak Forest, Oak Parkland, Oak Scrub, Open Desert Wadis, Open Habitats, Open Oak Woodland, Open Woods, Pasture, Pine Forest, Pine Woodland, Plains, Remnants of Oak Forest near Villages, Roadsides, Scree, Scrub, Steppe, Steppe Grassland, Steppic Grassland, Subalpine, Sub-desert, Under Juniper, Under Oak, Under Pine, Upland Steppe, Wadis, Waste Fields, Waste Land, Waste Ground, Wells, Wooded Hill Sides, Wooded Valleys, Woodland

All Locations:

Alpine/Alpine Regions, Alpine Meadows, Alpine Rocky Slopes, Alpine Summit, Among Remnants of Oak Forest, Among Rocks, Among Shrubs, Arable Fields, Banks on Limestone, Barley Fields, Barren Fields, Barren Hill Sides, Barren Places, Barren Rocks, Basalt-strewn Plains, Below Tree Line, Broken Country with Limestone Ridges, Calcareous Areas, Calcareous Clay, Calcareous Foothills, Calcareous Ground, Calcareous Loam, Calcareous River Gorges, Calcareous Scree, Calcareous Scree on Limestone, Calcareous Soil, Calcareous Steppe, Chalky Scree, Chalky Slopes, Chalky Soil, Clay, Clearings in Oak Forest, Cliffs, Coastal Plains, Compact Sandy Desert, Compact Sandy Gravel, Conglomerate, Conglomerate Hills, Coppiced Oak, Coppiced Oak Scrub, “Corn” Fields, Cultivated Fields, Cultivated Ground, Cultivated Hill-Forest by a Stream, Cultivated Hill Sides, Cultivated Places, Cultivated Slopes, Degraded Barren Conglomerate Hills, Denuded Oak Forest, Depressions, Depressions Where Rain Water Accumulates and Gradually Evaporates, Desert Depressions where Rainwater is Gathering and Gradually Evaporating, Deserts, Desert Places, Desert Plains, Desert Wadis, Destroyed Forest (Grassland), Disturbed Ground, Disturbed Habitats, Dry Alpine Slopes, Dry and Stony Places, Dry Barren Places, Dry Fields, Dry

Foothills, Dry Grassy Steppic Hill Sides, Dry Gravel by Roadside, Dry Habitats, Dry Hills, Dry Hill Sides, Dry Hill Tops, Dry Mountain Slopes, Dry Places, Dry Plains, Dry Rocky Mountain Slopes, Dry Silt Ridges, Dry Steppic Gypsaceous Hills, Dry Steppic Hill Sides, Dry Steppic Slopes, Dry Steppic Plains, Dry Stony Steppic Degraded Foothills, Dry Stony Steppic Gypsaceous Foothills, Dry Stony Steppic Hills, Dry Stony Steppic Plains, Dry Subalpine Regions, Dry Subalpine Slopes and Valleys, Dry Wadi Beds, Dunes, East Facing Mountain Slopes, East Facing Slope, Edges of Cultivation, Eroded Banks, Fallow Fields, Felled Forest, Field Borders, Field Margins, Fields, Forest, Forested Mountainsides, Grassy Mountain Slopes, Grassy Mountainsides, Grassy Places, Gravel, Gravelly Hillocks, Gravelly Soils, Gypsaceous Desert Plains, Gypsaceous Limestone Hills, Gypsaceous Sandy Hills, Gypsaceous Soil, Gypsiferous Pebble-strewn Plain, Gypsiferous Subdesert, Gypsum Desert, High Meadows, High Rocky Mountains, High Rocky Mountain Slopes, Hill Slopes, Hills, Hilly Pasture, Hilly Steppe, Igneous Rock, Igneous Slopes, In Dry Watercourses, In a Ravine, In Wadis, Limestone, Limestone Mountain on or near Summit, Limestone Mountains, Limestone Mountainside, Limestone Scree, Limestone Slopes, Loam, Loamy Plains, Loose Sandy Soil, Lower Mountain Slopes, Lower Mountain Slopes among Scattered or Coppiced Oak, Macchie, Marly Banks, Meadows, Metamorphic Rock, Moist Steppe, Mountains, Mountainsides, Mountain Slopes, Mountain Slopes in Coppiced Oak, Mountain Slopes in Oak Forest, Near Melting/Melted Snow, Neglected Fields, Oak Forest, Oak Parkland, Oak Scrub, Oak Scrub on Limestone, On Alluvium, On Conglomerate, On Gravel, On Gravelly Soil, On Igneous Rock, On Limestone, On Sand, On Sandy Clay, On Sandy Gravel, On Serpentine, On Very Dry Shale and Other Formations, Open Desert Wadis, Open Habitats, Open Oak Woodland, Open Rocky Escarpment, Open Rocky Places, Open Woods, Pasture, Pebble-strewn Desert, Pebble-strewn Desert Plains, Pine Forest, Pine Woodland, Plains, Red Marls, Red Marl Banks, Remnants of Oak Forest near Villages, Roadsides, Rocky Alpine Slopes, Rocky Alpine Summits, Rocky Basalt-strewn Desert, Rocky Desert Hills, Rocky Foothills, Rocky Hill Sides, Rocky Ledges, Rocky Limestone, Rocky Limestone Banks, Rocky Limestone Desert, Rocky Limestone Slopes, Rocky Mountain Ridges, Rocky Mountainsides, Rocky Mountain Slopes, Rocky Mountain Summits, Rocky Places, Rocky Places above Tree Line, Rocky Sandstone, Rocky Slopes, Rocky Subalpine

Slopes, Rocky Wadis, Saline Alluvium, Saline Silt, Sand, Sand Dunes, Sand Pockets in Wadis, Sandstone, Sandstone Banks, Sandstone Hills, Sandstone Slopes, Sandy Clay, Sandy Clay in Depressions, Sandy Desert, Sandy Desert Hill Slopes, Sandy Desert Places, Sandy Desert Plains, Sandy Desert Wadis, Sandy Eroded Soil, Sandy Fields, Sandy Gravel, Sandy Gravel Desert, Sandy Gravel Plains, Sandy Gravel Soils, Sandy Hills, Sandy Hill Slopes, Sandy Places, Sandy Places in Desert Depressions, Sandy Places in Desert Wadis, Sandy Places on Hard Pebble-strewn Gypsiferous Desert, Sandy Plains, Sandy Pockets in Rocky Limestone Hills, Sandy Slopes, Sandy Soils, Sandy Wadis, Sandy Waste, Scree, Scrub, Serpentine, Shale, Shale Hills, Shale Hill Sides, Shale Sandstone Hills, Silt, Silty Depressions, Silty Desert Depressions, Silty Gravel-strewn Plain, Silty Places, Silty Soils, Slight Depressions, Slightly Saline Soil, Slopes, Steep Rocky Hill Side, Steppe, Steppe Grassland, Steppic Grassland, Steppic Gypsaceous Foothills, Steppic Foothills, Steppic Hilltops, Steppic Plains, Steppic Rolling Plains, Steppic Stony Sand Ridges, Stony Alpine Slopes, Stony Calcareous Ground, Stony Clay, Stony Clay Hill Sides, Stony Desert Wadis, Stony Foothills, Stony Ground, Stony Hills, Stony Mountain Slopes, Stony Places, Stony Places on Hills, Stony Plains, Stony Red Soil, Stony Slopes, Stony Soil, Subalpine, Subalpine Mountain Slopes, Subalpine Rocky Mountain Slopes, Sub-desert, Summits, Under Juniper, Under Oak, Under Pine, Upland Steppe, Upper Mountain Slopes, Upper Steppe Approaching Forest Climate, Valleys, Wadis, Waste Fields, Waste Land, Waste Ground, Wells, Wooded Hill Sides, Wooded Valleys, Woodland

Bellevalia sp.

(3rd and 4th Millennium B.C.)

Elevation: 50 to 3600m

Slope: 0+ degrees

Quarry, Hills, Hillsides, Slopes, Depressions, Valleys, Plains, Banks, Caves, Mountains, Lower Mountains, Low Mountain Pass, Cliff Face, Northern Mountain Slopes

Soil/Matrix:

Marble Quarry on Clay, Alluvial Soils, Calcareous Rocks, Calcareous Substrate, Chalky Hills, Coarse Sand and Flint, on Limestone, on Clay Soil, Deep Loamy Soil, Dry Rocky Places, Alluvial Soils, Deep Heavy and Humid Alluvial Soil, Heavy Alluvial Soils, Reddish Earth, Moist Alluvial Soils, on Clay, Open Stony Places, Pockets of Soil, Rocky Clay, Rocky Conglomerate, Rocky, Rocky Sandstone, Sandy Gravel, Sandy Loam, Sandy Places, Sandy Soils/Substrate, Sandy Clay, Stony Places

Habitats:

Abandoned Marble Quarry, Among *Astragalus,* Among Oak, At the Sea, Batha, Between Fields, Cereal Fields, Coppiced Oak, Corn Fields, Cultivated Land/Places, Damp Meadows, Grassland, Desert, Destroyed Woodland, Devastated Forest/Woodland, Disturbed Habitats, Dry Overgrazed Steppe, Destroyed Oak Forest, Fallow Fields, Fields, Grassy Banks, In Caves, In Irrigated Derelict Fields, Irrigated Fields, Denuded Oak Forest, Macchie, Meadows, Melting Snow, Near Late Snow, Oak Forest, Open Forest, Orchards, Palm Forests, Plains, Snow, Steppe, Tragacanth Tree Woodland/Grove/Plantation, Uncultivated Fields, Vineyards, Waste Derelict Fields, Wet to Very Wet Grass, Wet Meadows, Wheat Fields

All Locations:

Abandoned Marble Quarry on Clay, Alluvial Soils, Among *Astragalus,* Among Oak, At the Sea, Batha, Calcareous Rocks, Between Fields, Calcareous Substrate, Cereal Fields, Chalky Hills, Coarse Sand and Flint, Coppiced Oak on Limestone, “Corn” Fields, Cultivated Land, Cultivated Places, Cultivated Places on Clay Soil, Damp

Meadows, Deep Loamy Soil on a Hillside, Deforested Slopes on Grassland, Desert Depression, Destroyed Woodland, Devastated Forest/Woodland, Disturbed Habitats, Dry Overgrazed Stony Steppic Hills, Dry Rocky Places among Destroyed Oak Forest, Fallow Fields, Fields, Fields in Valley and Plains, Fields on Alluvial Soils, Fields on Deep Heavy and Humid Alluvial Soil, Fields on Heavy Alluvial Soils, Fields on Reddish Earth, Grassy Banks, Hills, Hillsides, In Caves, In Irrigated Derelict Fields, Irrigated Fields, Limestone Mountains, Lower Mountains, Low Mountain Pass in Denuded Oak Forest, Macchie, Meadows, Melting Snow, Moist Alluvial Soils, Moist Banks, Mountains, Mountain Regions, Near Late Snow, Northern Mountain Slopes, Oak Forest, Open Forest on Clay Slope, Open Stony Places, Orchards, Palm Forests, Plains, Pockets of Soil on Cliff Face, Rocky Clay Desert Plains, Rocky Conglomerate Hills, Rocky Hills, Rocky Sandstone Hills, Sandy Gravel, Sandy Hills, Sandy Loam, Sandy Places, Sandy Soils, Sandy Substrate, Snow, Southeast Slopes, Steep Loose Slopes, Steppe, Steppic Hills, Steppic Plains, Steppic Sandy Clay, Stony Hillsides, Stony Mountainsides, Stony Places, Tragacanth Tree Woodland/Grove/Plantation, Uncultivated Fields, Valleys, Vineyards, Waste Derelict Fields, Wet to Very Wet Grass, Wet Meadows, Wheat Fields

Bromus sp.

(3rd and 4th Millennia B.C.)

Elevation: near Sea Level to 3960m

Slope: 0+ degrees

Banks, Plains, Slopes, Hillsides, Hillocks, Hills, Gorges, Ditches, Mountain Slopes, Depressions, Hill Tops, Ridges, Foothills

Soil/Matrix:

Among Sandstone Rocks, Between Metamorphic Rocks, Calcareous Sandstone, Alluvial Plain, Clay between Rocks, Chalk, Clay on Rocky Ground, Comparatively Dry Silt, Conglomerate, Limestone, Cultivated Soil, Calcareous Ground, Conglomerate, Dry Silty Soil, Gypsaceous Ground, Limestone Scree, Rocky Places, Sandy Places, Gravel, Gravelly Gypsum, Gravelly Places, Heavy Slightly Saline Soils, Heavy Soil, Slightly Saline, Igneous Rock, Irrigated Land, Metamorphic Rock, Open Sandy Rocky Areas, Red Clay between Limestone Boulders, Rocky Limestone, Rocky Places/Regions, Saline Silt, Saline Soils, Sandstone, Sandy Calcareous Soil, Sandy Depression, Sandy Desert Soil, Sandy Desert Soil with Silt, Sandy Gravel, Sandy Places, Sandy Soils, Sandy Soil over Rocks, Silt, Silty Soil, Calcareous Sandstone, Stony, Stony Silt, Stony Soil, Various Soils

Habitats:

Along Channels, Alpine, Alpine Meadows, Arid Places, Arid Waste Places, Banks of Canals, Batha, Margin of Thorn-Cushion Zone, By Stream in Shade, Canal Bank on Alluvial Plain, Coastal Shingle, Coppiced, Cultivated Fields, Cultivated Ground, Cultivated Hillside in Forest, Cultivated Land, Cultivated Soil, Damp Gully in Oak Scrub, Damp Places, Desert, Desert Places, Desert Wells, Disturbed Ground, Ditches, Dry Grassland, Dry Greenland, Scree, Dry Open Banks, Dry Open Grassland, Dry Open Greenland, Dry Open Pastures, Dry Parts of Marsh, Dry Places, Dry Steppe, Fallow Fields, Fields, Field Margins, Fields in Steppe, Forest Clearings, Forest, Gardens, Grassy Places, Grassy Slope in Spray of Waterfall, Grassy Steppe, Hammada, Slightly Saline Desert, In Cultivation, Irrigated Fields, Irrigated Orchard

Pasture, Irrigated Orchards, Irrigated Places, Macchie, Margins of Fields, Maritime, Marshes, Moist Fields, Moist Sandy Places in Dry Steppe and Sub-desert, Moist Steppe Meadows, Oak Forest, Oak Phrygana, Open Cedar and Pine Forest, Open Habitats, Open Phrygana, Open Regions, Open Woodland, Orchards, Pine Forest, Recently Opened Steppe, River Banks, Roadsides, Roofs, Ruderal Habitats, Ruins, in Wadis, Sea Coast, Sea Shore, Shady Gardens, Shingle, under Shrubs, Steppe, Steppic Grassland, under Oak Trees, in Forest, Wadi Beds, Walls, Waste Fields, Waste Ground, Waste Land, Waste Places, Waysides, Wet Places, Wet Waste Land, Woodland

All Locations:

Along Channels, Alpine, Alpine Meadows, Among Sandstone Rocks, Arid Places, Arid Waste Places, Banks of Canals, Batha, Between Metamorphic Rocks on Margin of Thorn-Cushion Zone, By Stream in Shade, Calcareous Sandstone, Canal Bank on Alluvial Plain, Clay between Rocks on Mountain Slopes, Chalk, Clay on Rocky Slopes, Coastal Shingle, Comparatively Dry Silt, Conglomerate, Coppiced Limestone Slope, Cultivated Fields, Cultivated Ground, Cultivated Hill Side in Forest, Cultivated Land, Cultivated Soil, Damp Gully in Oak Scrub, Damp Places, Desert, Desert Places, Desert Wells, Disturbed Ground, Ditches, Dry Calcareous Hills, Dry Conglomerate Hills, Dry Grassland, Dry Grassy Slopes in Mountains, Dry Greenland, Dry Gypsaceous Hills, Dry Hills, Dry Limestone Gorges, Dry Limestone Scree, Dry Mountainous Slopes, Dry Open Banks, Dry Open Grassland, Dry Open Greenland, Dry Open Pastures, Dry Parts of Mountain Marsh, Dry Places, Dry Rocky Places, Dry Rocky Slopes in Mountains, Dry Sandy Places, Dry Silty Soil, Dry Slopes, Dry Slopes on Lower Mountains, Dry Steppe on Gypsaceous Hills, Dry Steppic Hills, Dry Stony Hills, Fallow Fields, Fields, Field Margins, Fields in Steppe, Forest Clearings, Forested Hill Sides, Gardens, Grassy Hills, Grassy Mountain Slopes, Grassy Slope in Spray of Waterfall, Grassy Steppe, Gravel, Gravel Depression in Desert, Gravel Plains, Gravelly Gypsum Desert, Gravelly Places in Wadis, Hammada, Heavy Slightly Saline Soils, Heavy Soil, Hills, Hill Sides, Hill Slopes, Hollow in Slightly Saline Desert, Igneous Rock, In Cultivation, Irrigated Fields, Irrigated Land, Irrigated Mountain Orchard Pasture, Irrigated Orchards, Irrigated Places, Limestone, Low Hills, Lower Mountain Slopes, Macchie, Margins of Fields, Maritime Sands, Marshes, Metamorphic Rock, Moist Depressions, Moist Fields, Moist Sandy Places in Dry Steppe and Sub-desert, Moist Steppe, Mountain Meadows, Mountain Slopes, Mountain Steppe, Oak Forest on Limestone, Oak Phrygana, On Limestone, Open Cedar and Pine Forest, Open Habitats, Open Phrygana, Open Regions, Open Sandy Rocky Areas, Open Woodland, Orchards, Pine Forest, Pine Forest on Limestone Crags, Plains, Recently Opened Steppe, Red Clay between Limestone Boulders, River Banks, Roadsides, Rocky Alpine Slopes, Rocky Hillsides, Rocky Limestone Desert Hill Tops, Rocky Limestone Slopes, Rocky Mountain Slopes, Rocky Places, Rocky Regions, Rocky Slopes, Rocky Steppe, Roofs, Ruderal Habitats, Ruins, Saline Silt, Saline Soils, Sandstone, Sandy Calcareous Soil, Sandy Depression in Desert, Sandy Depressions in Wadi, Sandy Desert, Sandy Desert Soil, Sandy Desert Soil with Silt, Sandy Fields, Sandy Gravel Plain, Sandy Hillocks, Sandy Hills, Sandy Patches between Desert Limestone Ridges, Sandy Places, Sandy Places in Wadis, Sandy Soils, Sandy Soil over Rocks, Sandy Steppe, Sea Coast, Sea Shore, Shady Gardens, Shady Mountain Slopes, Shallow Silty Desert Depressions, Shingle, Silt, Silty Depressions, Silty Desert Depressions, Silty Soil, Single Island in River under Shrubs, Slopes, Steep Calcareous Sandstone, Steep Calcareous Sandstone Slope, Steep Rocky Mountainside, Steppe, Steppic Foothills, Steppic Grassland in Foothills and Upper Plains, Steppic Grassland on Conglomerate Hills, Steppic Range, Stony Desert Places, Stony Desert Slopes, Stony Ground under Oak Trees, Stony Hillocks, Stony Mountainside, Stony Silt Plain, Stony Slopes, Stony Soil, Stony Steppic Grassland, Subalpine, Under Shrubs on Shingle, Various Soils, Various Soils in Forest, Wadi Beds, Walls, Waste Fields, Waste Ground, Waste Land, Waste Places, Waysides, Wet Places, Wet Waste Land, Woodland on Limestone Mountain Ridge

Bupleurum sp.

(4th Millennium B.C.)

Elevation: near Sea Level to 3900m

Slope: 0+ degrees

Banks, Mountains, Wadis, Hill Slopes, Hillsides, Plains, Slopes, Hills, Ledges, Mountains, Northern Mountain Slopes, River Banks, River Valleys, Southern Mountain Slopes, Stream Banks, Subalpine and Middle Mountains, Valleys, Walls, Western Slopes

Soil/Matrix:

Calcareous Substrate, Calcicole, Cultivated Ground, Dry Sandy Places, Granite Substrate, Calcareous Soils, Volcanic Rock, Rocks, Rocky Gneiss, Rocky Mica Schist, Rocky Places, Rocky Schist, Rocky Serpentine, Saline Earth, Saline Soil, Sandy Places, Serpentine, Stony Ground, Walls

Habitats:

Among Winter Crops, Batha, Cedar Forest, Cultivated Fields, Cyprus Wood/Grove/Plantation, Deciduous Woodland, Desert Wadis, Deserts, Dry Bushy Places, Dry Fields, Dry More or Less Open Places, Dry Open Habitats, Dry Open Localities, Dry Open Places, Dry Places, Plains, Fields, Forests, Grassy Places, In Grass, Juniper Forest, Macchie, Meadows, Oak Forest, Open Dry Habitats, Open Forest, Open Habitats, Open Oak Forest, Open Pine Forest, Open Woodland, Pastures, Phrygana, Pine Forest, Maritime, River Banks, Roads, Roadsides, Ruderal, Scree, Scrub, Scrub Vegetation, Seashores, Segetal, Steppe, Sterile Places, Stream Banks, Subalpine, Walls, Woodland

All Locations:

Among Winter Crops, Banks, Batha, Calcareous Mountains, Calcareous Steppe, Calcareous Substrate, Calcicole, Cedar Forest, Cereal Weed, Cultivated Fields, Cultivated Ground, Cyprus Wood/Grove/Plantation on Calcareous Substrate, Deciduous Woodland, Desert Wadis, Deserts, Dry Bushy Places, Dry Fields, Dry Hill

Slopes, Dry Hillsides, Dry More or Less Open Places, Dry Open Habitats, Dry Open Localities, Dry Open Places, Dry Places, Dry Sandy Plains, Dry Slopes, Fields, Forests, Granite Substrate, Grassy Places, Hills, Hillsides, In Grass, Juniper Forest, Ledges, Macchie, Meadows, Mountain Steppe, Mountains, Northern Mountain Slopes, Oak Forest, Open Dry Habitats, Open Forest, Open Habitats, Open Oak Forest, Open Pine Forest, Open Woodland, Pastures, Phrygana, Pine Forest, Preferably Maritime, Preferably on Calcareous Soils, Preferably on Volcanic Rock, River Banks, River Valleys, Roads, Roadsides, Rocks, Rocky Gneiss, Rocky Mica Schist, Rocky Places, Rocky Schist, Rocky Serpentine, Rocky Slopes, Ruderal Plant, Saline Earth, Saline Soil, Sandy Plains, Scree, Scrub, Scrub Vegetation, Seashores, Segetal Weed, Serpentine Mountains, Slopes, Southern Mountain Slopes, Steppe, Sterile Places, Stony Ground, Stream Banks, Subalpine and Middle Mountains, Valleys, Walls, Western Slopes, Woodland

Centaurea sp.

(4th Millennium B.C.)

Elevation: near Sea Level to 3500m

Slope: 0+ degrees

Banks, Hills, Cliffs, Dunes, Hillsides, Slopes, Ridges, Mountain Regions, Plains, Vertical Rocks

Soil/Matrix:

Calcareous Soil, Chalky, Chalky Rocks, Consolidated Sand Dunes, Cultivated Ground, Desert Soil, Heavy Alluvial Soils, Limestone, Limestone Ridges, Limestone Rocks, Loess, Loose Sandy Desert Soils, Mainly Granite, Maritime Sands, Mostly on Chalky Soil, Not Rocks, Rocks, Rocky Places, Sandstone, Sandy Loam Poor in Calcium, Sandy Places, Sandy Soil, Stony Places, on Calcareous Soil, Terra Rosa

Habitats:

Along Canal Banks, Alpine Regions, Batha, Borders of Fields, Bushy Places, Cultivated Land, Desert Wadis, Deserts, Disturbed Pine Forests, Dry Meadows, Dry Pastures, Dry Places, Dry Waste Ground, Dry Woodland, Edges of Cultivation, Fallow Fields, Field Margins, Fields, Forests, Grassy Places, Hammadas, Grassland, Macchie, Maritime, Meadows, Oak Forests, Oak Scrub, Open Pine Forest, Pastures, Pine Forests, Plains, Plowed Fields, Roadsides, Coastal Plains, Littoral Plains, Wadis, Scree, Semi-desert, Shrubs, Steppe, Sterile Places, Subalpine Regions, Waste Land, Waste Places, Weed of Cultivation, Woodland

All Locations:

Along Canal Banks, Alpine Regions, Batha, Borders of Fields, Bushy Places, Calcareous Soil, Chalky Hills, Chalky Rocks, Cliffs, Consolidated Sand Dunes, Cultivated Ground, Cultivated Land, Desert Hillsides, Desert Soil, Desert Wadis, Deserts, Disturbed Pine Forests, Dry Banks, Dry Hills, Dry Hillsides, Dry Meadows, Dry Pastures, Dry Places, Dry Rocky Slopes, Dry Slopes, Dry Stony Slopes, Dry Waste Ground, Dry Woodland, Edges of Cultivation, Fallow Fields, Field Margins, Fields, Forests, Grassy Places, Hammadas, Heavy Alluvial Soils, High Mountain Steppe, Hills, Limestone, Limestone Cliffs, Limestone Grassland, Limestone Hillsides, Limestone Ridges, Limestone Rocks, Loess, Loose Sandy Desert Soils, Macchie, Mainly Granite, Maritime Sands, Meadows, Mostly on Chalky Soil, Mountain Regions, Mountain Steppe, Not Rocks, Oak Forests, Oak Scrub, Open Pine Forest, Pastures, Pine Forests, Plains, Plowed Fields, Roadsides, Rocks, Rocky Hillsides, Rocky Places, Rocky Slopes, Rocky Steppe, Sandstone, Sandstone Hills, Sandy Coastal Plains, Sandy Deserts, Sandy Fields, Sandy Littoral Plains, Sandy Loam Poor in Calcium, Sandy Places, Sandy Soil, Sandy Wadis, Scree, Semi-desert, Shrubs, Steppe, Sterile Hills, Sterile Places, Stony Places, Stony Slopes, Stony Slopes on Calcareous Soil, Stony Wadis, Subalpine Regions, Terra Rosa, Valleys, Vertical Rocks, Waste Land, Waste Places, Weed of Cultivation, Woodland

Cephalaria syriaca

(3rd and 4th Millennia B.C.)

Elevation: 120-2600m

Slope:

At the Entrance to a River Gorge, Hills, Mountains, Plains, Slopes, Valleys

Soil/Matrix:

Calcareous Substrate, Gravelly Serpentine, Rocky

Habitats:

Between Fields, Crop Fields, Deserts, Desert Margins, Fallow Fields, Fields, Gardens, Grain Fields, Oak Forest, Oak Woodland, Plains, Roadsides, Waste Ground

All Locations:

At the Entrance to a River Gorge, Between Fields, Calcareous Substrate, Crop Fields, Deserts, Desert Margins, Fallow Fields, Fields, Gardens, Grain Fields, Gravelly Serpentine, Hills, Mountains, On Arid Slopes, Open Places, Open Rocky Oak, Oak Forest, Oak Woodland, Plains, Roadsides, Rocky Mountains, Valleys, Waste Ground

Coronilla sp.

(3rd Millennium B.C.)

Elevation: 0 to 2150m

Slope:

Mountains, Mountain Slopes, Hills, Slopes, Upland Slopes

Soil/Matrix:

Basic Soils, Clay Soils, Cultivated Ground, Disturbed Ground, Metamorphic Rock, Rocky Places, Sandy Soils, Stony Red Soil, Stony Places

Habitats:

By Stream under Walnut Trees, By Stream, Cultivated Ground, Damp Places, Deciduous Woodland, Disturbed Habitats, Fields, Grassy Places, Orchards, Scrub, Woodland

All Locations:

Basic Soils, By Mountain Stream under Walnut Trees, By Stream, Clay Soils, Cultivated Ground, Damp Places on Mountain Slopes, Deciduous Woodland, Disturbed Ground, Disturbed Habitats, Fields, Grassy Hills, Hills, Metamorphic Rock, Orchards, Rocky Slopes, Sandy Soils, Scrub, Stony Red Soil, Stony Slopes, Upland Slopes, Woodland

Eremopyrum sp.

(4th Millennium B.C.)

Elevation: 50-2500m

Slope: 0 to 60 degrees

Banks, Hill Sides, Slopes, Plains

Soil/Matrix:

Arid Sandy Soils, Clayey Ground, Conglomerate, Desert, Dry Calcareous Ground, Gravel, Gravel Soils, Gypsum, Igneous, Muddy Ground, River Deposited Silt, Rocky Ground, Saline Soil, Sand, Sandy Gravel, Sandy Patches in Pebble-strewn Gypsum Ground, Sandy Soils, Shale Slopes, Silt, Silty Soil

Habitats:

Arid Areas, Canal Banks, Desert, Desert Areas, Dry Arid Areas, Dry Places, Dry Wadi Beds, Fallow Fields, Fields, Hammada, Lake Margins, Open Habitats, Rocky Ground, Plains, Steppe, Steppic Sub-desert Plain, Vineyard

All Locations:

Arid Areas, Arid Sandy Soils, Canal Banks, Clayey Ground, Conglomerate, Desert, Desert Areas, Dry Arid Areas, Dry Calcareous Hill Sides, Dry Places, Dry Slopes, Dry Wadi Beds, Fallow Fields, Fields, Gravel, Gravel Soils, Gypsum, Hammada, Hill Sides, Igneous Slopes in Steppe, Lake Margins, Muddy Ground, Open Habitats, River Deposited Silt, Rocky Ground, Saline Soil, Sandy Gravel, Sandy Gravel Plains, Sandy Patches in Pebble-strewn Gypsum Desert, Sand, Sandy Soils, Shale Slopes in Steppe, Silt, Silty Soil, Steppe, Steppic Sub-desert Plain, Vineyard

Ficus carica

(3rd Millennium B.C.)

Elevation: 10 to 2000m

Slope: 0+ degrees

Cliff of a Gorge, Gorge, Gorge near Waterfall, Hills, Mountain Slopes, Mountains, River Gorge, River Valleys, Rock Fissures, Shady Crevices, Side of Wadi in Fissure, Slopes, Valleys

Soil/Matrix:

Calcareous Substrate, Rocky, Rock Fissures, Calcareous Rocks, Sandstone Fissure, Stony Places

Habitats:

By Lakes, By Rivers, Cultivated for Figs, Near Waterfall, Mixed Forests, Moist Places, Oak Forest, Pine Forest, River Valleys, Side of a Wadi

All Locations:

By Lakes, By Rivers, Calcareous Cliff of a Gorge, Calcareous Substrate, Cultivated for Figs, Gorge, Gorge near Waterfall, Hills, Mixed Forests, Moist Places on Rocky Mountain Slopes, Mountains, Oak Forest, Open Places, Pine Forest, River Gorge, River Valleys, Rock Fissures, Shady Crevices on Calcareous Rocks, Side of a Wadi in Sandstone Fissure, Slopes, Stony Slopes in River Valleys, Valleys

Ficus sp.

(4th Millennium B.C.)

Elevation: 10 to 2000m

Slope: 0+ degrees

Cliff of a Gorge, Cliffs, Eastern Volcano Slopes, Gorge, Gorge near Waterfall, Hills, Mountain Slopes, Mountains, River Gorge, River Valleys, Fissures, Crevices, Side of a Wadi in Fissure, Slopes, Valleys

Soil/Matrix:

Calcareous Substrate, Gysaceous Substrate, Rock Fissures, Calcareous Rocks, Rocky Places, Sandstone, Stony Places

Habitats:

By Lakes, By Rivers, Cultivated for Figs, Near Waterfall, Mixed Forests, Moist Places, Oak Forest, Pine Forest, River Valleys, Side of a Wadi

All Locations:

By Lakes, By Rivers, Calcareous Cliff of a Gorge, Calcareous Gorge, Calcareous Substrate, Cliffs, Cultivated for Figs, Eastern Volcano Slopes, Gorge, Gorge near Waterfall, Gypsaceous Substrate, Hills, Mixed Forests, Moist Places on Rocky Mountain Slopes, Mountains, Oak Forest, Open Places, Pine Forest, River Gorge, River Valleys, Rock Fissures, Shady Crevices on Calcareous Rocks, Side of a Wadi in Sandstone Fissure, Slopes, Stony Slopes in River Valleys, Valleys

Fumaria sp.

(4th Millennium B.C.)

Elevation: 0 to 2000m

Slope: 0+ degrees

Ancient Mounds, Hills, Mountainsides, Ditches, Depressions, Mountain Slopes, Mountains, Slopes, Plains, Foothills, Banks, Under Ledges, Walls

Soil/Matrix:

Cultivated Soil, Damp Soil, Gravelly, Silty, Limestone, Stony, Moist Clay, Rocky, Sandy Gravel, Sandy Loam, Silty Alluvial Soils, Silty Deposits, Under Sandstone Ledges

Habitats:

Among Shrubs, Ancient Mounds, By a Spring, Coast, Cultivated Fields, Cultivated Ground, Date Gardens, Disturbed Land, Disturbed Places, Ditches in Date Gardens, Fields, Gardens, Hedges, Humid Shady Places, Maritime Region, Overgrazed Land, Oak Scrub, Orchards, Plains, Roadsides, Sheltered Cultivated Ground under Shrubs or Trees, Banks of Rivers, Vineyards, Walls, Walnut Grove near a Stream, Waste Ground, Waste Places

All Locations:

Among Shrubs, Ancient Mounds, By a Spring, Coast Ranges, Cultivated Fields in Hills, Cultivated Ground, Cultivated Soil, Damp Soil on Mountainsides, Date Gardens, Disturbed Land, Disturbed Places, Ditches in Date Gardens, Fields, Gardens, Gravelly Hills, Hedges, Humid Shady Places, In Silty Depressions, Limestone Hills, Maritime Region, Mountain Slopes, Mountains on Stony Overgrazed Limestone Slopes, Oak Scrub on Moist Clay, Orchards, Plains, Roadsides, Rocky Shady Places, Rocky Slopes, Sandy Gravel Plains and Foothills, Sandy Loam Foothills, Shady Places, Sheltered Cultivated Ground under Shrubs or Trees, Silty Alluvial Soils, Silty Deposits on Banks of Rivers, Slopes, Stony Banks, Stony Ground, Under Sandstone Ledges, Vineyards, Walls, Walnut Grove near a Stream, Waste Ground, Waste Places

Galium sp.

(4th Millennium B.C.)

Elevation: 0 to 3650m

Slope: 0+ degrees

Banks, Cliffs, Cliffs in Gorges, Crannies in Crags, Crevices, Crevices in Caverns, Hills, Dunes, Ditches, Mountain Slopes, Under Cliffs, Depressions, Ledges, Hill Sides, Gorges, Plains, Mountain Slopes, Under Walls

Soil/Matrix:

on Limestone, on Loamy Clay between Rocks, Among Stones, Conglomerate, Cracks in Limestone, Crannies in Limestone, Cultivated Soil, Limestone Rocks, on Serpentine Rocks, Earth, Conglomerate Gravelly and Gypsaceous Ground, Hard Limestone, Igneous Rock, Limestone, Limestone Rocks, Metamorphic Rock, on Clay, on Disturbed Soil, Rocks, Rocky Ground, Rocky Limestone, Rocky Places, Sandstone, Sandy Ground, Sandy Gravel, Sandy Loam, Sandy Places, Serpentine Rock, Silty Soil, Stony Places/Ground, Tumbled Rocks, Under Walls

Habitats:

Alpine Tall Herb Communities, Among Coppiced Oak, Among Oak Trees, Among Ruins, At Foot of Trees, Banks of Streams, Batha, By Springs, By Streams under Walnut Groves, Close Turf, Cultivated Fields, Cultivated Ground, Cultivated Land, Cultivated Soil, Damp Places, Damp Scrub, Date Groves, Desert Wadi Beds, Disturbed Rocky Roadsides, Dried Up Marshes, Dried Up Riverbeds, Dry Forest, Dry Open Habitats, Dry Places, Dunes, Edge of a Stream on Serpentine Rocks, Fallow Fields, Fields, Foot of Earth Bank, Forest Vegetation, Gardens, Grassland, Grassy to Bushy Places, Groves, Hedges, Humid to Mesic Places, In Garden Lawns, In Riverine Tamarisk Thickets, Irrigation Ditches, Macchie, Meadows, Moist Grassland, Damp Turfy Places, Destroyed Oak Forest, Near Springs, Oak Forest, Oak Trees in Villages, Oak Woodland, Open Oak Forest, Open Forest, Open Shrub, Open Woodland, Orchards, Pine Woodland, Plains, Poorly Irrigated Orchards, River Banks, Riversides, Roadsides, by Waterfalls, Desert Wadis, in Wadis, Desert, Scree, Scrub, Shade in Oak

Forest, in Date Garden, under *Ziziphus* Shrubs in Desert Depressions, Springs, in Desert Wadis, Steppe, Steppe Plains, between Vineyards, Pastures, in Dry Stream Beds, Under Walls, in Oak Shade, Vineyards, Walls, Walnut Groves near Stream, Woodland

All Locations:

Alpine Tall Herb Communities, Among Coppiced Oak on Limestone, Among Oak Trees, Among Ruins on Loamy Clay between Rocks, Among Stones at Foot of Trees, Banks of Streams, Batha, By Spring, By Stream under Walnut Grove, Cliffs, Cliffs in Gorges, Close Turf, Coastal Cliffs, Conglomerate, Cool Damp Shady Places, Cracks in Shady Limestone Cliffs, Crannies in Limestone Crags above Treeline, Crevices, Crevices in Caverns, Cultivated Fields, Cultivated Ground, Cultivated Land, Cultivated Soil, Damp Places, Damp Scrub, Damp Shady Limestone Rocks, Date Groves, Desert Wadi Beds, Disturbed Rocky Roadsides, Dried Up Marshes, Dried Up Riverbeds, Dry Forest, Dry Hills, Dry Open Habitats, Dry Places, Dry Rocky Slopes, Dry Stony Steppic Hills, Dunes, Edge of a Stream on Serpentine Rocks, Fallow Fields, Fields, Foot of Earth Bank, Forest Vegetation, Gardens, Grassland on Dry Steppic Conglomerate Gravelly and Gypsaceous Hills, Grassy Northern Slopes of Dry Steppic Hills, Grassy to Bushy Places, Groves, Hard Limestone Cliffs, Hedges, Humid to Mesic Places, Igneous Rock, In Garden Lawns, In Riverine Tamarisk Thickets, Irrigation Ditches, Limestone, Limestone Rocks on Mountain Slopes, Limestone Rocks under Cliffs, Lowlands to Montane to Alpine, Macchie, Meadows, Metamorphic Rock, Moist Depressions in Grassland, Moist Grassland, Moist Rocky Ledges, Mountain Slopes, Mountain Summit, Mountains, Mountains in Damp Turfy Places, Mountains in Destroyed Oak Forest on Limestone Slopes, Mountainsides, Near Springs at Foot of Mountains, Northern Slope, Oak Forest, Oak Forest on Limestone, Oak Trees on Clay in Villages, Oak Woodland, On Limestone, Open Oak Forest on Limestone, Open Forest, Open Rocky Slopes, Open Shrub, Open Woodland, Orchards, Overhanging Shady Rocks, Pine Woodland, Plains on Disturbed Soil, Poorly Irrigated Orchards, River Banks, Riversides, Roadsides, Rock Crevices, Rocks, Rocky and Shady Hill Sides, Rocky Gorges, Rocky Ground, Rocky Hill Sides, Rocky Limestone Cliffs, Rocky Limestone Slopes, Rocky Mountain Slopes, Rocky Mountainsides, Rocky Places, Rocky Shady Places, Rocky Slopes, Rocky Slopes by Waterfalls, Sandstone Hill Sides, Sandy Desert Wadis, Sandy Gravel Soil, Sandy Loam in Wadis, Sandy Places in Limestone Desert, Scree, Scrub, Serpentine Rock, Shade in Oak Forest, Shady and Rocky Places, Shady Places, Shady Places in Date Garden, Shady Places on Mountain Slopes, Shady Rocks, Sheltered Habitats, Sheltered Hill Sides, Sheltered Rocky Crevices, Silty Soil under *Ziziphus* Shrubs in Desert Depressions, Springs, Stony Hills, Stony Places, Stony Places in Desert Wadis, Steppe, Steppe Plains, Steppic Hills, Stony Ground between Vineyards, Stony Hills, Stony Mountain Slopes, Stony Pastures, Stony Places in Dry Stream Beds, Stony Slopes, Sunny Limestone Rocks, Tumbled Rocks, Under Walls, Valley Bottoms, Valley Bottoms in Oak Shade, Vineyards, Walls, Walnut Groves near Stream, Warm Rocks, Waste Ground, Woodland

Gypsophila sp.

(3rd and 4th Millennia B.C.)

Elevation: 100 to 3800m

Slope: 0 to 60 degrees

Cliffs, Hills, Plains, Ditches, Slopes, East Slopes, Gorges, Mountains, Banks, River Valleys, Steep Northern Exposure, Summits, Valleys, Western Flank of Mountains

Soil/Matrix:

Steppe, Calcareous Rocks, Calcareous Substrate, Clay, Clay Conglomerate Hills, Clay Hills, Conglomerate Hills, Dry Schist Rocks, Rocky Ground, Stony and Sandy Places, Gypsaceous Soils, Gypsaceous Substrate, Gypsum Rocks, Gypsum Substrate, Igneous Substrate, In Gravel, In Schist Metamorphic Rocks, Limestone Rocks, Loess Substrate, Loam, Mineral-rich Water, Mudrock, Porphrytic Substrate, Saline Sand, Saline Soils, Sand, Schist, Serpentine Rocks, Stony Soils, Stony Places, Subdesert Soils

Habitats:

Alpine Pastures, At Artificial Lakes, At the Confluence of Rushing Streams, Basin/Channel, Beaches, Crop Fields in Plains, Cultivated Fields, Cultivated Land, Destroyed Oak Forest, Destroyed Oak Woodland, Ditches, Dry Places, Fallow Fields, Fields, Field Margins, Gardens, Mineral-rich Water, Semi-Deserts, In Grass, Near Rivers, Oak Forest, Oak Woodland, Open Oak Forest, Open Oak Woodland, Open Pine Forest, River Banks, Roadsides, Wadis, Steppe, Thickets, Wet Places

All Locations:

Alpine Pastures, Among Rocks, At Artificial Lakes, Beaches, Calcareous Rocks, Calcareous Substrate, Clay, Clay Conglomerate Hills, Clay Hills, Conglomerate Hills, Crop Fields in Plains, Cultivated Fields, Cultivated Land, Destroyed Oak Forest, Destroyed Oak Woodland, Ditches, Dry Hills, Dry Places, Dry Rocky Slopes, Dry Schist Rocks, Dry Slopes, Dry Stony and Sandy Places, East Slopes, Fallow Fields, Fields, Field Margins, Gardens, Gorges, Gypsaceous Semi-deserts, Gypsaceous Soils, Gypsaceous Substrate, Gypsum Cliffs, Gypsum Rocks, Hills, Igneous Substrate, In

Grass, In Gravel at the Confluence of Rushing Streams, In Schist Metamorphic Rocks, Limestone Rocks, Loess Substrate, Mineral-rich Water, Mountains, Mudrock, Near Rivers, Northern Slopes, Oak Forest, Oak Woodland, On Dry Loam, Open Oak Forest, Open Oak Woodland, Open Pine Forest, Porphrytic Cliffs, River Banks, River Valleys, Roadsides, Rocky Mountains, Rocky Oak Forest, Rocky Oak Woodland, Rocky Slopes, Rocky Wadis, Saline Sand, Saline Soils, Sand, Sandy Fields, Sandy Hills, Sandy Soils, Sandy Wadis, Schist Slope, Serpentine Rocks, Slopes, Steep Northern Exposure, Steppe, Stony Basins/Channels, Stony Slopes, Stony Soils, Subdesert Soils, Summits, Thickets, Valley, Western Flank of Mountains, Wet Places

Heliotropum sp.

(3rd and 4th Millennia B.C.)

Elevation: Near Sea Level to 3550m

Slope: 0 to 60 degrees

Mountains, Slopes, Banks, Hills, Mountains, Embankments, Plains, River Valleys, Valleys, Mountainous Regions, Mountain Flank, Gorge

Soil/Matrix:

Alluvial Soils Inundated in Winter, Calcareous Ground, Calcareous Rocks, Calcareous Substrate, Cultivated Ground, Gravel, Gravelly Places, Limestone Rocks, Moving Sand, Pebbles, Rocky Places, Rocky Sandy Ground, Saline Places, Sand, Sandy Soils, Serpentine Rocks, Shingle of Streambeds, Stony Places, Very Salty Places

Habitats:

Batha, By Rivers, Coastal Regions, Cultivated Fields, Deserts/Desert Places, Disturbed Habitats, Fallow Fields, Fields, Fruit Plantations, Margin of Deserts, Margins of Fields, Northern Lakeshore in Town, Northern Mountain Slopes, Oak Forest, Oak Woodland, Orchards, Plains, Pool of Water, Riverbeds, Roadsides, Ruderal Places, Shingle of Streambeds, Steppe, Vineyards, Waste Ground, Waste Place

All Locations:

Alluvial Soils Inundated in Winter, Batha, By Rivers, Calcareous Mountains, Calcareous Rocks, Calcareous Substrate, Coastal Regions, Cultivated Fields, Cultivated Ground, Deserts, Desert Places, Disturbed Habitats, Dry Disturbed Slopes, Fallow Fields, Fields, Fruit Plantations, Gorge, Gravel Banks, Gravel, Gravelly Places, Gravelly Slopes, Hills, Limestone Rocks, Margins of Fields, Mountains, Moving Sand at the Margin of Deserts, Northern Lakeshore in Town, Northern Mountain Slopes, Oak Forest, Oak Woodland, Orchards, Pebble Embankments, Places Overflowed in Winter, Plains, Pool of Water, River Valleys, Riverbeds, Roadsides, Rocky Oak Forest, Rocky Oak Woodland, Rocky Places, Rocky Sandy Hills, Rocky Slopes, Ruderal Places, Saline Mountainous Regions, Saline Places, Sand, Sandy Banks, Sandy Soils, Serpentine Rocks, Shingle of Streambeds, Steppe, Stony Deserts, Stony Places, Valleys, Very Salty Desert, Vineyards, Waste Ground, Waste Places, Western Mountain Flank

Hordeum sativum

(4th Millennium B.C.)

Elevation: unknown

Slope:

unknown

Soil/Matrix:

unknown

Habitats:

Crop Fields

All Locations:

Crop Fields

Hordeum sp.

(4th Millennium B.C.)

Elevation: Near Sea Level to 2250m

Slope: 0+ degrees

Banks, Flats, Plains, Hills

Soil/Matrix:

Alluvial Soils, on Limestone, Cultivated Soil, Damp Ground, Sand, Gravel, Gypsaceous Ground, Igneous, Alluvium, Maritime Sand, Mud in Rivers, Rocky Limestone, Rocky Places, Saline Soil, Salty Places, Sand, Sandy Gravel Gypsum, Silt, Stony

Habitats:

Banks of Rivers, Batha, Bushes, Canal Banks, Cereal Fields, "Corn" Fields, Clearings in Oak Forest, Coppiced Oak Scrub, Corn Fields, Crop Fields, Cultivated Both for Fodder and Grain, Cultivated Cereal (2, 4, and 6 row barley), Cultivated Fields, Cultivated Land, Desert, Dry Cultivation, Dry Steppe, Pastures, Fallow Fields, Fields, Forest, Forest Margins, Grassy Places, Irrigated Cultivation, Irrigated Pastures, Lake Margins, Luxuriant/Lush Meadows, Maritime, Marly Banks, Marshland, Meadows, in Rivers, Near Habitations, Oak Forests, Oak Woodland, Open Coppiced Oak Scrub, Open Habitats, Roadsides, Ruderal Places, Saline Marshes, Saline Soil, Salt Marshes, River Flats, River Plains, Scrub, Sea Coast, Steppe, Steppic Plains, Embankments, Sub-desert, Upper Plains, Wadi Bottoms, Waste Places, Weed of Cultivation

All Locations:

Alluvial Flats, Alluvial Soils, Banks of Rivers, Batha, Bushes, Canal Banks, Cereal Fields, "Corn" Fields, Clearings in Oak Forest, Coppiced Oak Scrub on Limestone, Corn Fields, Crop Fields, Cultivated Both for Fodder and Grain, Cultivated Cereal (2, 4, and 6 row barley), Cultivated Fields, Cultivated Land, Cultivated Soil, Damp Ground, Desert, Desert Sand, Dry Cultivation, Dry Foothill Pastures, Dry Hill Sides, Dry Hill Slopes, Dry Hills, Dry Places, Dry Slopes, Dry Steppe, Fallow Fields, Fields, Forest, Forest Margins, Grassy Places, Gravel, Gravel in Wadis, Igneous Slopes, Irrigated Cultivation, Irrigated Mountain Pastures, Lake Margins, Limestone Steppe, Low-lying Alluvium, Low Mountain Pastures, Luxuriant/Lush Meadows, Maritime, Maritime Sand, Marly Banks, Marshland, Mountain Meadows, Mountain Pasture, Mountain Steppe, Mountains, Mud in Rivers, Near Habitations, Oak Forests, Oak Forests in Valleys, Oak Woodland, Often on Gypsaceous Hills, Open Coppiced Oak Scrub on Limestone, Open Habitats, Pastures, River Banks, Roadsides, Rocky Limestone, Rocky Limestone Slopes, Rocky Places, Rocky Slopes, Ruderal Places, Saline Marshes, Saline Soil, Salt Marshes, Salty Places, Sand, Sandy Fields, Sandy Gravel Gypsum Plain, Sandy River Flats, Sandy River Plains, Sandy Soil on Dry Conglomerate Hills, Sandy Soils, Scrub, Sea Coast, Silt, Silt Banks, Silt Plain, Steppe, Steppic Plains, Stony Embankments, Stony Mountain Slopes, Stony Slopes, Sub-desert, Upper Plains, Volcano Slopes, Wadi Bottoms, Waste Places, Weed of Cultivation

Hordeum spontaneum

(3rd and 4th Millennia B.C.)

Elevation: 30 to 1650m

Slope: 0+ degrees

Slopes, Hills, Banks, Plains, Embankments

Soil/Matrix:

on Limestone, Cultivated Soils, Gravel, Gypsaceous Ground, Rocky Limestone, Rocky Places, Sand, Sandy Soil on Dry Conglomerate, Silt, Stony

Habitats:

Batha, Bushes, Cereal Fields, Coppiced Oak Scrub, Cultivated Land, Deserts, Dry Steppe, Fallow Fields, Fields, in Wadis, Pastures, Marly Banks, Oak Forests, Oak Woodland, Open Coppiced Oak Scrub, Scrub, Steppic Plains, Waste Places

All Locations:

Batha, Bushes, Cereal Fields, Coppiced Oak Scrub on Limestone, Cultivated Land, Cultivated Soils, Deserts, Dry Hill Slopes, Dry Hills, Dry Steppe, Fallow Fields, Fields, Gravel, Gravel in Wadis, Low Mountain Pastures, Marly Banks, Oak Forests, Oak Woodland, Often on Gypsaceous Hills, Open Coppiced Oak Scrub on Limestone, Pastures, Rocky Limestone Slopes, Rocky Mountain Slopes, Rocky Places, Rocky Slopes, Sand, Sandy Soil on Dry Conglomerate Hills, Scrub, Silt, Steppic Plains, Stony Embankments, Stony Mountain Slopes, Stony Slopes, Waste Places

Hyoscyamus sp.

(4th Millennium B.C.)

Elevation: 0 to 3900m

Slope: 0+ degrees

Cliffs, Fissures of Cliffs, Gorges, Mountains, Habitations, Walls, Plains, River Valleys, Crevices, Slopes, Mountain Slopes

Soil/Matrix:

Calcareous Ground, Chalky Soils, Fissures of Limestone, Old Walls, Rock Crevices, Rocks, Rough Ground, Ruins, Sandy Ground, Sandy Soils, Stone Walls, Stony Places, Loess, Walls

Habitats:

Alpine Regions, Cereal Fields, Cultivated Fields, Cultivated Ground in Deserts, Deserts, Fields, Near Habitations, Old Walls, Plains, Roadsides, Ruins, Southwestern Lakeshore, Stone Walls, Vineyards, Wadis, Walls, Waste Places, Woodland

All Locations:

Alpine Regions, Calcareous Ground, Cereal Fields, Chalky Soils, Cliffs, Cultivated Fields, Cultivated Ground in Deserts, Deserts, Fields, Fissures of Limestone Cliffs, Gorges, Mountains, Near Habitations, Northern Mountain Slopes, Old Walls, Plains, River Valleys, Roadsides, Rock Crevices, Rocks, Rough Ground, Ruins, Sandy Ground, Sandy Soils, Slopes, Southern Mountain Slopes, Southwestern Lakeshore, Stone Walls, Stony Places, Valleys, Vineyards, Wadis on Loess and Chalky Soils, Walls, Waste Places, Western Mountain Slopes, Woodland

Lathyrus sp.

(4th Millennium B.C.?)

Elevation: Near Sea Level to 3000m

Slope: 0+ degrees

Channels in Plains, Banks, Slopes, Hill-Foot, Mountains, Plains, Stream Banks

Soil/Matrix:

Between Rocks, Calcareous Substrate, Cultivated Ground, Disturbed Ground, on Calcareous Silt, Hard Limestone Scree, Igneous Substrate, Marshy Ground, on Limestone, On Metamorphic Rock, Pebbly, Rocks, Rocky Places, Rocky Limestone, Sandy Places, Scree, Slate, Moist Loam, Volcanic Outcrops, With Limestone Boulders

Habitats:

Along Water Channels, Among Bushes, Among Remains of Oak Scrub, by Streams, Borders of Cultivation, Bushy Places, By Lakes, Climbing in Bushes near a Spring, "Corn" Fields, Crop Fields, Cultivated as Garden Flower, Cultivated for Fodder, Cultivated Ground, Cultivated Ground by Stream, Cultivated Land, Cultivated Places, Damp Places, Deciduous Oak Forest, Deciduous Woodland, Denuded Habitats, Desert, Destroyed Oak Forest, Destroyed Oak Woodland, Disturbed Steppe, Dry Oak Scrub, Edges of Cultivation, Fallow Fields, Field Borders, Field Crop, Field Margins, Fields, Forest, Gardens, Grain Fields, Grassy Places, Grassy Places in Coppiced or Dispersed Oak Forest, Hedges, Hedges of Orchards, In Grass, In Herbage, In *Trifolia* Fields, Irrigated Alluvial Fields, Irrigated Fields, Irrigated Orchard Pastures, Irrigated Orchards, Lush Meadows, Macchie, Marshes, Meadows, Moist Meadows, Near the Coast, Oak Forest, Oak Macchie, Oak Scrub, Oak Woodland, Orchards, Orchards by Streams, *Ostrya* Forest, Phrygana, Pine Forest, Plains, Roadsides, Scrub, Scrub by Streams, Shady Places in Oak Forests, Steppe, Stream Banks, Streamsides, Subalpine, Thicket on Plains, Thickets, Under Walnut Trees by a Stream, Vineyards, Walnut Forest, Walnut Woodland, Waste Ground, Water Meadows, Wet Meadows, Weed, Weed in Cereal Fields, Weed in Fields, Weed of Cultivation, Wheat Fields, Among Dispersed Oak Trees, Woodland

All Locations:

Along Water Channels in Plains, Among Bushes, Among Remains of Oak Scrub, Banks, Banks by Streams, Between Rocks on Dry Slopes, Borders of Cultivation, Bushy Places, By Lakes, Calcareous Substrate, Climbing in Bushes near a Spring, “Corn” Fields, Crop Fields, Cultivated as Garden Flower, Cultivated for Fodder, Cultivated Ground, Cultivated Hill-Foot by Stream, Cultivated Land, Cultivated Places, Damp Slopes, Deciduous Oak Forest, Deciduous Woodland, Denuded Mountains, Desert, Destroyed Oak Forest, Destroyed Oak Woodland, Disturbed Ground, Disturbed Steppe, Ditches, Dry Oak Scrub, Edges of Cultivation, Fallow Fields, Field Borders, Field Crop, Field Margins, Fields, Fields in Mountains, Foot of Scarp on Calcareous Silt, Forested Hills, Gardens, Gorges, Grain Fields, Grassy Hillsides, Grassy Mountainsides, Grassy Mountainsides in Coppiced or Dispersed Oak Forest, Grassy Places, Grassy Places in Mountains, Grassy Valleys, Hard Limestone Scree, Hedges, Hedges of Mountain Orchards, Hill Sides, Hills, Igneous Hills, Igneous Slopes, In Grass, In Herbage, In *Trifolia* Fields, Irrigated Alluvial Fields on Plains, Irrigated Fields, Irrigated Orchard Pastures, Irrigated Orchards, Limestone Slopes, Lush Meadows, Macchie, Marshes, Marshy Ground, Meadows, Moist Meadows, Mountain Meadows, Mountain Slopes, Mountain Valleys, Mountains, Near the Coast, Northern Mountain Slopes, Northern Slopes, Oak Forest, Oak Forest on Limestone, Oak Macchie, Oak Scrub, Oak Woodland, On Grassy Slope by Stream, On Metamorphic Rock, Orchards, Orchards by Streams, *Ostrya* Forest, Pebbly Hillsides, Phrygana, Pine Forest, Plains, River Valleys, Roadsides, Rocks, Rocky Grassy Places, Rocky Hills, Rocky Limestone Slopes, Rocky Mountainsides, Rocky Slopes, Sandy Fields, Sandy Plains, Scree, Scree of Hard Limestone, Scrub, Scrub by Streams, Shady Places in Oak Forests, Slate Mountainsides, Steppe, Stream Banks, Streamsides, Subalpine, Thicket on Moist Loam on Plains, Thickets, Under Walnut Trees by a Stream, Valleys, Vineyards, Volcanic Outcrops, Walnut Forest, Walnut Woodland, Waste Ground, Water Meadows, Wet Meadows, Weed, Weed in Cereal Fields, Weed in Fields, Weed of Cultivation, Western Mountain Slopes, Wheat Fields, With Limestone Boulders among Dispersed Oak Trees, Woodland

Lens culinaris

(3rd Millennium B.C.)

Elevation: 0 to 2740m

Slope: 0+ degrees

Gorges, Valleys

Soil/Matrix:

Unknown

Habitats:

Field Crop

All Locations:

Field Crop, Gorges, Valleys

Lens sp.

(3rd and 4th Millennia B.C.)

Elevation: 0 to 2800m

Slope: 0+ degrees

Hills, Slopes, Gorges, Mountain Slopes, Mountainsides, Mountains, Steep, Valleys

Soil/Matrix:

Basalt Soils, Conglomerate, Gravelly Places, On Limestone, Rocky Limestone, Rocky Places, Steep Limestone, Stony Places

Habitats:

Coppiced Oak, Cultivated, Disturbed Steppe, Dry Grassy Places, Fallow Fields, Fields, Grassy Places, Oak Forest, Oak Scrub, Pine Forest, Pine Woodland, Vineyards

All Locations:

Basalt Soils, Conglomerate Hills, Coppiced Oak, Cultivated, Disturbed Steppe, Dry Grassy Slopes, Fallow Fields, Field Crop, Fields, Gorges, Grassy Mountain Slopes, Gravelly Places, Mountainsides, Oak Forest, Oak Scrub, On Limestone, Pine Forest, Pine Woodland, Rocky Limestone Mountains, Rocky Places, Steep Limestone, Stony Places, Valleys, Vineyards, Weed

Linum sp.

(3rd and 4th Millennia B.C.)

Elevation: 0 to 13,500m

Slope: 0+ degrees

Pass in Foothills, Hills, Hillsides, Mountain Summits, Mountains, Clefts and Fissures in Limestone Cliffs, Slopes, Ditches, Gorges, Hillsides, Mountainsides, Foothills, Eroded Slopes, Northern Slopes, River Valleys, Plains, Valleys

Soil/Matrix:

Calcareous Ground, Calcareous Rocks, Clay, Limestone, Conglomerate, Cultivated Soil, Alluvium, Gypsum, Loose Sandy Soil, Rocky Clay, Rocky Places, Rocky Schist, Sandy, Scree, Shallow Stony Soil, Stony Clay between Rocks, Stony Ground, Stony Places

Habitats:

Barren Pass in Foothills, By Spring, By Well, Cyprus Woodland/Groves, near Rivers, near Streams, Dammed River, Disturbed Steppe, Ditches in Irrigated Alluvium, Dry Grassy Slopes, Dry Steppe, Fallow Fields, Fields, Grassland in Oak and Pine Forest, Grassy Places, among Oak Relicts, Destroyed Oak, Marly Vineyards, Mid-Coppiced Oak, North Fork of a River towards an Exposure, On Grassy Patches among Oak Scrub, Coppiced Oak, Open Grassy Places, Open Habitats, Open Oak Scrub, Pine Forest, Pine Woodland, River Valleys, Scree, Scrub, Steppe, Steppic Plains, Sub-alpine Pasture, Uncultivated Coast, Valleys, Waste Ground, Wooded Hills

All Locations:

Barren Pass in Foothills, By Spring, By Well, Calcareous Hills, Calcareous Rocks in Mountains, Clay, Clefts and Fissures in Limestone Cliffs, Conglomerate, Conglomerate Slopes near Rivers, Conglomerate Slopes near Streams, Cultivated, Cultivated Soil, Cyprus Woodland/Groves, Dammed River, Disturbed Calcareous Steppe, Ditches in Irrigated Alluvium, Dry Grassy Slopes, Dry Hillsides, Dry Mountainsides above Treeline, Dry Steppic Foothills, Eroded Clay Slopes, Fallow

Fields, Fields, Foothills, Gorges, Grassland in Oak and Pine Forest, Grassy Places, Gypsum, Hills, Hillsides, Limestone, Limestone in Mountains among Oak Relicts, Loose Sandy Soil, Lower Mountain Slopes, Lower Mountains, Lower Mountains on Grassy Limestone Slope (Destroyed Oak), Marly Vineyards, Mid-Coppiced Oak, Mountain Summits, Mountains, Mountains above Treeline, Near Rivers, Near Streams, North Fork of a River towards an Exposure, Northern Slopes, On Grassy Patches among Oak Scrub, On Limestone with Coppiced Oak, Open Grassy Places, Open Habitats, Open Oak Scrub, Pine Forest, River Valleys, Rocky Clay Slopes, Rocky Hillsides, Rocky Pine Woodland, Rocky Places, Rocky Schist Valleys, Rocky Slopes, Scree, Scrub, Shallow Stony Soil, Southern Slopes, Steppe, Steppic Plains, Stony Clay between Rocks on Hillsides, Stony Places, Stony Steppic Hillsides, Stony Steppic Plains, Sub-alpine Pasture, Uncultivated Sandy Coast, Valleys, Waste Ground, Wooded Hills

Linum usitatissimum

(4th Millennium B.C.)

Elevation: 300 to 2400m

Slope:

unknown

Soil/Matrix:

unknown

Habitats:

Cultivated

All Locations:

Cultivated

Lolium sp.

(3rd and 4th Millennia B.C.)

Elevation: 0 to 2200m

Slope: 0+ degrees

Slopes, Hillsides, Foothills, Plains, Embankments, Banks, Mountain Valleys, Dunes, Hills, Depressions

Soil/Matrix:

Alluvial Soils, Basalt Rocks, Basalt Soils, Calcareous Soils, Clay, Stony, Limestone, Metamorphic, Gravel, Water, Loam, Mainly Calcareous and Basalt Soils, on Basalt, Rocks, Rocky, Sand, Sandy and Sandy-Loess Soils, Sandy Soil, Silty, Various Soils

Habitats:

Areas of Cultivation, Barley Fields, Batha, Beaches, Corn Fields, Crop Fields, Cultivated, Damp Places, Damp Shady Places, Denuded Oak Forest, Desert, Dry Plains, Dunes, Edges of Fields, Embankments, Fallow Fields, Fields, Fields of Cereal Crops, Gardens, Grain Fields, Grassy River Bank, Steppe, Grazing Land, Hillsides, In Water, Irrigated Fields, Meadows, Moist Situations, Orchard, Near Irrigation Canals and Seepages, Near Springs, Open Meadows, Open Places in Oak Forest, Pastures, Phrygana, Roadsides, Rocks, Sand Dunes, near Coast, Scrub, Under Walnut Trees by Stream, Valuable Pasture and Fodder Plants, Vineyards, Waste Ground, Waste Land, Waste Places, Waste Places on Plains, Waysides, Weed of Cultivation

All Locations:

Alluvial Soils, Areas of Cultivation, Barley Fields, Basalt Rocks, Basalt Soils, Batha, Beaches, Calcareous Soils, Clay, Clay Slopes, Corn Fields, Crop Fields, Cultivated, Damp Places on Stony Hillsides, Damp Shady Places, Denuded Oak Forest on Limestone Slopes, Desert, Dry Foothills, Dry Metamorphic Slopes, Dry Plains, Dunes, Edges of Fields, Embankments, Fallow Fields, Fields, Fields of Cereal Crops, Gardens, Grain Fields, Grassy River Bank, Gravel Hills in Steppe, Grazing Land, Hillsides, In Water, Irrigated Fields, Loam, Low Elevation Desert Places, Mainly Calcareous and

Basalt Soils, Meadows, Moist Situations in Mountains, Mountain Orchard, Mountain Valleys, Near Irrigation Canals and Seepages, Near Springs, Open Meadows on Basalt, Open Places in Oak Forest, Pastures, Phrygana, Roadsides, Rocks, Rocky Fields, Sand, Sand Dunes, Sandy Fields, Sandy Hills in Steppe, Sandy and Sandy-Loess Soils, Sandy Soil near Coast, Scrub in Mountains, Silty Depressions, Steppe, Under Walnut Trees by Stream, Valuable Pasture and Fodder Plants, Various Soils, Vineyards, Waste Ground, Waste Land, Waste Places, Waste Places on Plains, Waysides, Weed of Cultivation

Malva nicaeensis

(4th Millennium B.C.)

Elevation: near Sea Level to 1700m

Slope: 0 to 60 degrees

Lower Mountain Slopes, Hills, Plains

Soil/Matrix:

unknown

Habitats:

Fields, Gardens, Roadsides, Steppic Hills and Plains, Waste Ground, Weed of Cultivation, Weedy Places

All Locations:

Fields, Gardens, Lower Mountain Slopes, Roadsides, Steppic Hills and Plains, Waste Ground, Weed of Cultivation, Weedy Places

Malva sp.

(3rd and 4th Millennia B.C.)

Elevation: near Sea Level to 3200m

Slope: 0+ degrees

Plains, Hills, Lower Mountain Slopes, Mountain Slopes, Mountains, Northern Mountain Slopes, Banks, River Gorges, River Valleys, Flats, Dunes, Southern Slopes, Valleys, Western Mountain Flanks

Soil/Matrix:

Alluvium, Clay, Earth, Loam, Metamorphic Rock, Gravelly and Silty Soil, Rocky, Saline, Sandy Gravel, Sandy Soils, Silt, Stony

Habitats:

By Paths, By Roads, Cultivated, Cultivated in Gardens, Desert, Disturbed Places, Steppe, Edges of Cultivation, Fields, Gardens, Open Habitats, Open Places, Plains, River Banks, Roadsides, Saline Flats, Dunes, Scrub, Steppic Hills, Steppic Plains, Waste Ground, Waste Places, Weed of Cultivation, Weedy Neglected Places, Weedy Places

All Locations:

Alluvium, By Paths, By Roads, Clay, Cultivated, Cultivated by Romans, Cultivated in Gardens, Desert, Desert Plains, Disturbed Places, Dry Hills, Dry Steppic Hills and Plains, Earth Desert, Edges of Cultivation, Fields, Gardens, Hills, Loam, Lower Mountain Slopes, Metamorphic Rock, Mountain Slopes, Mountains, Northern Mountain Slopes, Open Habitats, Open Places, Plain on Gravelly and Silty Soil, River Banks, River Gorges, River Valleys, Roadsides, Rocky Desert, Saline Flats, Sandy Dunes, Sandy Gravel, Sandy Soils, Scrub, Silt, Southern Slopes, Steppe, Steppic Hills, Steppic Plains, Stony Desert, Valleys, Waste Ground, Waste Places, Weed of Cultivation, Weedy Neglected Places, Weedy Places, Western Mountain Flanks

Medicago radiate

(4th Millennium B.C.)

Elevation: 200 to 1850m

Slope: 0 to 60 degrees

Lower Mountain Slopes, Hillsides, Depressions, Valleys

Soil/Matrix:

Gravel, Sandy Clay, Silty

Habitats:

Fields, Steppe, Pastures

All Locations:

Fields on Lower Mountain Slopes, Gravel, Hillsides, Sandy Clay, Silty Depressions, Steppe, Valley Pastures

Medicago sp.

(3rd and 4th Millennia B.C.)

Elevation: near Sea Level to 2500m

Slope: 0+ degrees

Hills, Banks, Cliffs in Gorges, Plains, Ditches, Foothills, Slopes, Hills in Gullies, Lower Mountain Slopes, Mountain Slopes, Slopes, Hillsides, in Depressions on Plains, Channels, Dunes, Cliffs, Depressions, Valleys

Soil/Matrix:

Alluvial Soils, Arable Ground, Barren Conglomerate, Calcareous Ground, Chalky Ground, Clay between Rocks, Limestone Gorges, Coastal Sands, Compact Sand, Cultivated Ground, Barren Stony Ground, Gravelly Ground, Gravel, Gypsaceous, Gypsum, Heavy Calcareous Soils, Heavy Damp Soil, Heavy Soils, Silt, Limestone, Loamy Ground, Maritime Sands, Rocky Limestone, Sand, Sandy Clay, Sandy Gravel, Sandy Soils, Shingle, Silty Ground, Slightly Saline Soils, Stony Ground

Habitats:

By Streams, Canal Seepages, Corn Fields, Cultivated Fields, Cultivated for Fodder, Cultivated Ground, Damp Grassy Places by Springs and Streams, Deciduous Forest, Desert, Desert Plains, Ditches, Barren Stony Places, Dry Places, Edges of Cultivated Fields, Edges of Cultivation, in Gullies, Fallow Fields, Fields, Gardens, Grassy Banks, Grassy Places, Grown for Fodder, Plains, Irrigated Cereal Fields, Irrigated Fields and Gardens, Irrigation Channels/Banks, Phrygana, Macchie, Maritime, Meadows, Moist Ground, Moist Situations, Roadsides, Oak Forest, Oak Woodland, Open Forest, Orchards, Pine Forest, Pine Woodland, River Banks, Sand Dunes, Wadis, Scrub, Sea Cliffs, Shingle, Sides of Irrigation Channels, Steppe, Steppe Grassland, Steppe Grassland in Destroyed Oak Forest, Steppic Plains, Thickets, Under Oak, Valley Pastures, Waste Fields, Waste Ground, Waste Places, Weed of Cultivation, Weedy Places, Wet Places, Woodland

All Locations:

Alluvial Soils, Arable Ground, Barren Conglomerate Hills, By Streams, Calcareous Slopes, Canal Seepages, Chalky Banks, Clay between Rocks, Cliffs in Limestone Gorges, Coastal Sands, Compact Sand, Corn Fields, Cultivated Fields, Cultivated for Fodder, Cultivated Ground, Damp Grassy Places by Springs and Streams, Deciduous Forest, Desert, Desert Plains, Ditches, Dry Barren Stony Foothills, Dry Foothills, Dry Gravelly Foothills, Dry Mountain Slopes, Dry Places, Edges of Cultivated Fields, Edges of Cultivation, Eroded Hills in Gullies, Fallow Fields, Fields, Fields on Lower Mountain Slopes, Gardens, Grassy Banks, Grassy Places, Grassy Places on Lower Mountain Slopes, Grassy Slopes, Grassy Steppic Mountain Slopes, Gravel, Grown for Fodder, Gypsaceous Hills, Gypsum Desert, Heavy Calcareous Soils, Heavy Damp Soil, Heavy Soils, Hills, Hillside Gullies, Hillsides, In Depressions on Silt Plains, Irrigated Cereal Fields, Irrigated Fields and Gardens, Irrigation Channels/Banks, Limestone, Limestone Phrygana, Loamy Hills, Lower Mountain Slopes, Macchie, Maritime Sands, Meadows, Moist Ground, Moist Situations, Mountain Roadsides, Mountain Slopes, Oak Forest, Oak Woodland, Open Forest, Orchards, Pine Forest, Pine Woodland, River Banks, Roadsides, Rocky Fields, Rocky Limestone Slopes, Rocky Mountain Slopes and Hillsides, Rocky Slopes, Ruins, Sand Dunes, Sandy Clay, Sandy Desert Places, Sandy Gravel Plains, Sandy Places, Sandy Pine Forest, Sandy Soils, Sandy Wadis, Scrub, Sea Cliffs, Shingle, Sides of Irrigation Channels, Silty Depressions, Slightly Saline Soils, Slopes, Steppe, Steppe Grassland, Steppe Grassland in Destroyed Oak Forest, Steppic Plains, Stony Fields in Mountain Valleys, Stony Fields in Valleys, Stony Ground, Stony Mountain Slopes and Hillsides, Stony Plains, Thickets, Under Oak, Valley Pastures, Valleys, Waste Fields, Waste Ground, Waste Places, Weed of Cultivation, Weedy Places, Wet Places, Woodland

Ornithogalum sp.

(3rd and 4th Millennia B.C.)

Elevation: 0 to 3600m

Slope: 0 to 60 degrees

Banks, Hills, Slopes, Foothills, Mountainsides, Hillsides, Lower Mountain Slopes, Lower Mountains, Lower Mountainsides, Mountain Slopes, Mountains, Mountain Valleys, High Mountains, Plains, Mountain Peaks, Summits, Slopes, High Plateau, Valleys, Deep Valleys

Soil/Matrix:

Among Rocks, Rocky Places, Calcareous Substrate, Clay, Clay Fields, Deep Alluvial Soils, Deep Loamy Soil, Deep Soil where Snow has Melted, Igneous Ground, Limestone, Near Melting Snow, Rocky Calcareous Ground, Sandy Calcareous Ground, Sandy Soil, Stony Places, Stony Gravelly Ground, Stony Waste, Trachyte, Various Soils

Habitats:

Along Rivers, Alpine, Alpine Meadows, Alpine Regions, Alpine Steppe, Among Coppiced or Degraded Oak Forest, Among Rocks, At a Dam, At the Sea, Banks, Barley Fields, Batha, Between Bushes, Between Bushy Places/Thickets, Brush, By Springs, By Streams, Field Margins, Clay Fields, Coppices, Corn Fields, Cultivated Fields, where Snow has Melted, Destroyed Oak, Devastated Oak, Fallow Fields, Fields, Fig Orchards, Gardens, Grain Fields, Grassy Places, In Grass, In Oak, in Oak Scrub, Macchie, Meadows, Mid-Coppiced Oak, Moist Places, Near Melting Snow by a Lake, Near Melting Snow in High Mountains, Near a Stream, Oak Forest/Woodland, Open Forest, Open Oak, Open Oak Forest/Woodland, Pasture, Phrygana, Pine Forest, Plains, Roadsides, Scrub, Sometimes Cultivated, Steppe, Steppic Plains, Stony Waste between Vineyards, Subalpine, Subalpine Meadows, Summits in Forest Clearings, Water Meadows, Wet Fields, Wheat Fields

All Locations:

Along Rivers, Alpine, Alpine Meadows, Alpine Regions, Alpine Steppe, Among Coppiced or Degraded Oak Forest, Among Rocks, At a Dam, At the Sea, Banks, Barley Fields, Batha, Batha on Rocky Places, Between Bushes, Between Bushy Places/Thickets, Brush, By Springs, By Streams, Calcareous Hills, Calcareous Slopes, Calcareous Substrate, Clay at Field Margins, Clay Fields, Coppices, Corn Fields, Cultivated Fields on Deep Alluvial Soils, Deep Loamy Soil, Deep Soil where Snow has Melted, Deep Valleys, Destroyed Oak, Devastated Oak, Fallow Fields, Field Margins, Fields, Fig Orchards, Foothills, Gardens, Grain Fields, Grassy Places, High Mountainsides, Hills, Hillsides, Igneous Slopes, In Grass, In Oak, Just below Snowline, Limestone Slopes, Lower Mountain Slopes in Oak Scrub, Lower Mountains, Lower Mountainsides, Macchie, Meadows, Mid-Coppiced Oak, Moist Places, Mountain Slopes, Mountains, Mountain Valleys, Near Melting Snow by a Lake, Near Melting Snow in High Mountains, Near a Stream, Oak Forest/Woodland, On Limestone, Open Forest on Clay, Open Oak, Open Oak Forest/Woodland, Pasture, Phrygana, Pine Forest, Plains, Roadsides, Rocky Calcareous Mountain Peak, Rocky Calcareous Summits, Sandy Calcareous Ground, Sandy Soil, Scrub, Slopes, Sometimes Cultivated, Steppe, Steppes on High Plateau, Steppic Foothills, Steppic Hills, Steppic Plains, Stony Mountain Slopes, Stony Places, Stony Steppic Gravelly Hills, Stony Steppic Hills and Plains, Stony Waste between Vineyards, Subalpine, Subalpine Meadows, Summits in Forest Clearings, Trachyte Hills, Valleys, Various Soils, Waste Places, Water Meadows, Wet Fields, Wheat Fields

Panicum sp.

(3rd Millennium B.C.?)

Elevation: near Sea Level to 1000m

Slope: 0+ degrees

Banks, Ditches

Soil/Matrix:

Sands, Inundated Land, Moist Sands, Riparian Mud Flats, Stony Places, Cultivated Soil

Habitats:

Bank of Rivers, Banks of Streams, Canal Banks, Channels where there is a Sufficiency of Water, Close to the Sea, Coastal, Crop Fields, Damp Places, Damp Places in Gardens and Fields, Deserts, Ditches, Ditches and Edges of Irrigation Canals, Edges of Creeks, Gardens, Good Camel Fodder, Inundated Land, Irrigation Ditches, Moist Habitats, Moist Sands usually Maritime, Rarely/Formerly Widely Cultivated in Asia and Eastern Europe (common millet), Rice Fields, Riparian Mud Flats, Roadsides, Desert Areas, Waste Places, Weed of Cultivated Soil

All Locations:

Bank of Rivers, Banks of Streams, Canal Banks, Channels where there is a Sufficiency of Water, Close to the Sea, Coastal Sands, Crop Fields, Damp Places, Damp Places in Gardens and Fields, Deserts, Ditches, Ditches and Edges of Irrigation Canals, Edges of Creeks, Gardens, Good Camel Fodder, Inundated Land, Irrigation Ditches, Moist Habitats, Moist Sands usually Maritime, Rarely/Formerly Widely Cultivated in Asia and Eastern Europe (common millet), Rice Fields, Riparian Mud Flats, Roadsides, Sands, Sandy Desert Areas, Sandy Places, Stony Places, Waste Places, Weed of Cultivated Soil

Papaver sp.

(3rd Millennium B.C.)

Elevation: near Sea Level to 3500m

Slope: 0+ degrees

Summit, Plains, Slopes, Foothills, Gorges, Hills, Eroded Slopes, Mountains, Hillsides, Ledges on Cliffs, Mountain Slopes, Ledges, Mountainsides, Northern Mountain Slopes, Mountain Slopes, Northern Slopes, River Gorges, River Valleys, Rock Fissures, Mountain Summits, Ruins, Depressions, Southern Mountain Slopes, Southern Slopes, Terraced Gardens

Soil/Matrix:

Among Rocks, Calcareous Rocky Ground, Calcareous Substrate, Chalky Ground, Clay, Clay among Rocks, Conglomerate, Cultivated Ground, Gravel, Gravelly Substrate, Gypsum, Igneous Rock, Igneous Substrate, Limestone, Loamy Clay, Metamorphic Rock, On Calcareous Rocks, on Sand, Silty Soil, Rock Fissures, Rocky Places, Sandstone, Sandy Clay, Sandy Gravel, Sandy Soils, Sandy Substrate, Scree, Serpentine, Silt, Slightly Sandy Soils, Stony Places, Stony Red Soil on Rocky Slopes, Stony Soil, Outcrops

Habitats:

Alpine Regions, Barley Fields, Batha, By Lakes, Vineyards, Cultivated Fields, Cultivated Ground, Desert Plains, Fallow Land, Field Borders, Fields, Forest Relicts, Scree, Lakesides, Meadows, Near Habitations, Oak Forest, Oak Scrub, Open Places, Open Vegetation, Orchards, Plains, Roadsides, Oak Woodland, Ruins, Wadis, Desert, Southwest Lakeshore, Steppe, Steppic Plains, Terraced Fig Gardens, Torrent Beds, Vineyards, Walnut Grove by Stream, Waste Ground, Waste Ground near Villages, Waste Places, Weed of Cultivation

All Locations:

Alpine Regions, Among Rocks, Barley Fields, Batha, By Lakes, Calcareous Gorges, Calcareous Rocky Summit, Calcareous Substrate, Chalky Vineyards, Clay, Clay among

Rocks, Conglomerate, Cultivated Fields in Valleys, Cultivated Ground, Desert Plains, Dry Slopes, Dry Steppic Foothills, Dry Stony Hills, Eroded Slopes, Fallow Land, Field Borders, Fields, Forest Relicts, Gorges, Gravel, Gravelly Mountains, Gravelly Slopes, Gravelly Substrate, Gypsum, Hills, Hillsides, Igneous Rock, Igneous Slopes, Igneous Substrate, Lakesides, Ledges on Limestone Cliffs, Limestone, Limestone Mountains, Limestone Screes, Loamy Clay, Lower Mountain Slopes, Meadows, Metamorphic Rock, Moist Open Mountain Slopes, Mountain Slopes, Mountains, Mountains on Shady Limestone Ledges, Mountainsides, Near Habitations, Northern Mountain Slopes, Northern Slopes, Oak Forest, Oak Scrub, On Calcareous Rocks, Open Places, Open Vegetation on Sand, Open Vegetation on Calcareous Substrata, Open Vegetation on Igneous Substrata, Orchards, Outcrops, Plains on Silty Soil, River Gorges, River Valleys, Roadsides, Rock Fissures, Rocky Hillsides, Rocky Mountain Summits, Rocky Oak Forest, Rocky Oak Woodland, Rocky Places, Rocky Slopes, Ruins, Sandstone, Sandy Clay, Sandy Clay Depressions, Sandy Gravel, Sandy Soils, Sandy Substrate, Sandy Wadis, Scree, Serpentine Mountains, Shaded Limestone Scree, Sheltered Places on Scree, Silt, Slightly Sandy Soils in Desert, Southwest Lakeshore, Southern Mountain Slopes, Southern Slopes, Steppe, Steppic Hills, Steppic Plains, Stony Hillsides, Stony Places, Stony Red Soil on Rocky Slopes, Stony Soil, Stony Slopes, Stony Steppe, Stony Wadis, Terraced Fig Gardens, Torrent Beds, Valleys, Vineyards, Vineyards in Hills, Walnut Grove by Stream, Waste Ground, Waste Ground near Villages, Waste Places, Weed of Cultivation

Phalaris sp.

(3rd and 4th Millennium B.C.)

Elevation: 0 to 2700m

Slope: 0+ degrees

Channels, Banks, Depressions, Ditches, Hill Slopes, Flat

Soil/Matrix:

Earthy, Gravel, Riverine Silt, Sandy Soil, Silty Soil, Slightly Saline Alluvial Flat, Slightly Saline Flat by Edge of Brackish Lake, On Gravelly Soil

Habitats:

Along Irrigation Channels, Canal Banks, Crop Fields, Cultivated Fields, Depressions in Desert and Steppe, Desert, Disturbed Habitats, Ditches, Earthy Bank of Irrigated Rice Fields, Edges of Streams, Eucalyptus Woodland, Fields, Gardens, Lakes, Margins of Fields, Marshlands, Moist Places in Forest, Near Margin of Stream, Open Habitats, Phrygana, Riparian Meadows, Rivers, Roadsides, Slightly Saline Flat by Edge of Brackish Lake, Waste Disturbed Ground, Waste Ground, Waste Places, Waysides, Winter Crop Fields

All Locations:

Along Irrigation Channels, Banks, Canal Banks, Crop Fields, Cultivated Fields, Depressions in Desert and Steppe, Desert, Disturbed Habitats, Ditches, Earthy Bank of Irrigated Rice Fields, Edges of Streams, Eucalyptus Woods, Fields, Gardens, Gravel, Hill Slopes, Island of Semi-disturbed Riverine Silt, Lakes, Margins of Fields, Marshlands, Moist Places in Forest, Near Margin of Stream, On Gravelly Soil, Open Habitats, Phrygana, Riparian Meadows, Rivers, Roadsides, Sandy Soil, Silty Soil, Slightly Saline Alluvial Flat, Slightly Saline Flat by Edge of Brackish Lake, Waste Disturbed Ground, Waste Ground, Waste Places, Waysides, Winter Crop Fields

Phoenix dactylifera

(3rd and 4th Millennium B.C.)

Elevation: unknown

Slope:

Banks

Soil/Matrix:

Alluvial Soils, Rocks, Sandy Soils

Habitats:

Canal Banks, Gardens, Parks, Riverbanks, Widely Cultivated

All Locations:

Alluvial Soils, Canal Banks, Gardens, Parks, Riverbanks, Rocks, Sandy Soils, Widely Cultivated

Pistacia lentiscus

(4th Millennium B.C.?)

Elevation: 0 to 300m

Slope:

Lower Hills

Soil/Matrix:

unknown

Habitats:

Coast, Garigue, Macchie, Wadi Beds

All Locations:

Coast, Garigue, Lower Hills, Macchie, Wadi Beds

Pistacia terebinthus

(4th Millennium B.C.?)

Elevation: Sea Level to 1500m

Slope:

Hills, Slope

Soil/Matrix:

Rocky

Habitats:

Macchie, Pine Forest, Pseudo-Macchie

All Locations:

Dry Hills, Macchie, Pine Forest, Pseudo-Macchie, Rocky Slopes

Pisum sativum

(3rd Millennium B.C.)

Elevation: 550 to 3450m

Slope:

unknown

Soil/Matrix:

Cultivated Ground

Habitats:

Cultivated Ground, Escape from Cultivation, Field Crop

All Locations:

Cultivated Ground, Escape from Cultivation, Field Crop

Pisum sp.

(3rd and 4th Millennia B.C.)

Elevation: 0 to 3450m

Slope:

Slopes

Soil/Matrix:

Cultivated Ground, Rocky Slopes

Habitats:

Cultivated Ground, Escape from Cultivation, Field Crop, Grassy Slopes, Margins of Fields, Open Habitats

All Locations:

Cultivated Ground, Escape from Cultivation, Field Crop, Grassy Slopes, Margins of Fields, Open Habitats, Rocky Slopes

Plantago sp.

(3rd Millennium B.C.)

Elevation: 0 to 2300m

Slope: 0+ degrees

Banks, Hills, Plains, Depressions, Slopes, Mountains, River Valleys, Ruins, Dunes, Valleys

Soil/Matrix:

Arid Soils, Basalt, Calcareous Ground, Calcareous Sandstone, Cultivated Soils, Gypsiferous Substrate, Limestone Rocks, Limestone, Mainly Desert Soils, Maritime Sands, Marshy Soils, Natural Winter-Wet Ground, Rocky Limestone, Rocky Places, Ruins, Sands, Sandy Soils in Wadis, Sandy Wadis, Stony Places

Habitats:

Batha, Beaches, By Lakes, By Rivers, By the Persian Gulf, Coastal Plains, Desert, Desert Wadis, Disturbed Habitats, Dry Grassland, Dry Grazing Land, Dry Pasture, Dry Places, Elevated Seashore, Fallow Fields, Fields, Forest, Grassy Places, Irrigated Gardens, Lake Shore, Macchie, Margins of Fields, Meadows, Olive Groves, Open Forest, Open Habitats, Open Pine Forest, Pasture, Pathsides, Plains, River Mouths, River Valleys, Roadsides, Ruins, Salt Marshes, Sandy Beaches, Sandy Dunes, Sandy Plains, Sandy Soils in Wadis, Sandy Wadis, Sea Shore, Steppe, Stony Macchie, Very Dry Stony Pasture, Wadis in Desert, Waste Place

All Locations:

Arid Soils, Banks, Basalt Hills, Batha, Beaches, By Lakes, By Rivers, By the Persian Gulf, Calcareous Ground, Calcareous Sandstone, Coastal Plains, Cultivated Soils, Depressions, Desert, Desert Wadis, Disturbed Habitats, Dry Grassland, Dry Grazing Land, Dry Hills, Dry Pasture, Dry Places, Elevated Seashore, Fallow Fields, Fields, Forest, Grassy Places, Gypsiferous Substrate, Hills, Irrigated Gardens, Islands, Lake Shore, Limestone Hills, Limestone Rocks, Limestone Slopes, Macchie, Mainly Desert Soils, Margins of Fields, Maritime Sands, Marshy Soils, Meadows, Montane Slopes, Mountains, Natural Winter-Wet Ground, Olive Groves, Open Forest, Open Habitats, Open Pine Forest, Pasture, Pathsides, Periodically Wet Places, Plains, River Mouths, River Valleys, Roadsides, Rocky Limestone Slopes, Rocky Places, Rocky Slopes, Ruins, Salt Marshes, Sands, Sands of Deserts, Sandstone Hills, Sandy Beaches, Sandy Dunes, Sandy Fields, Sandy Ground, Sandy Hills, Sandy Places, Sandy Plains, Sandy Soils in Wadis, Sandy Wadis, Sea Shore, Steppe, Stony Hills, Stony Macchie, Stony Slopes, Valleys, Very Dry Stony Pasture, Wadis in Desert, Waste Places

Poa sp.

(3rd Millennium B.C.)

Elevation: near Sea Level to 4300m

Slope: 0+ degrees

Cliffs, Dip between Hills, Ditches, Hills, Mountains, Riverbeds, Plains, Hill Districts, Hillsides and Valleys in Mountains, Mountain Regions, Ledges, Foothills, Upper Plains, Banks, Slopes, Plateaus, River Flats

Soil/Matrix:

Conglomerate, Denuded Conglomerate, Silt, Friable Patches on Well-Drained Alluvium, Gravelly Places, Greyish Calcareous Soil, Igneous Rock, Lava Flows, Metamorphic Rock, Limestone Ledges, Other Soils, Rocky Limestone, Rocky Places, Sandy Gravel, Sandy Gypsum, Sandy Places, Slate, Stony Places, Stony Soils, Terra Rosa, Volcanic Scree, Wet Mud River Flats

Habitats:

Alpine Grassy Steppe, Alpine Pasture, By Streams, Coastal Grassland, Damp Meadows, Damp Places, Damp Roadsides, Damp Shady Ground among Willows by Stream, Damp Stream Sides, Degraded Batha, Disturbed Habitats, Desert, Dry Fallow Land, Dry Grassland, Dry Grassy Places on Hills, Dry Riverbeds, Dry Silt Plain, Fields, Gardens, Grassy Places, Herb-rich Alpine Pasture, Irrigated Sites/Areas, Lake Sides, Lava Flows, Macchie, Marshes, Meadows, Moist Meadows, Moist Places, Mountain Roadsides, Near Habitations, Oak Forest, Phrygana, Pine Forest, Pine Forest Clearings, River Banks, Roadsides, Rocky Desert, Alpine Regions, Seeds carried to Plains in Rivers and Streams, Steppe, Stream Sides, Volcanic Scree, Waste Places, Wet Mud River Flats, Woodlands

All Locations:

Alpine Grassy Steppe, Alpine Pasture, By Streams, Cliffs, Coastal Grassland, Damp Meadows, Damp Places, Damp Roadsides, Damp Shady Ground among Willows by Stream, Damp Stream Sides, Degraded Batha, Dip between Hillocks in Steppe, Disturbed Habitats, Ditches, Dry Conglomerate Hills, Dry Denuded Conglomerate, Desert, Dry Fallow Land, Dry Grassland, Dry Grassy Places on Hills, Dry Hills, Dry Mountains, Dry Places, Dry Riverbeds, Dry Silt Plain, Fields, Foothills, Friable Patches on Well-Drained Alluvium, Gardens, Grassy Places, Gravelly Places on Hills, Greyish Calcareous Soil, Herb-rich Alpine Pasture, Hill Districts, Hills, Hillsides and Valleys in Mountains, Igneous Rock, Irrigated Sites/Areas, Lake Sides, Lava Flows, Macchie, Marshes, Meadows, Metamorphic Rock, Moist Meadows, Moist Places, Mountain Regions, Mountain Roadsides, Mountains on Limestone Ledges, Near Habitations, Oak Forest, Other Soils in Foothills and Upper Plains, Phrygana, Pine Forest, Pine Forest Clearings, River Banks, Roadsides, Rocky Desert, Rocky Limestone Slopes, Rocky Places, Rocky Slopes, Sandy Alpine Regions, Sandy Gravel, Sandy Gravel Plains, Sandy Gypsum Plateau, Sandy Places, Seeds carried to Plains in Rivers and Streams, Shaded Hillsides, Slate, Steppe, Stony Alpine Regions, Stony Soils, Stream Sides, Terra Rosa, Volcanic Scree, Waste Places, Wet Mud River Flats, Woodlands

Polygonum corregioloides

(4th Millennium B.C.)

Elevation: 500 to 1600m

Slope: 0 to 60 degrees

Mountains, Valleys

Soil/Matrix:

Wet Sand

Habitats:

unknown

All Locations:

Mountains, Valleys, Wet Sand

Polygonum sp.

(3rd Millennium B.C.)

Elevation: 0 to 4000m

Slope: 0+ degrees

Cliffs, Ditches, Flood Plains, Hills, Mountains, Northern Mountain Slopes, Northern Slopes, Flats, Slopes, Southern Mountain Slopes, Valleys

Soil/Matrix:

Cultivated Land, Gravelly Regions, Sandy Places, Wet Sands

Habitats:

By Lakes, Cultivated Land/Places, Damp Places, Deserts, Desert Margins, Disturbed Ground/Places, Ditches, Dry Places, Fields, Flood Plains, Marshes, Moist/Damp Places, Open Habitats/Places, Near Streams, River Banks, River Valleys, Roadsides, Sandy Flats, Swamps, Waste Ground, Waysides, Weed of Cultivation

All Locations:

Alpine, By Lakes, Cliffs, Cultivated Land, Cultivated Places, Damp Places, Deserts, Desert Margins, Disturbed Ground/Places, Ditches, Dry Places, Fields, Flood Plains, Gravelly Regions, Hills, Marshes, Moist/Damp Places, Mountains, Near Streams, Northern Mountain Slopes, Northern Slopes, Open Habitats, Open Places, River Banks, River Valleys, Roadsides, Rocky Places, Sandy Fields, Sandy Flats, Sandy Places, Slopes, Southern Mountain Slopes, Subalpine, Swamps, Valleys, Waste Ground, Waysides, Weed of Cultivation, Wet Sands

Prosopis farcta

(3rd Millennium B.C.)

Elevation: 0 to 1500m

Slope: 0+ degrees

Depressions, Dunes, Mountain Valleys, Banks, River Valleys, Alluvial Plains

Soil/Matrix:

Clay, Red Marl, Alluvial Plains, Sandy Places, Silty Depressions

Habitats:

By Canals, Desert, Dry Places, Dry Waste Places, Dunes, Moist Places in Steppe, Red Marl Banks in Open Forest, River Valleys on Alluvial Plains, Sandy Places on Haswa, Silty Depressions around Wells

All Locations:

By Canals, Clay Depressions in Desert, Desert, Dry Places, Dry Waste Places, Dunes, Moist Places in Steppe, Mountain Valleys, Red Marl Banks in Open Forest, River Valleys on Alluvial Plains, Sandy Hillsides, Sandy Places on Haswa, Silty Depressions around Wells

Prosopis sp.

(3rd and 4th Millennia B.C.)

Elevation: 0 to 1500m

Slope: 0+ degrees

Depressions, Dunes, Mountain Valleys, Banks, River Valleys on Alluvial Plain, Hillsides

Soil/Matrix:

Clay, Red Marl, Alluvial Plains, Sandy Places, Silty Depressions

Habitats:

By Canals, Desert, Dry Places, Dry Waste Places, Dunes, Moist Places in Steppe, Red Marl Banks in Open Forest, River Valleys on Alluvial Plains, Sandy Places on Haswa, Silty Depressions around Wells, Waste Fields

All Locations:

By Canals, Clay Depressions in Desert, Desert, Dry Places, Dry Waste Places, Dunes, Moist Places in Steppe, Mountain Valleys, Red Marl Banks in Open Forest, River Valleys on Alluvial Plain, Sandy Hillsides, Sandy Places on Haswa, Silty Depressions around Wells, Waste Fields

Rumex pulcher

(4th Millennium B.C.)

Elevation: 0 to 1600m

Slope: 0+ degrees

Ditches, Dunes, River Valleys, Valleys

Soil/Matrix:

unknown

Habitats:

Borders of Canals, Damp Places, Dunes, Fields, Moist Ground, River Valleys, Roadsides

All Locations:

Borders of Canals, Damp Places, Ditches, Dunes, Fields, Moist Ground, River Valleys, Roadsides, Valleys

Rumex sp.

(3rd and 4th Millennia B.C.)

Elevation: near Sea Level to 3300m

Slope: 0+ degrees

Banks, Ditches, Dunes, Eastern Mountain Slopes, Flood Plains, Hillsides, Mountains, North Mountain Slopes, Plains, River Banks, River Valleys, Slopes, Southern Mountain Slopes, Valleys

Soil/Matrix:

Among Rocks, Cultivated Ground, Damp Soil, Inundated Ground, Moist Ground, Moist Places, Sandy Places, Sandy Soils, Stony Places

Habitats:

Batha, Borders of Canals, By Lakes, By Rivers, Canal Edges, Canals, Cultivated, Cultivated Land, Damp Places, Desert Wadis, Dunes, Fields, Forests, Gardens, Grassy Places, Macchie, Marshes, Meadows, Moist Waste Ground, Open Habitats, Palm Forest/Plantation, Pastures, Plains, River Banks, River Mouths, Roadsides, Rocky Oak Forest, Rocky Oak Woodland, Rocky Places on the Coast, Rich Meadows, River Valleys, Rocky Desert Wadis, Sandy Desert Wadis, Sandy Deserts, Sandy Places on the Coast, Scrub, Seashore, Steppe, Swamps, Waste Places, Wet Meadows

All Locations:

Among Rocks, Banks, Batha, Borders of Canals, By Lakes, By Rivers, Canal Edges, Canals, Coast, Cultivated, Cultivated Ground, Cultivated Land, Damp Places, Damp Soil, Desert Wadis, Ditches, Dunes, Eastern Mountain Slopes, Fields, Flood Plains, Forests, Gardens, Grassy Places, Hillsides, Inundated Ground, Macchie, Marshes, Meadows, Moist Ground, Moist Places, Moist Waste Ground, Mountains, North Mountain Slope, Open Habitats, Palm Forest/Plantation, Pastures, Plains, River Banks, River Mouths, Roadsides, Rocky Oak Forest, Rocky Oak Woodland, Rocky Places on the Coast, Rich Meadows, River Valleys, Rocky Desert Wadis, Sandy Desert Wadis, Sandy Deserts, Sandy Places, Sandy Places on the Coast, Sandy Soils, Scrub, Seashore, Shady Places, Slopes, Southern Mountain Slopes, Steppe, Stony Places, Swamps, Valleys, Waste Places, Wet Meadows, Wet Places

Scirpus maritimus

(3rd and 4th Millennia B.C.)

Elevation: 0 to 2400m

Slope: 0+ degrees

Flats, Caves, Ditches, Riverbeds, Banks

Soil/Matrix:

Alluvial Flats, Marshes, Mostly on Somewhat Saline Soil, Saline Flats, Soda Lakes, Stagnant Swamps, Swamps, Thermal Springs

Habitats:

Beaches, By Rivers, By Streams, Caves, Dried Riverbeds, Edges of Irrigation Ditches, Lake Shore, Marshes, On Roads, River Banks, Saline Flat, Soda Lakes, Stagnant Swamps, Swamps, Thermal Springs, Water Meadows

All Locations:

Alluvial Flats, Beaches, By Rivers, By Streams, Caves, Ditches, Dried Riverbeds, Edges of Irrigation Ditches, Lake Shore, Marshes, Mostly on Somewhat Saline Soil, On Roads, River Banks, Saline Flats, Soda Lakes, Stagnant Swamps, Swamps, Thermal Springs, Valleys, Water Meadows

Secale sp.

(4th Millennium B.C.?)

Elevation: 0 to 3050m

Slope: 0+ degrees

Southern Slopes, Gorges, Hillsides, Mountainsides, Volcanic Slopes, Irrigation Ditches, Mountain Slopes, Ravines, Slopes, Volcanic Slopes

Soil/Matrix:

Calcareous, Dry Stony, Eroded Volcanic, Limestone, Non-arable, On Serpentine, Rocky Slopes, Sandy Soils, Serpentines, Silty, Volcanic

Habitats:

Cultivated, Edges of Oak-Pine Forests, Field Margins, Irrigation Ditches, Margins of Oak Forests, Margins of Pine Forests, Mountain Vineyards, Non-arable Steppe, Oak Forest, Paths, Roadsides, by Coast/near Sea Coast, Under Light Oak Forest

All Locations:

Calcareous Southern Slopes, Cultivated, Dry Gorges, Dry Hillsides, Dry Stony Mountainsides, Edges of Oak-Pine Forests, Eroded Volcanic Slopes, Field Margins, Irrigation Ditches, Limestone, Margins of Oak Forests, Margins of Pine Forests, Mountain Slopes, Mountain Vineyards, Non-arable Steppe, Oak Forest, On Serpentine, Paths, Ravines, Roadsides, Rocky Mountain Slopes, Rocky Mountainsides, Rocky Slopes, Sandy Soil by Coast, Sandy Soils near Sea Coast, Serpentines, Silty Depressions, Under Light Oak Forest, Volcanic Slopes

Setaria sp.

(3rd Millennium B.C.?)

Elevation: 0 to 2300m

Slope: 0+ degrees

Banks, Mountain Slopes, Ditches

Soil/Matrix:

Limestone, Irrigated Ground, Moist Ground

Habitats:

Banks of Ditches, Cultivated, Damp Waste Places, Disturbed Ground, Disturbed Shady Graveyard on Limestone Mountain Slope, Ditches, Fields, Gardens, Irrigated Cultivation, Irrigated Field Edges, Irrigated Fields, Irrigated Gardens, Irrigated Ground, Irrigated Places, Irrigation Channels, Moist Ground in Damp Shady Gardens, Moist Waste Places, Oak Forest by Stream, Shady Gardens, Sides of Ditches, Waste Places, Weed of Cultivation

All Locations:

Banks of Ditches, Cultivated, Damp Waste Places, Disturbed Ground, Disturbed Shady Graveyard on Limestone Mountain Slope, Ditches, Fields, Gardens, Irrigated Cultivation, Irrigated Field Edges, Irrigated Fields, Irrigated Gardens, Irrigated Ground, Irrigated Places, Irrigation Channels, Moist Ground in Damp Shady Gardens, Moist Waste Places, Oak Forest by Stream, Shady Gardens, Sides of Ditches, Waste Places, Weed of Cultivation

Silene sp.

(3rd and 4th Millennium B.C.)

Elevation: 0 to 2300m

Slope: 0+ degrees

Hills, Banks, Cliffs, Crevices, Entrances to River Gorges, Fissure of Cliff in a Gorge, Fissures, Gorges, Hillsides, Valleys, Slopes, Mountains, Mountain Slopes, Northern Mountain Slopes, Plateaus, River Valleys, Ledges, Slopes, Southern Mountain Slopes, Southern Volcano Slopes, Western Mountain Slopes

Soil/Matrix:

Among Rocks, Calcareous Rocks, Calcareous Substrate, Chalky Districts, Clay, Coastal Sands, Conglomerate Substrate, Crevices of Conglomerate, Crevices of Limestone, Crevices of Serpentine Rocks, Dry Sandy Places, on Light Soils, Gravel at the Confluence of Rivers, Gypsaceous Substrate, Igneous, In Gravel, In Moving Sand, Maritime Sands, Moist Ground, Moving Gravel, Mudrock, Rock Crevices, Rock Ledges, Rocks, Rocky Ground, Rocky Mudrock, Rocky Places, Rocky Scree, Sand, Sandy Places, Sandy Soils, Sandy Substrate, Serpentine Substrate, Schist Rocks, Scree, Siliceous Substrate, Sterile Rocky Places, Stony Ground, Stream Gravel, Walls, Weathered Nubian Sandstone

Habitats:

Among Crops, At a Small Brook, Batha, Bushy Places, By Lakes, By Rivers, Crop Fields, Cultivated Fields, Cultivated Ground, Cultivated Land, Cultivated Plots, Desert, Desert Margin, Desert Wadis, Destroyed Oak Forest, Destroyed Oak Woodland, Dunes, Edge of River Fork, Fallow Fields, Fields, Gardens, at the Confluence of Rivers, In Juniper Forest, In Juniper Woodland, In Swamp/Marsh at a Lake, Lakeshore, In Oak Forest, In Oak Woodland, Irrigated Fields, Mountain Pastures, Not Maritime, Open Forest, Open Subalpine, Orchards, Plains, River Valleys, Roadsides, Scree, Steppe, Stony Thickets, Subalpine Regions, Vineyards, Walls, Waste Ground, Waste Places, Weed of Cultivation, Woodland

All Locations:

Above Treeline, Among Crops, Among Rocks, Arid Hills, Banks, Batha, Bushy Places, By Lakes, By Rivers, Calcareous Rocks, Calcareous Substrate, Chalky Districts, Clay, Clay Hills, Cliffs, Coastal Sands, Conglomerate Hills, Conglomerate Substrate, Crevices of Conglomerate, Crevices of Limestone, Crevices of Serpentine Rocks, Crop Fields, Cultivated Fields, Cultivated Ground, Cultivated Land, Cultivated Plots, Desert, Desert Margin, Desert Wadis, Destroyed Oak Forest, Destroyed Oak Woodland, Dry Sandy Places, Dunes, Edge of Calcareous River Fork, Entrances to River Gorges, Fallow Fields, Fallow Fields on Light Soils, Fields, Fissure of Calcareous Cliff in a Gorge, Fissures, Gardens, Gorges, Gravel at the Confluence of Rivers, Gypsaceous Substrate, Hills, Hillsides, Hot Ravines, Igneous Hills, In Gravel, In Gravel at a Small Brook, In Juniper Forest, In Juniper Woodland, In Moving Sand, In Oak Forest, In Oak Woodland, In Rocky Oak Forest, In Rocky Oak Woodland, In Stream Gravel, In Swamp/Marsh at a Lake, Irrigated Fields, Mainly Sandy Deserts, Maritime Sands, Moist Ground, Mountain Pastures, Mountain Regions, Mountain Valleys, Mountains, Moving Gravel, Mudrock, Northern Mountain Slopes, Northern Slopes, Not Maritime, Oak Forest, Oak Forest Mountains, Oak Woodland, Oak Woodland Mountains, Open Oak Forest/Woodland, Open Forests, Open Places, Open Rocky Oak, Open Subalpine, Orchards, Plains, Plateaus, River Valleys, Roadsides, Rock Crevices, Rock Ledges, Rocks, Rocky Fields, Rocky Ground, Rocky Lakeshore, Rocky Mudrock, Rocky Oak Forest, Rocky Oak Woodland, Rocky Places, Rocky Scree, Rocky Slopes, Sand, Sandy Desert, Sandy Places, Sandy Places near the Sea, Sandy Soils, Sandy Substrate, Serpentine Substrate, Schist Rocks, Scree, Siliceous Substrate, Slopes, Southern Mountain Slopes, Southern Volcano Slopes, Steppe, Sterile Rocky Places, Stony Deserts, Stony Ground, Stony Thickets, Stony Wadis, Subalpine Region, Sunny Sandy Islands, Valleys, Vineyards, Wadi Beds, Walls, Waste Ground, Waste Places, Weathered Nubian Sandstone, Weed of Cultivation, Western Mountain Slopes, Woodland

Stipa sp.

(3rd and 4th Millennium B.C.)

Elevation: near Sea Level to 3200m

Slope: 0+ degrees

Bank, Eminences, Plain, Mountain Regions, Mountain Slopes, Hills, Mountain Ridges, Hillsides, near Mountain Top, Slopes

Soil/Matrix:

Between Serpentine Rocks, Boulder Scree, Calcareous Soil, Conglomerate, on Sandy Gravel, Dry Sandy Places, Eroded Clays, Gravel, Gypsaceous Alluvium, Limestone, Limestone Scree, On Eroded Clays, On Limestone, Rocks, Rocky Places, Salt-Impregnated Soil, Sands, Sandy Clay, Sandy Places, Sandy Pockets in Limestone, Serpentine Rocks, Silt, Stony Ground, Stony Places

Habitats:

Abandoned Vineyards, Bank in Orchard, Batha, Boulder Scree, Desert, Desert Areas, Dry Places, Dry Steppic Desert Plains, Dry Steppic Hills, Garigue, In Coppiced Oak Scrub, In Denuded Forest, Lower Margin of Denuded Oak Forest, Macchie, Oak Forest, Oak Scrub, Open Habitats, Open Scrub, Open Steppe, Open Woodland, Part-shade in Oak Forest, Protected Area of Steppic Grassland, Stream Sides

All Locations:

Abandoned Vineyards, Bank in Orchard, Batha, Between Serpentine Rocks, Boulder Scree, Calcareous Soil, Conglomerate, Desert Areas, Desert Eminences, Desert Plain on Sandy Gravel, Dry Foothills, Dry Hills, Dry Mountain Regions, Dry Places, Dry Places in Mountain Regions, Dry Rocky Mountain Slopes, Dry Sandy Places, Dry Steppic Desert Plains, Dry Steppic Hills, Dry Stony Mountain Slopes, Eroded Clays, Garigue, Gravel, Gypsaceous Alluvium, In Coppiced Oak Scrub, In Denuded Forest, In Hills, Limestone, Limestone Scree, Lower Margin of Denuded Oak Forest, Macchie, Mountain Slopes, Oak Forest, Oak Scrub, On Eroded Clays, On Limestone, Open Habitats, Open Scrub, Open Steppe, Open Woodland, Part-shade in Oak Forest, Protected Area of Steppic Grassland, Rocks, Rocky Mountain Ridges, Rocky Mountain Slopes, Rocky Places, Rocky Slopes, Salt-Impregnated Soil, Sands, Sandy Clay Desert Hillsides, Sandy Deserts, Sandy Places, Sandy Pockets in Limestone, Serpentine Rocks near Mountain Top, Silt, Steppe, Stony Ground, Stony Mountain Slopes, Stony Places, Stony Rocky Mountains, Stony Slopes, Stream Sides

Suaeda sp.

(4th Millennium B.C.)

Elevation: -20 to 2400m

Slope: 0+ degrees

Dunes, Hills, Marshes, Flats, River Valleys, Banks, Valleys

Soil/Matrix:

Coastal Sand, Coastal Sandy Soil, Hot Desert Saline Marshes, Inland Sandy Soil, Maritime Places, Saline Soil, Salty Places, Sandy Places

Habitats:

By Lakes, Cultivated Land, Desert, Dunes, Edges of Salt Marshes, Gulf Shore, Hot Desert Saline Marshes, Lakeshores, Maritime Places, Mud Flats, Near Rivers, River Valleys, Saline Places, Saline Steppe, Salt Marshes, Salty Maritime Places, Salty Places, Salty Steppe, Sandy Salty Stream Banks, Sandy Steppe, Sea Shore, Swamps, Waste Places

All Locations:

By Lakes, Coastal Sand, Coastal Sandy Soil, Cultivated Land, Desert, Dunes, Edges of Salt Marshes, Gulf Shore, Hills, Hot Desert Saline Marshes, Inland Sandy Soil, Lakeshores, Maritime Places, Mud Flats, Near Rivers, River Valleys, Saline Places, Saline Soils in Desert, Saline Steppe, Salt Marshes, Salty Maritime Places, Salty Places, Salty Steppe, Sand Dunes, Sandy Places, Sandy Salty Stream Banks, Sandy Steppe, Sea Shore, Swamps, Valleys, Waste Places

Teucrium sp.

(4th Millennium B.C.?)

Elevation: near Sea Level to 3600m

Slope: 0+ degrees

Banks, Hills, Slopes, Cliffs, Gorges, Hillsides, Mountain regions, Mountain Slopes, Mountains, Northern Mountain Slopes, Overhanging Rocks, Plains, River Valleys, Slope at the Entrance to a River Gorge, Banks, Hill Country, Valleys, Vertical Cliffs, Vertical Rocks, Volcano

Soil/Matrix:

Sandstone, Sandy Loam, Stony and Rocky Ground, Volcanic Soils, Calcareous Clay, Calcareous Loam, Calcareous Rocks, Calcareous Substrate, Clay, Coastal Sands, Alluvial Soils, Dry Igneous Slopes, Dry Limestone Slopes, Dry Places, Dry Rocky Slopes, Igneous Rocky Slopes, Igneous Slopes, Limestone Rocks, Limestone Slopes, Overhanging Rocks, Rocks, Rocky Places, Sand, Scree, Serpentine Gravel, Shady Wet/Damp Rocks, Stony Ground, Stony Serpentine, Tufa Rocks, Vertical Rocks

Habitats:

At a Dammed River, At Small Brooks, Batha, Bushes, By Lakes, By Roads, By Springs, By Wells, Corn Fields, Crop Fields, Desert, Desert Wadis, Devastated Oak Forest/Woodland, Dry Fields, Dry Grassland, Dry Places, Dry Thickets, Dunes, Fallow Fields, Field Sides, Fields, Garigue, Macchie, Margins of Fields, Meadows, Oak Bushes, Oak Macchie, Oak Scrub, Open Forest, Open Oak Forest, Open Oak Woodland, Open Pine Forest, Open Places, Open Woodland, Pine Forest, Plains near Road, River Valleys, Roadsides, Scrub, Shrubby Places, Southeastern Edge of a Lake, Southern Edge of a Lake, Steppe, Thickets, Waste Fields, Waste Places, Waste Ground

All Locations:

Arid Hills, At a Dammed River, At Small Brooks, Batha on Sandstone, Batha on Sandy Loam, Batha on Stony and Rocky Ground, Batha on Volcanic Soil, Bushes, By Lakes, By Roads, By Springs, By Wells, Calcareous Clay, Calcareous Loam, Calcareous Rocks, Calcareous Substrate, Clay Hills, Clay Slopes, Cliffs, Coastal Sands, Corn Fields, Crop Fields on Alluvial Soils, Desert, Desert Wadis, Devastated Oak Forest/Woodland, Dry Fields, Dry Grassland, Dry Hills, Dry Igneous Slopes, Dry Limestone Slopes, Dry Places, Dry Rocky Slopes, Dry Thickets, Dunes, Eastern Mountain Slopes, Fallow Fields, Field Sides, Fields, Garigue, Garigue on Stony and Rocky Ground, Gorges, Hills, Hillsides, Igneous Rocky Slopes, Igneous Slopes, Limestone Rocks, Limestone Slopes, Macchie, Margins of Fields, Meadows, Mountain Regions, Mountain Slopes, Mountains, Northern Mountain Slopes, Oak Bushes, Oak Macchie, Oak Scrub, On an Arid Slope at the Entrance to a River Gorge, Open Forest, Open Oak Forest, Open Oak Woodland, Open Pine Forest, Open Places, Open Rocky Woodland, Open Slopes, Open Woodland, Overhanging Rocks, Pine Forest, Plains near Road, River Valleys, Roadsides, Rock Steppe, Rocks, Rocky Bank at the Southeastern Edge of a Lake, Rocky Banks, Rocky Places, Rocky Slopes, Rocky Volcano, Sand, Sandy Hills, Scree, Scrub, Serpentine Gravel, Shady Wet/Damp Rocks, Shrubby Places, Slopes, Southern Edge of a Lake, Southern Mountain Slopes, Steppe, Stony Batha, Stony Ground, Stony Macchie, Stony Serpentine Slopes, Thickets in Hill Country, Tufa Rocks, Valleys, Vertical Cliffs, Vertical Rocks, Waste Fields, Waste Places, Waste Ground, Weed on Alluvial Soils

Torilis sp.

(4th Millennium B.C.?)

Elevation: 0 to 2500m

Slope: 0+ degrees

Banks, Hills, Ditches, Eroded Banks, Gorges, Mountains, Slopes, Plains, River Gorges, River Valleys, Terraces

Soil/Matrix:

Calcareous Substrate, Conglomerate, Rocks, Rocky Places, Scree, Serpentine Gravel, Stony

Habitats:

Batha, By Lakes, Confluence of Rivers, Desert Places, Disturbed Habitats, Ditches, Dry Fields, Eroded Banks, Fallow Fields, Fields, Garigue Hedges, Irrigated Fields, Macchie, Margins of Fields, Neglected Places, Oak Forest, Oak Woodland, Palm Forest/Woodland, Plains, River Banks, River Terraces, Riverbeds, Thicket by a Lake, Roadsides, Rocky Bushes, Scree, Scrub, Waste Places, Woodland

All Locations:

Banks, Batha, By Lakes, Calcareous Substrate, Confluence of Rivers, Conglomerate Hills, Desert Places, Disturbed Habitats, Ditches, Dry Fields, Eroded Banks, Fallow Fields, Fields, Garigue, Gorges, Hedges, Hills, Irrigated Fields, Macchie, Margins of Fields, Mountains, Neglected Places, Oak Forest, Oak Woodland, Open Rocky Slopes, Palm Forest/Woodland, Plains, River Banks, River Gorges, River Terraces, River Valleys, Roadsides, Rocks, Rocky Bushes, Rocky Slopes, Scree, Scrub, Serpentine Gravel, Slopes, Stony Riverbed, Thicket by a Lake, Waste Places, Woodland

Trigonella sp.

(3rd Millennium B.C.)

Elevation: near Sea Level to 1900m

Slope: 0+ degrees

Slopes, Hills, Channels, Depressions, Plains, Dunes, Lower Mountain Slopes, Lower Mountains, Valleys, Hillsides in Foothills, Mountain Slopes, Old Mounds, Ridges, Ruins, Steep Calcareous Sandstone,

Soil/Matrix:

Alluvial Soils, Bare Limestone, Calcareous, Chalky, Cultivated Ground, Cultivated Soil, Limestone, Irrigated Alluvium, Dry Rocky, Dry Stony, Sand, Gravel, Gypsum Places, Igneous, Limestone Scree, Not Saline Soil, Old Mounds, On Fairly Good Soils, On Gravel, Rocky Limestone, Saline Soils, Sandy Clay, Sandy Soils, Silty Places, Calcareous Sandstone, Stony, Good Soil

Habitats:

Barren Degraded Steppe, Channels, Coppiced Oak Forest, Cultivated Fields, Cultivated for Fodder, Cultivated Ground, Cultivated Land, Degraded Stipa Steppe, at the Lower Limit of Oak Forest, toward Lower Limit of Forest, Denuded Oak Forest, Dry Steppe, Desert Pastures, Dry Stony Steppe, Fallow Fields, Fields, Foot of Sand Dunes at Margin of Desert, Gardens, Garden Lawns, Garigue, Grassland, Grassy Pasture, Grassy Places among Scattered Oak Trees, Grassy Places, Desert, Scree, Lower Limit of Forest, Oak Bushes, Oak Forest, Oak Scrub, Old Mounds, in Oak Forest, Open Poa Steppe, Open Steppe, Pastures, Pine Forests, Pine Woodland, Riversides, Ruins, by Roadsides, Sub-desert, Seashores, Steppe, Steppic Plains, Denuded Forest, Vineyards, Wadis, Waste Fields, Waste Ground, Waste Places, Water Meadows, Waysides

All Locations:

Alluvial Soils, Bare Limestone Slope below Treeline, Barren Degraded Steppe, Calcareous Steppe, Chalky Hills, Channels, Coppiced Oak Forest, Cultivated Fields, Cultivated for Fodder, Cultivated Ground, Cultivated Land, Cultivated Soil, Degraded Stipa Steppe, Denuded Limestone Slopes at the Lower Limit of Oak Forest, Denuded Limestone Slope toward Lower Limit of Forest, Denuded Oak Forest, Depressions in Dry Steppe, Desert Pastures in Irrigated Alluvium, Dry Rocky Slopes, Dry Steppic Slope, Dry Stony Steppic Hills, Dry Stony Steppic Plains, Fallow Fields, Fields, Foot of Sand Dunes at Margin of Desert, Gardens, Garden Lawns, Garigue, Grassland on Lower Mountain Slopes, Grassy Limestone Slopes, Grassy Mountain Pasture, Grassy Places among Scattered Oak Trees, Grassy Places in Lower Mountains, Grassy Places in Valleys, Gravel Desert, Gypsum Places, Hillsides in Foothills, Igneous Slopes, Limestone Scree, Limestone Slopes, Low Dry Steppic Hills, Lower Limit of Forest on Limestone, Lower Mountain Slopes, Macchie, Marly Steppe, Mountain Slopes in Denuded Oak Forest, Not Saline Soil, Oak Bushes, Oak Forest, Oak Scrub, Old Mounds, On Fairly Good Soils, On Gravel, On Limestone Ridge in Oak Forest, Open Poa Steppe, Open Steppe, Pastures, Pine Forests, Pine Woodland, Riversides in Mountains, Rocky Limestone Ridges, Rocky Limestone Slopes, Rocky Slopes, Ruins, Saline Places, Saline Soils, Sand Dunes, Sandy Clay by Roadsides, Sandy Desert, Sandy Desert Places, Sandy Places in Sub-desert, Sandy Places near the Sea, Sandy Seashores, Sandy Soils, Silty Depressions, Silty Depressions in the Desert, Silty Places, Slopes, Steep Calcareous Sandstone, Steppe, Steppic Plains, Steppic Slopes Denuded of Forest in the Lower Mountains, Stony Hillsides, Stony Slopes, Stony Steppic Plains, Subalpine, Vineyards, Wadis in Foothills, Waste Fields, Waste Ground, Waste Places, Waste Places with Good Soil on Plains, Water Meadows, Waysides

Triticum boeoticum

(4th Millennium B.C.)

Elevation: 100 to 2000m

Slope: 15-60 degrees

Slopes, Ditches, Hills, Lower Mountain Slopes

Soil/Matrix:

Basalt, Calcareous Soil, Limestone

Habitats:

Degraded Oak Forest, Ditches, Fallow Fields, Fields, Fig Gardens, Grassland, Oak Scrub, Old Vineyards, Open Scrub, Overgrazed Steppe, Roadsides, Steppe

All Locations:

Basalt, Basalt Slopes, Calcareous Soil, Degraded Oak Forest, Ditches, Fallow Fields, Fields, Fig Gardens, Grassland, Low Grassy Hills, Lower Limestone Mountain Slopes, Oak Scrub, Old Vineyards, Open Scrub, Overgrazed Steppe, Roadsides, Steppe

Triticum dicoccum

(4th Millennium B.C.)

Elevation: 700-1300m

Slope:

Mountain

Soil/Matrix:

Limestone, Hard Limestones, Rocky Places, Soils developed on Basalt

Habitats:

Cultivated, Degraded Oak Forest, Open Places

All Locations:

Cultivated, Degraded Oak Forest on Limestone Mountain, Hard Limestones, Rocky Open Places in Full Sunlight, Rocky Places, Soils developed on Basalt

Triticum monococcum

(4th Millennium B.C.)

Elevation: 110-1000m

Slope:

Edges of Ditches, Mountains, Mountain Slopes

Soil/Matrix:

Rocky

Habitats:

Cultivated, Edges of Ditches, Fallow Fields, Grassy Places, Open Pasture

All Locations:

Cultivated, Edges of Ditches, Fallow Fields, Grassy Places in Mountains, Open Pasture, Rocky Mountain Slopes

Triticum sp.

(4th Millennium B.C.)

Elevation: 40 to 2000m

Slope: 0+ degrees

Slopes, Mountains, Ditches, Plains, Mountain Slopes, Edges of Ditches, Hills, Hill Slopes, Lower Mountain Slopes

Soil/Matrix:

Basalt, Calcareous Soil, Chalky, Limestone, Hard Limestones, Hot Moist Fertile Soil, Rocky Places, Sandy Places, Soils developed on Basalt, Volcanic Rock

Habitats:

Crop Fields, Cultivated, Degraded Oak Forest, Ditches, Dry Plains, Edges of Ditches, Fallow Fields, Fields, Fig Gardens, Grassland, Grassy Places, Oak Forest, Oak Scrub, Old Vineyards, Open Grassy Places in Coppiced Oak Scrub, Open Pasture, Open Places, Open Scrub, Overgrazed Steppe, Roadsides, Steppe

All Locations:

Basalt, Basalt Slopes, Calcareous Soil, Chalky Steppe, Crop Fields, Cultivated, Degraded Oak Forest, Degraded Oak Forest on Limestone Mountain, Ditches, *[Extinct],* Dry Mountain Slopes, Dry Plains, Edges of Ditches, Fallow Fields, Fields, Fig Gardens, Grassland, Grassy Places in Mountains, Hard Limestones, Hill Slopes, Hot Moist Fertile Soil, Limestone Slopes, Low Grassy Hills, Lower Limestone Mountain Slopes, Oak Forest, Oak Scrub, Old Vineyards, Open Grassy Places in Coppiced Oak Scrub, Open Pasture, Open Scrub, Overgrazed Steppe, Roadsides, Rocky Mountain Slopes, Rocky Open Places in Full Sunlight, Rocky Places, Rocky Places in Mountains, Sandy Places, Soils developed on Basalt, Volcanic Rock

Vaccaria pyramidata

(4th Millennium B.C.)

Elevation: 0 to 2000m

Slope:

unknown

Soil/Matrix:

Cultivated Land

Habitats:

Cultivated Land, Fields, Grain Fields, Steppe

All Locations:

Cultivated Land, Fields, Grain Fields, Steppe

Vaccaria sp.

(3rd and 4th Millennia B.C.)

Elevation: 0 to 2800m

Slope: 0 to 60 degrees

Canals, Mountains, Valleys

Soil/Matrix:

Calcareous Substrate, Clay, Cultivated Land, Mudrock, Rocky

Habitats:

At Streams, Canals, Crop Fields, Cultivated Land, Destroyed Oak Forest, Destroyed Oak Woodland, Fallow Fields, Field Margins, Fields, Grain Fields, Irrigated Fields, Irrigation Canals, Oak Forest/Woodland, Riverbeds, Rocky Oak Forest/Woodland, Ruderal Gardens, Ruderal Places, Steppe, Streams, Vineyards

All Locations:

At Streams, Calcareous Substrate, Canals, Clay, Crop Fields, Cultivated Land, Destroyed Oak Forest, Destroyed Oak Woodland, Fallow Fields, Field Margins, Fields, Grain Fields, Irrigated Fields, Irrigation Canals, Mountains, Mudrock, Oak Forest/Woodland, Riverbeds, Rocky Oak Forest/Woodland, Ruderal Gardens, Ruderal Places, Steppe, Streams, Valleys, Vineyard

Valerianella dentate

(4th Millennium B.C.)

Elevation: 0 to 2100m

Slope: 0 to 60 degrees

Mountains, Mountain Summits, Valleys

Soil/Matrix:

Cultivated Soil

Habitats:

Cultivated Land, Woodland

All Locations:

Cultivated Land, Cultivated Soil, in Mountains, Mountain Summits, Valleys, Woodland

Verbascum sp.

(3rd and 4th Millennia B.C.)

Elevation: 0 to 2700m

Slope: 0+ degrees

Hills, Hillsides, Slopes, Flanks of Hills, Hanging from Walls, Mountain Regions, Plains, Ruins

Soil/Matrix:

Coastal Sands, Hanging from Walls, Limestone Rocks, Limestone, Rocks, Ruins, Scree, Stony Places, Various Soils

Habitats:

Barren Fields, Batha, Coniferous Forest, Corn Fields, Deciduous Forest, Deserts, Dry Places, Fallow Fields, Hammada, Hanging from Walls, Macchie, Meadows, Moist Places, Near Water, Oak Scrub, Pasture, Pine Forest, Plains, Rich Places, Riversides, Roadside Banks, Roadsides, Ruins, Scree, Scrub, Steppe, Sterile Places, Desert Wadis, Vineyards, Waste Places, Waysides, Wet Places, Wheat Fields, Wooded Hillsides

All Locations:

Barren Fields, Batha, Coastal Sands, Coniferous Forest, Corn Fields, Deciduous Forest, Deserts, Dry Hills, Dry Hillsides, Dry Places, Dry Slopes, Fallow Fields, Flanks of Hills, Hammada, Hanging from Walls, Limestone Rocks, Limestone Slopes, Macchie, Meadows, Moist Places, Mountain Regions, Near Water, Oak Scrub, Pasture, Pine Forest, Plains, Rich Places, Riversides, Roadside Banks, Roadsides, Rocks, Rocky Slopes, Ruins, Scree, Scrub, Shady Places, Steppe, Sterile Places, Stony Desert Wadis, Stony Slopes, Various Soils, Vineyards, Waste Places, Waysides, Wet Places, Wheat Fields, Wooded Hillsides

Vicia ervilla

(3rd and 4th Millennia B.C.)

Elevation: 0 to 3000m

Slope: 0 to 60 degrees

Mountain Slopes, Northern Mountain Slopes, Slopes, Valleys

Soil/Matrix:

Cultivated Ground, On Limestone, Scree, Stony Places

Habitats:

Coppiced Oaks, Cultivated Crop, Cultivated Fields, Cultivated Ground, Fields, Roadsides, Scree, Vineyards

All Locations:

Coppiced Oaks, Cultivated Crop, Cultivated Fields, Cultivated Ground, Fields, Mountain Slopes, Northern Mountain Slopes, Oak Scrub, On Limestone, Roadsides, Scree, Stony Slopes, Valleys, Vineyards

Vicia sativa

(3rd Millennium B.C.)

Elevation: near Sea Level to 2800m

Slope: 0+ degrees

Under a Cliff, Slopes, Depressions, Ditches, Banks, Hills, Mountainsides

Soil/Matrix:

Among Rocks, Calcareous Ground, In Wadis, Irrigated Areas, Rocky Calcareous Ground, Rocky Limestone Ground, Rocky Places

Habitats:

By Streams, Corn Fields, Cultivated Desert, Ditches, Fallow Fields, Fields, Gardens, Grassy Banks, Hedges, In Wadis, Irrigated Alluvial Fields, Irrigated Areas, Meadows, Oak Scrub, Orchards, Path Sides, Plantations, Wadis on Steppe, Waste Places, Weed of Cultivation

All Locations:

Among Rocks under a Cliff, By Streams, Calcareous Slopes, Corn Fields, Cultivated Desert Depressions, Ditches, Fallow Fields, Fields, Gardens, Grassy Banks, Hedges, Hills, In Wadis, Irrigated Alluvial Fields, Irrigated Areas, Meadows, Mountainsides, Oak Scrub, Orchards, Path Sides, Plantations, Rocky Calcareous Slopes, Rocky Limestone Slopes, Rocky Slopes, Upland Fields, Wadis on Steppe, Waste Places, Weed of Cultivation

Vicia sp.

(4th Millennium B.C.?)

Elevation: 0 to 2300m

Slope: 0+ degrees

Under a Cliff, Banks, Slopes, Hillsides, Depressions, Ditches, Gorges, Hills, Foothills, Mountains, Lower Alluvial Plains, Mountain Slopes, Mountain Valleys, Mountains, Mountainsides, Northern Mountain Slopes, Plains, Ridges, Rifts, River Valleys, Mountain Summits, Rolling Plains, Cliffs, Southern Mountain Slopes, Steep Alpine Slopes, Valleys

Soil/Matrix:

Among Large Stones and Rocks, Among Rocks, Calcareous Soils, Clay, Cultivated Ground, Damp Places, In Wadis, Irrigated Alluvial Fields, Irrigated Land, Limestone, Loam, Lower Alluvial Plains, Moist Soils, On Limestone, Ridge of Calcareous Limestone, Rifts by Melting Snowdrifts, Rocky Limestone, Rocky Places, Sandy Clay, Sandy Loam, Sandy Soils, Siliceous, Scree, Limestone Scree, Stony Ground, Stony Red Loam, Uncultivated Ground, Volcano Soils, Wadis

Habitats:

Alongside Streams, By Streams, Coppiced Oak, Coppiced Oak Scrub, Corn Fields, Cultivated Crop, Cultivated Desert, , Cultivated Fields, Cultivated Ground, Damp Hedges, Damp Places, Deciduous Oak Scrub, Deciduous Scrub, Disturbed Ground, Disturbed Steppe, Ditches, Dry Alpine Regions, Edges of Cultivation, Edges of Fields, Fallow Fields, Field Margins, Fields, Forest, Frequently Cultivated, Gardens, Grain Fields, Grassy Places, Grassy Steppe, Hedgerows, Hedges, In Wadis, Irrigated Alluvial Fields, Irrigated Areas, Macchie, Meadows, Moist Hedges, Moist Meadows, Near Water, Oak Forest, Oak Scrub, Oak Woodland, Open Coniferous Forests, Open Forests, Open Pine Forests, Orchards, Pastures, Path Sides, Phrygana, Pine Forests, Pine Woodland, Plains, Plantations, by Melting Snowdrifts, River Banks, River Valleys, Riverbeds, Roadsides, Ruderal Habitats, Scree, Scrub, Segetal Habitats, Steppe, Steppic Upland Plains, Thickets, Uncultivated Ground, Under Light Oak

Scrub, Upland Fields, Vacant Fields, Vineyards, Wadis, Wadis on Steppe, Waste Ground, Waste Places, Weed of Cultivation, Woodland

All Locations:

Alongside Streams, Among Large Stones and Rocks, Among Rocks, Among Rocks under a Cliff, Banks, By Streams, Calcareous Slopes, Calcareous Soils, Calcareous Steppe, Clay, Clay Fields, Clay Hillsides, Coppiced Oak, Coppiced Oak Scrub, Corn Fields, Cultivated Crop, Cultivated Desert Depressions, Cultivated Fields, Cultivated Ground, Damp Hedges, Damp Places, Deciduous Oak Scrub, Deciduous Scrub, Disturbed Ground, Disturbed Steppe, Ditches, Dry Alpine Regions, Edges of Cultivation, Edges of Fields, Eroded Hills, Fallow Fields, Field Margins, Fields, Foothills, Forest, Frequently Cultivated, Gardens, Gorges, Grain Fields, Grassy Banks, Grassy Mountain Slopes, Grassy Places, Grassy Steppe, Hedgerows, Hedges, Hills, Hillsides, In Wadis, Irrigated Alluvial Fields, Irrigated Areas, Irrigated Land, Limestone, Limestone Mountains, Loam, Lower Alluvial Plains, Macchie, Meadows, Moist Hedges, Moist Meadows, Moist Soils, Mountain Meadows, Mountain Slopes, Mountain Steppe, Mountain Valleys, Mountains, Mountainsides, Near Water, Northern Mountain Slopes, Oak Forest, Oak Scrub, Oak Woodland, On Limestone, Open Coniferous Forests, Open Forests, Open Pine Forests, Orchards, Pastures, Path Sides, Phrygana, Pine Forests, Pine Woodland, Plains, Plantations, Ridge of Calcareous Limestone in Forest, Rifts by Melting Snowdrifts, River Banks, River Valleys, Riverbeds, Roadsides, Rocky Limestone Slopes, Rocky Mountain Slopes, Rocky Mountains, Rocky Places, Rocky Slopes, Rocky Slopes near Mountain Summits, Rolling Plains, Ruderal Habitats, Sandy Clay, Sandy Loam, Sandy Shores, Sandy Soils, Scree, Scrub, Segetal Habitats, Shady Places, Siliceous Cliffs, Slopes, South Screes, South-facing Limestone Scree, Southern Mountain Slopes, Steep Alpine Slopes, Steppe, Steppic Upland Plains, Stony Alpine Regions, Stony Red Loam Slope, Stony Slopes, Thickets, Uncultivated Ground, Under Light Oak Scrub, Upland Fields, Vacant Fields, Valleys, Vineyards, Volcano Soils, Wadis, Wadis on Steppe, Waste Ground, Waste Places, Weed of Cultivation, Woodland

Vitis vinifera

(3rd Millennium B.C.)

Elevation: 0 to 2200m

Slope:

unknown

Soil/Matrix:

unknown

Habitats:

Broad-Leaf Mixed Forests, Crop Stands, Cultivated, Near Water Sources

All Locations:

Broad-Leaf Mixed Forests, Crop Stands, Cultivated, Near Water Sources

Ziziphora sp.

(3rd Millennium B.C.)

Elevation: near Sea Level to 4700m

Slope: 0+ degrees

Eastern Volcano Slopes, Banks, Mountains, Gorges, Hills, Hillsides, Hilly Fields, Igneous Hills, Mountain Peaks, Mountain Summits, Northern Mountain Slopes, Plains, River Gorges, River Valleys, Slopes, Embankments, Southern Mountain Slopes, Southern Slopes, Valleys, Western Mountain Slopes

Soil/Matrix:

Calcareous Substrate, Gravel, Gravelly Places, Gravelly Serpentine Places, Gypsum Substrate, Metamorphic Substrate, Rocky Outcrops, Rocky Places, Sandy Soils, Schist Substrate, Scree, Serpentine Substrate, Siliceous Substrate, Standing Water, Stony Places

Habitats:

Alpine Regions, Batha, Desert, Dry Open Places, Dry Places, Fallow Fields, Fields, Glacier, Mudrock, Near Lakes, Near Ruins, Northern Lakeshore, Pine Forest, Pine Woodland, Plains, River Valleys, Scree, Standing Water, Steppe, Waste Fields

All Locations:

Alpine Regions, Batha, Calcareous Gorges, Calcareous Substrate, Desert, Dry Hills, Dry Open Places, Dry Places, Eastern Volcano Slopes, Fallow Fields, Fields, Gorges, Gravel Banks, Gravelly Mountains, Glacier, Gravelly Serpentine Mountains, Gypsum Substrate, Hills, Hillsides, Hilly Fields, Igneous Hills, Metamorphic Substrate, Mountain Summit, Mountains, Mudrock, Near Lakes, Near Ruins, Northern Lakeshore, Northern Mountain Slopes, Pine Forest, Pine Woodland, Plains, River Valleys, Rocky Mountain Peaks, Rocky Mountain Summit, Rocky Outcrops, Rocky River Gorges, Rocky Slopes, Rocky Steppe, Rocky Wadi Beds, Sandy Banks, Sandy Embankments, Sandy Soils, Schist Substrate, Scree, Serpentine Mountains, Serpentine Substrate, Siliceous Substrate, Southern Mountain Slopes, Southern

Slopes, Standing Water, Steppe, Stony Embankments, Stony Hills, Stony Slopes, Subalpine Regions, Valleys, Waste Fields, Western Mountain Slope