BRONZE AGE SETTLEMENT PATTERNS AND THE DEVELOPMENT OF COMPLEX SOCIETIES IN THE SOUTHERN URAL STEPPES (3500-1400 BC)

by

Denis V. Sharapov, PhD

B.S., University of Colorado at Colorado Springs, 2006

M.A., Georgia State University, 2008

M.A., Georgia State University, 2011

Submitted to the Graduate Faculty of the

Kenneth P. Dietrich School of Arts and Sciences in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

University of Pittsburgh

2017

UNIVERSITY OF PITTSBURGH

DIETRICH SCHOOL OF ARTS AND SCIENCES

This dissertation was presented

by

Denis V. Sharapov

It was defended on

April 14, 2017

and approved by

Francis Allard, Associate Professor, Department of Anthropology, Indiana University of Pennsylvania

Loukas Barton, Assistant Professor, Department of Anthropology, University of Pittsburgh

Marc Bermann, Associate Professor, Department of Anthropology, University of Pittsburgh

Dissertation Advisor: Robert D. Drennan, Distinguished Professor, Department of Anthropology, University of Pittsburgh

BRONZE AGE SETTLEMENT PATTERNS AND THE DEVELOPMENT OF COMPLEX SOCIETIES IN THE SOUTHERN URAL STEPPES (3500-1400 BC)

Denis V. Sharapov, PhD

University of Pittsburgh, 2017

The ethnohistorical record of the Eurasian steppes points to the long-term predominance of extensive herding economies, associated with low population densities and high levels of geographic mobility. Consequently, investigations of early forms of complex socio-political organization in this region have thus far been primarily focused on Bronze Age (ca. 3500 - 1000 BC) funerary and ceremonial monuments, which presumably served as aggregation points for dispersed populations. When it comes to settlement pattern evidence, researchers claim that traditional models of regional-scale demographic organization, developed in the context of settled societies, cannot be applied to the early complex communities of the steppes.

In order to learn more about the underlying social forces that were behind the independent emergence of larger more complex social formations in different world regions, this research focuses on the Sintashta (2050 - 1700 BC) development of southern Russia, which commanded particular attention of archaeologists due to the identification of more than twenty nucleated fortified settlements. Chiefly communities associated with these settlements have been considered odd in comparison to other early complex societies due to their small demographic size, lack of supra-local organization, a fairly short chronological span, and an apparent lack of local antecedents.

Regional-scale investigation of the demographic and spatial parameters of Bronze Age communities, conducted in the context of this dissertation, indicates that the fortified settlements were centers of larger districts and therefore represented regional organization that was typical of other chiefdoms. Moreover, supra-local settlement organization and demographic centralization prevailed in the study area for another 300 years after the presumed Sintashta ‘collapse’. Such continuity in material correlates of social complexity took place in the context of substantial demographic growth. These

results counter some of the previously held notions about the unusualness of the Sintashta trajectory. The novelty of this research stems from the employment of a survey methodology that relied on systematic sub-surface testing, which has never been utilized in the region before. Perhaps more interestingly, by reaffirming the unusually small demographic scale of Sintashta societies, the results of this dissertation support the notion that small scale societies are capable of complex socio-political organization.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

To my grandfather

ACKNOWLEDGEMENTS

First and foremost, I would like to thank my dissertation advisor Dr. Robert (Dick) Drennan for his undying support and guidance throughout the entire research process. I appreciate you sticking up for me. I think I speak for all of the Pitt Archaeology alumni when I say that we are very lucky to have studied under you.

I would also like to thank the members of my dissertation committee: Luke, Francis, and Marc. I appreciate the rewarding and stimulating discussions that I had with true scholars, like yourselves. Francis, I learned a lot during our coffee talks.

I thank the University of Pittsburgh and especially the Center for Comparative Archaeology for the financial support that aided in the completion of this dissertation. I am also deeply appreciative of the high-resolution satellite imagery of my study area, provided by the DigitalGlobe Foundation.

This research would not be possible without the support of my Russian colleagues and friends. Thanks to you all, over the past seven years Chelyabinsk became my second home. My gratitude goes out to G. B. Zdanovich, D. G. Zdanovich, T. S. Malutina, E. V. Kupriyanova, Natasha Batanina, Anya Plaksina, Masha Makurova, as well as all other associates of the Arkaim Center. Special thanks goes out to Yuri Makurov and E. I. Slastuhina for their understanding. I am also grateful to Igor Chechushkov for all of his help in and outside of the field. Good luck with your research! Thanks to all of the Chelyabinsk archaeologists who have worked with me in the field. This document is the reason why I pushed you all and myself so hard. Enjoy!

I would like to express my gratitude to the administration of Katsbakhskoye – a special place full of interesting people.

Needless to say that my family were the ones who have always believed in me and backed me up 100%. Thank you, mama, papa, Kolyan, and Kirill, who has been a good brother and got a chance to try his hand at archaeology.

1.0 INTRODUCTION

1.1 GLOBAL PATTERNS OF SOCIAL CHANGE

For the majority of our history as human beings, we lived in small, egalitarian, autonomous communities. Around 10,000 years ago, different regions of the world witnessed the development of larger, more complex social formations, often referred to as chiefdoms, middle-range, or early complex societies. These new kinds of social entities were usually associated with hierarchical organization and greater levels of social, political, and economic differentiation (Drennan and Peterson 2012; Flannery 1972). One of the central questions in anthropological archaeology is how and why early complex societies emerged independently in multiple locations around the world (Drennan and Peterson 2012; Feinman 2013; Kennet et al. 2009; Smith and Choi 2007; Tainter 1988).

To some researchers, the existing global-scale evidence suggests that early complex societies were brought into being by similar social forces, operating consistently, in a limited number of ways (Drennan and Peterson 2012; Pauketat 2007). Although some associate contemporary study of chiefdoms with the use of rigid societal typologies that mask human variation, in reality the analytical framework used in the comparative study of early complex societies has been greatly refined since the neoevolutionary approaches of the 1960's (Fried 1967; Service 1962) and categorization schemes of the second half of the 20th century (Blanton et al. 1996; D'Altroy and Earle 1985; Renfrew 1974; Wright 1984). As opposed to working with a restricted number of societal types, more recent scholarship focuses on social processes, recognized to be only broadly similar (Smith 2012).

Empirical comparative analysis of early complex societies based on a series of data categories has been carried out for numerous world regions including coastal Peru, central and southern Highlands of Mexico, northeastern China, the Andes of southern Colombia, the Middle Niger Delta, the American Southwest, the Mississippi River Basin, as well as the Eurasian steppe / forest steppe (Peterson and Drennan 2012; Drennan et al. 2011). These studies aim to both test the existing and develop new theoretical models by analyzing archaeological data from different world regions (Drennan and Petersen 2012:65; Drennan et al. 2010:72). Along with recognizing cross-cultural similarities, it has been noted that focusing on the variability in developmental pathways can offer avenues into a better understanding of general principles behind the global emergence of early complex societies (Drennan 1992; Drennan 1996a). This dissertation builds on this approach further by investigating certain dimensions of archaeological evidence along which the Sintashta formation of southern Russia seems unusual from a comparative perspective.

1.2 STUDY MACRO-REGION: RUSSIAN STEPPE

Due to political, historical, and logistic concerns, prehistoric developments that occurred over a vast landmass of modern Russia are rarely incorporated into the Anglo-American archaeological scholarship (Hanks 2010; Kohl 2007). Nonetheless, primary archaeological data from this part of the world can enhance our understanding of how human societies changed over time. For instance, the Sintashta development - the focus of this this dissertation - occurred in the middle of the Eurasian steppes - a vast ecological zone of arid grasslands, characterized by a certain level of uniformity in environmental characteristics, cultural traditions, and historical trajectories (Atwood 2007; Christian 1998).

Due to the arid environments of this region, historical and ethnographic sources point to the long-term predominance of extensive herding economies associated with low population densities and high levels of geographic mobility. Researchers often claim that these factors preclude applying anthropological models developed in the agricultural and hunter-gatherer contexts to prehistoric pastoralist societies of the Eurasian steppes (Frachetti 2012; Honeychurch 2013). There is a notion that the particulars of local environments and subsistence economies caused the developmental trajectories of prehistoric Eurasian steppe societies, including Sintashta, to differ substantially from other world regions (Frachetti 2008, 2009; Johnson and Hanks 2012; Honeychurch and Amartuvshin 2006; Rogers 2011; Sneath 2007).

The earliest material correlates of complex socio-political organization in this area took the form of Bronze Age (3500-800 BC) funerary and ritual monuments, such as *khirigsuurs* in central Mongolia and *kurgans* in the steppes of Ukraine, Kazakhstan, and Russia (Allard and Erdenebaatar 2005; Anthony 2007; Houle 2010). For instance, in Mongolia, the khirigsuur rock monuments have been viewed as periodic meeting points or “central places” where dispersed herder groups aggregated to carry out community rituals (Allard 2009; Houle 2009). Since the investigations of early forms of complex political organization in the Eurasian steppes have been primarily focused on such mortuary and monumental evidence, the Middle Bronze Age (MBA) (2050-1700 BC) developments in the Southern Urals region of Russia commanded particular attention of archaeologists due to the identification of more than twenty nucleated fortified settlements, which have been interpreted as a network of proto-urban steppe 'towns' (Figure 1, Figure 2) (Zdanovich and Batanina 2007; Zdanovich and Zdanovich 2002).

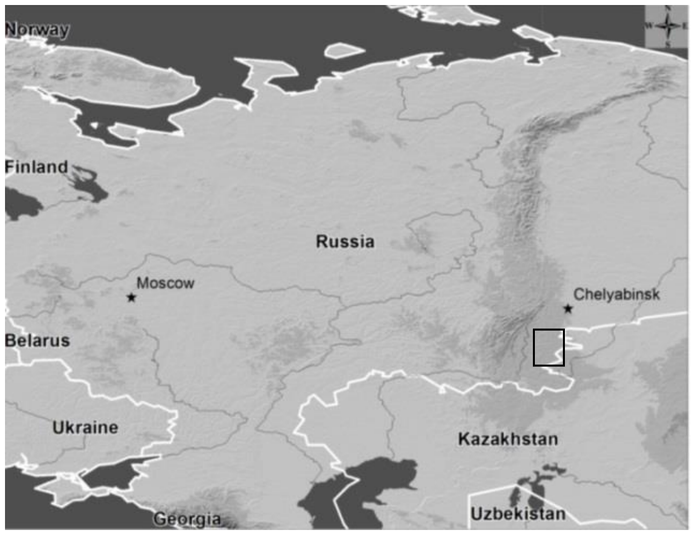


Figure 1: Location of Sintashta sites in the Southern Urals.

1.3 SINTASHTA AND SOCIAL COMPLEXITY: COMPARATIVE PERSPECTIVE

During the MBA period, the essential elements of the Neolithic way of life, as it is commonly conceived, coalesced for the first time in the Southern Ural steppes, including permanent settlements, reliance on food producing economies, intensified use of ceramics, and utilization of storage. Fortified settlements dating to this period possessed a number of essential attributes of towns, i.e., 1) they adhered to fairly ordered architectural templates, suggesting a certain level of centralized planning; 2) a number of them contained socially integrative architectural features, such as open central plazas and shared house walls; 3) they were firmly delineated in space by ditches and defensive walls (*town* shares origin with German *zaun* or Dutch *tuin*, meaning *fence*); 4) they contained populations numbering into the hundreds but not thousands, i.e., they were large enough where all residents could not maintain 'meaningful relationships' with every other resident, yet not large enough to qualify as 'urban' (Dunbar 1992;

Greenberg 2011; Joffe 2013; Price and Feinman 2013). In addition to highly organized nucleated fortified settlements, technological advances in metallurgy and chariot use, as well as elaborate burials associated with prestige items and animal sacrifice led some scholars to characterize the MBA 'Sintashta' (name of the archaeological culture, *Rus.*) development as a 'middle-range', 'early complex' or a 'chiefdom-like' society (Berezkin 1995; Koryakova 1996, 2002; Masson 1998).

Social factors that drove the emergence of complex societies in other parts of the world also endured among the MBA societies of the Southern Urals. For instance, social ranking, which has been considered among the most conspicuous features of early complex societies (Arnold 1996; Fried 1967; Price and Feinman 1995; Service 1962), is well documented by the Sintashta mortuary evidence. Public, permanent, and monumental nature of Sintashta kurgan burials makes it seem likely that the interred individuals, some of whom were children, were highly revered during their lifetime. Anthony (2007:405-407), based on estimates of meat provided by sacrificed animals (up to a few tons) during a single feasting event connected with a MBA kurgan burial, suggested that such rituals were part of regional 'tournaments of value' between the elite groups, as well as between elites and commoners. Demographic estimates indicate that only a small portion of the dead were buried under kurgans (Epimakhov 2002a), while the depositions of sacrificial domestic animals, metal weapons, jewelry, stone maces, as well as spoke-wheeled chariots into the graves have been interpreted as evidence of social stratification (Berezkin 1995; Koryakova 1996, 2002; Masson 1998; Epimakhov 2002b; Koryakova and Epimakhov 2007; Zdanovich 1997). Furthermore, substantial labor investment in the construction of kurgan monuments suggests the presence of powerful leaders within the Sintashta communities.

Settlement evidence, on the other hand, points to a uniform or 'egalitarian' nature of the households within the fortified settlements (Hanks 2009), being virtually undifferentiated in terms of house size, house plans, and artifact assemblages (Epimakhov 2002b; Gening et al. 1992; Koryakova and Epimakhov 2007). Such combination of burial and household evidence indicates that the power of elites buried within the Sintashta kurgans was largely rooted in social prestige and/or military pursuits and did not manifest itself in higher standards of living. Such archaeological pattern, pointing to the lack of overlap between social status and material well-being, is common among some of the "classic" examples in chiefdom literature. For instance, in the pre-Hispanic Alto Magdalena chiefly communities of southwestern Colombia, elaborate tombs, typically containing single individuals, were associated with only the slightest evidence of wealthier households (Drennan 2008).

Four to five meter wide fortification walls constructed of sod bricks and wood, as well as 2-4 m deep concentric ditches, which surrounded the Sintashta settlements (Gening et al. 1992; Koryakova et al. 2013; Malutina and Usachuk 2004; Vinogradov 2011; Zdanovich and Malutina 2004) emphasize military organization and indicate the presence of sufficient managerial leadership necessary to organize such construction projects. High levels of craft development achieved by the Sintashta communities, manifested in the production of spoke-wheeled chariots and copper alloy objects, including weapons and jewelry, point to the existence of a fairly complex economic system, characterized by some level of productive specialization. Recent compositional analysis of slag debris suggests that Sintashta metal production may have been a segmented process, with only the final phase of smelting taking place within the fortified settlements (Doonan et al. 2014), while burial evidence suggests that only certain individuals within the Sintashta communities were involved in the production of copper alloy objects (Hanks et al. 2012).

In summary, the lines of archaeological evidence outlined above allow us to associate the MBA communities of the Southern Urals with hereditary social inequality, highly developed craft technologies, substantial labor investment into public works projects, and a focus on military organization – features that are shared by countless early complex societies around the world.

1.3.1 Lack of supra-local organization

To those interested in the study chiefdoms, one of the most pertinent questions has been how to trace their development through material record. Out of various data categories, settlement pattern evidence seems to offer the most direct path toward such inquiries. Numerous times around the world, emergence of chiefdoms was associated with formation of larger political units, which are commonly referred to as ‘polities’, ‘districts’, or ‘supra-local communities’. Robert Carneiro (1981:85), for example, defined chiefdom as “an autonomous political unit comprising a number of villages or communities...” Empirical comparative analysis confirms this notion by identifying integration of smaller local communities into spatial clusters as a common thread associated with the emergence of larger, more complex social formations (Peterson and Drennan 2012).

In light of such considerations, the proclaimed absence or near-absence (Johnson 2014; Epimakhov 2002b) of one of the most widely shared features of early complex societies, i.e., supra-local organization, makes the Sintashta development seem highly unusual, if not unprecedented, in the context of comparative chiefdom studies. Academic discussions of the hinterland component of the Sintashta towns began when Zdanovich and Batanina (1995) hypothesized that every fortified town must have been surrounded by a few unfortified settlements, thereby forming a supra-local community pattern. This hypothesis was later confirmed for the Arkaim settlement, with the excavations at two unfortified settlements located in its vicinity (1-2 km away) producing cultural material similar to that recovered from the fortified site (Figure 2). However, the number of other smaller unfortified settlements in the region from which Sintashta material has been recovered is minimal (6 hinterland settlements in comparison to 22 'centers') (Figure 2).

1.3.2 Small demographic scale

The importance of establishing the demographic scale of prehistoric social entities is rooted in the notion that integration of human populations at higher demographic (and often spatial) scales creates a more complicated context for social interaction. Comparative study of the emergence of larger, more complex social formations is therefore firmly tied to the domain of regional demography. In this regard, it is important to note that another factor that sets Sintashta towns apart from a number of other chiefly communities in the Eurasian steppes as well as other world regions is their relatively small demographic scale.

Existing population estimates of people living within the fortified walls of Sintashta towns are often based on the counts of the housing structures, the outlines of which have been detected through the stereoscopic analysis of Soviet-era aerial photographs (Zdanovich and Batanina 2007) or by means of geophysical prospection (Hanks et al. 2013; Patzelt 2013). According to these lines of evidence, the MBA settlements ranged from 1 to 3 ha in size and contained anywhere from 12 to 70 housing depressions, ~200 m^2 each (Koryakova and Epimakhov 2007; Krause and Koryakova 2013; Zdanovich and Batanina 2007). Zdanovich and Zdanovich (1995:54) provided a population estimate of 2,000-3,000 people for the settlement of Arkaim based on the maximum number of people (30-50) that could pack into each of the 60 20x10 m structures in times of warfare escalation. Such demographic estimates have been considered unrealistically high (Epimakhov 2002a; Johnson and Hanks 2012; Kohl 2007), especially with researchers more recently agreeing on the fact that only portions of Sintashta structures were used as living quarters, with the rest of the space dedicated to metal or other craft production; storage; and perhaps keeping small domestic livestock during the harsh winter months (Johnson and Hanks 2012; Vinogradov 2011). More recent estimates, derived from placing 5-15 people into each structure, provide a range of 60 to 1,050 people per Sintashta settlement, with an average-size Sintashta town containing a few hundred (300-400) people (Johnson and Hanks 2012; Johnson 2014; Krause and Koryakova 2013:349).

Such demographic parameters make Sintashta settlements quite small in comparison to chiefly centers documented in other world regions. For instance, Quachilco, the central village of the earliest supra-local community in the Tehuacan Valley of Mexico, had an estimated population of 2,000 people. In the neighboring Basin of Mexico, large villages serving as central foci for the earliest supra-local communities contained around 5,000 people (Sanders et al. 1979:55-56). In the Eurasian steppe/forest steppe zone, generally characterized by lower population densities, the Iron Age Sargat-Gorohovo chiefly center of Rafailovo was estimated to have contained over 1,700 people (Matveeva 2002). When chiefly centers demographically comparable to the Sintashta towns did occur in other world regions, they were parts of larger supra-local population clusters that numbered in the thousands (Peterson and Drennan 2012). For example, while the central communities of Cahuamarca (1000-350 BC) polities in the Santa Valley of coastal Peru contained around 500 residents, the polities themselves contained 1,000-2,000 people (Wilson 1988).

1.3.3 Lack of antecedents

Employing a diachronic perspective is crucial for understanding the processes that drove the emergence and the subsequent disintegration of early complex societies in the Southern Urals. Prior to the emergence of the Sintashta towns, the Southern Urals steppe zone was associated with the Early Bronze Age (EBA) (3500-2000 BC) kurgan burials and Eneolithic (4500-2200 BC) camp sites (Epimakhov 2010a; Koryakova and Epimakhov 2007; Malutina and Zdanovich 1995; Matyushin 1982; Mosin 2000; Potemkina and Degtyareva 2007). The chronological overlap between the Eneolithic and the EBA periods points to some period of co-existence of these two archaeological traditions in the Southern Urals. Occupation evidence for both of these archaeological patterns is rare and extremely ephemeral in the area where Sintashta sites later emerged. For example, the EBA habitation sites are limited to occasional isolated artifact finds, while the biggest Eneolithic camp site includes just 6-8 distinct dwellings, ~30 m^2 each (Matyushin 1982:19; Mosin 1996, 2000, 2004; Vinogradov et al. 2008). Such disproportions in the occupation evidence between the EBA/Eneolithic on the one hand and the MBA, on the other, make it difficult to identify clearly recognizable antecedents of Sintashta in the Southern Urals steppe zone.

1.3.4 Sintashta collapse

Researchers agree that the Sintashta towns disappeared in the Late Bronze Age (LBA) (1700-1400 BC) as regional populations disaggregated. LBA unfortified settlements no longer featured socially integrative architectural features, such as shared house walls and open central plazas. These settlements were less nucleated, and contained structures that were arranged in either linear or 'chaotic' fashion (Zdanovich 1995). In addition, existing data indicates that typical LBA settlements were several times smaller than Sintashta towns (Epimakhov 2009). Based in part on the lines of evidence outlined above, various researchers characterized the MBA-LBA transition in the Southern Urals as "social simplification" (Epimakhov 2002b:62), "devolution" (Koryakova and Epimakhov 2007:324), "the emergence of a less stratified social structure" (Kohl 2007:178), and "collapse of a center-oriented ethos" (Johnson and Hanks 2012:363) - phrasing that is frequently associated with societal collapse.

Another noteworthy aspect of the MBA pattern is its limited longevity (~350 years), manifested in a sharp decline in elaborate burials, fortification features, and military attributes by the onset of the LBA period. Pronounced markers of complex societies do not re-emerge in the region until the Early Iron Age (1st millennium BC), when the Southern Ural steppes become associated with the historically known Sauramatian and Sarmatian groups (Koryakova and Epimakhov 2007). In terms of its chronological span, Sintashta is comparable to some of the most short-lived early complex societies, such as the Chacoan system (~300 years) (Lekson 2006) or the Moundville chiefdom (~350 years) (Byers 2013; Steponaitis 1991). In this sense, the Sintashta formation serves as an example of a cycle of development that came to an end without leading to the emergence of yet larger and more complex social formations, much like the Hohokam societies of the American Southwest or the Jenné-jeno polity of West Africa (Bayman 2001; McIntosh and McIntosh 1980; Peterson and Drennan 2012).

1.4 RESEARCH PROBLEM

To summarize, the existing evidence suggests that while the Sintashta communities possessed a number of chiefdom-like characteristics, they also exhibited some fairly unusual attributes when compared to other early complex societies. Namely, they (1) largely lacked a supra-local characteristic, (2) were extremely small demographically, (3) lacked recognizable local antecedents, and (4) disaggregated into smaller social formations during the LBA, after existing for a fairly short period of time. However, such view of the Sintashta communities is based on fragmentary, inconclusive data.

There are reasons to believe that smaller, more ephemeral Bronze Age occupations/activity zones have not been accounted for. Firstly, smaller sites would not be visible on aerial photographs, which is how many Bronze Age settlements, including most Sintashta towns, were discovered. Secondly, habitations located outside of "likely" locations targeted by previous pedestrian surveys may have been overlooked. Lastly, even in the previously surveyed areas, sites not exposed by plowing or erosion processes may have remained invisible. Existing evidence supports the validity of such concerns. For example, researchers (Johnson 2014; Mosin 1996; Zdanovich et al. 2003) repeatedly report the presence of isolated sherd and lithic scatters located outside of previously known settlements. Epimakhov (2010) explains such artifact scatters by the existence of above-ground (vs. semi-subterranean) structures that would not be seen on aerial photographs.

James Johnson's (2014) systematic regional survey (the first of its kind in the Southern Urals) posed similar questions to the ones outlined below and attempted to account for some of the previously overlooked data categories, i.e., smaller artifact scatters, sites not seen on aerial photographs, and sites located in unexpected (and therefore uninspected) places. However, visual scanning of earth's surface, employed by Johnson, produced only two MBA sherds in a 142 km^2 area that included two previously known MBA fortified settlements. For comparison, previous excavations of MBA settlements have repeatedly yielded hundreds of ceramic sherds (Malutina and Zdanovich 1995; Krause and Koryakova 2013; Vinogradov and Alaeva 2013). Sparseness of evidence recovered by Johnson may have been due to the visibility issues stemming from the dense steppe grass cover, as well as geomorphological processes, resulting in Bronze Age surfaces being covered by tens of centimeters of soil, on average (Kupriyanova 2013; Levit 2005:36; Vinogradov 2003; Plehanova 2006). Furthermore, modern plowing activities and soil erosion processes, which would improve visibility, tend to be sparse and irregular in the Southern Urals, as in many other world regions.

Such "highly problematic ... [and] ... highly variable field conditions" (Johnson 2014:76) posed a challenge to recovering large-enough samples of datable archaeological material from Bronze Age occupation areas – a procedure that is essential to answering questions pertaining to shifting patterns in regional community structure, especially when dealing with multi-phased sites. For instance, data collected in the field by Johnson during 2009 and 2011 pointed to a complete absence of hinterland populations living outside of two fortified MBA settlements (Stepnoye and Chernorech'ye). However, subsequent 2012 field season's excavations by Kupriyanova recovered MBA ceramics from a habitation site located just outside of Chernorech'ye. Although Johnson's surface collection identified LBA archaeological material at this site, Kupriyanova's excavations illustrated that detecting earlier, less substantial MBA occupation required obtaining larger and possibly sub-surface samples of material.

This study applied a more intensive methodology (outlined in Chapter 2) to cope with the gaps in settlement pattern evidence outlined above in order to answer the following **research questions** more effectively:

1) How much more evidence of EBA/MBA/LBA occupation is there beyond the previously recorded sites?

2) How large were EBA/MBA hinterland/LBA populations?

3) To what extent were these populations mobile or sedentary?

4) Does the occupation evidence from the survey zone suggest the presence of a supra-local community comprised of one known MBA fortified settlement surrounded by a cluster of smaller unfortified local communities? Similarly, to what extent were there settlement clusters dating to the EBA or the LBA that suggest supra-local community(-ies)? If so, what was the demographic and spatial scale of these entities?

1.5 RESEARCH AREA

Fieldwork activities were carried out over the course of two field seasons in the Zingeyka River valley, located in the northeastern part of the Kizil'skiy District of the Chelyabinsk Oblast', southern Russia (Figure 3). The 40 km^2 research area, being a sub-set of a larger 30,000 km^2 territory over which the Sintashta fortified settlements spread, was selected for the following reason. It is a subset of a larger region for which basic patterns of Bronze Age settlements and burials have been extracted from Soviet-era aerial photographs and pedestrian surveys (Zdanovich et al. 2003). Exploratory analysis of this macro-regional (4,400 km^2) dataset allowed the author to outline an area that contained numerous traces of EBA, MBA, and LBA occupation, concentrated in a fairly compact area (Sharapov 2011; Zdanovich et al. 2003; Znadovich and Batanina 2007).

Namely, the research area contained one previously unexcavated (aside from test pits) MBA fortified settlement named Sarym-Sakly. Stereoscopic readings of aerial photographs pointed to Sarym-Sakly occupying an area of about 1.5 ha and containing around 30 housing depressions (Zdanovich and Batanina 2007). A more recent geophysical prospection of the settlement largely matched these results and confirmed the presence of 27 structures, measuring ~200 m^2 each (Fedorova et al. 2013). When compared to other Sintashta settlements, such spatial parameters qualify this site as average in terms of size. Characteristic Sintashta ceramics were previously recovered from 2 test pits, suggesting a date of 2050 – 1700 BC. The study area also contained 9 unfortified Bronze Age settlements, 8 of which were dated based on the results of small scale excavations, test pits, and surface collections. All dated unfortified settlements produced LBA materials, while one yielded "MBA-like" ceramics as well (Petrova 2001). Traces of human occupation that predated the Sintashta development were also identified in the research area. Namely, previous surveys discovered 3 camp sites containing lithic materials assigned into the Mesolithic-Neolithic chronological window (8000 BC – 4500 BC). Such characteristics pointed to a high level of research potential of the selected study area. To summarize, while archaeologists have previously established presence of human occupation in the study area in the EBA-LBA periods, further research was needed to address the issues of demography and community structure.

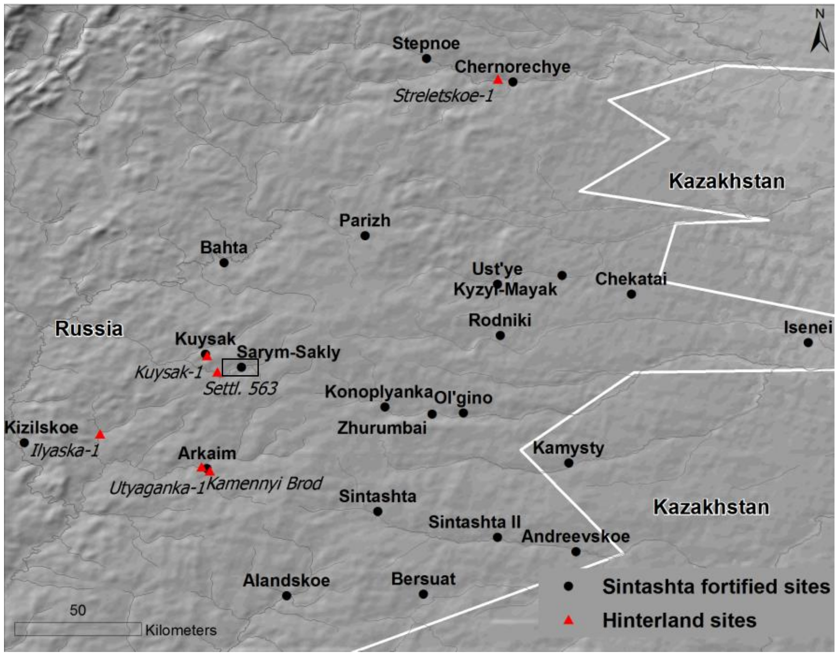


Figure 2: Distribution of Sintashta fortified sites and unfortified hinterland settlements. Survey zone is denoted by a black rectangle.

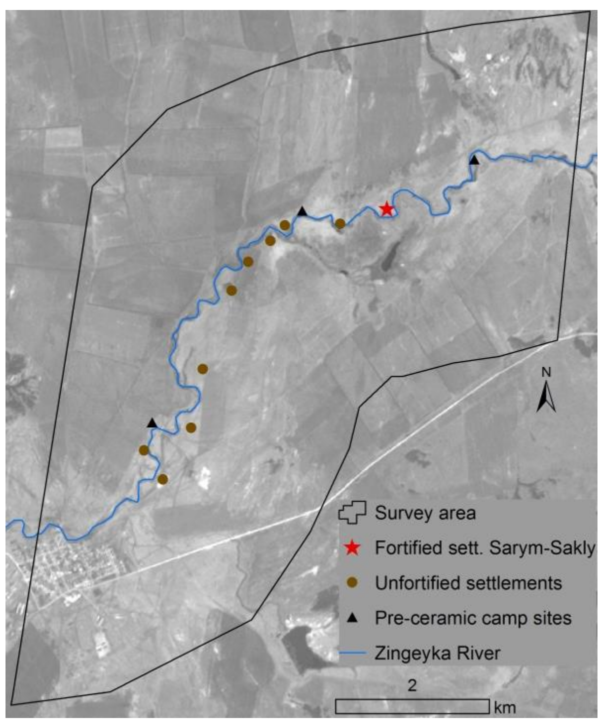


Figure 3: Outlines of the Zingeyka valley survey zone with previously known settlement sites.

2.0 METHODS FOR REGIONAL DEMOGRAPHIC ANALYSIS

Answering the research questions that were posed in the previous chapter requires determining how people distributed themselves across the landscape within the study area. The methodology described in this chapter is based on an area-density approach to paleodemography, which relies on quantifying the amounts of garbage humans left behind to arrive at population estimates (Drennan et al. 2015). In addition to relying on the above principles, the field methodology described below was designed to incorporate categories of occupational data that have been largely unaccounted for thus far in the Southern Urals: smaller sites not visible on aerial photographs; habitations located outside of "likely" locations targeted by previous pedestrian surveys; sites located in poor visibility areas.

2.1 FIELD METHODS

A contiguous 40 km^2 stretch of the valley, encompassing territories located within 2 km from the Zingeyka River, was chosen as the appropriate study area. The 2 km limit was chosen based on the local prehistoric, historical, and ethnographic data from the Southern Urals, which suggest it being highly unlikely that areas beyond 2 km from permanent freshwater sources were occupied to any significant degree (Reshin 2010; Yanguzin 2002; Zdanovich et al. 2003). For instance, seasonal migration routes of Turkic-speaking Bashkir pastoralists of the Southern Ural steppes were largely confined to moving up and down small rivers (like Zingeyka), highlighting the importance of accessibility to water, even in the context of more mobile settlement patterns (Yanguzin 2002).

It is worth noting that Zingeyka is a small steppe river and the survey zone is located fairly close (~30 km) to its source. This fact, coupled with the visual analysis of aerial photographs and satellite images indicates that the river channel is quite stable. Given that the topography of the region finished forming in mid-Pleistocene (Levit and Belgorodskiy 2009), we suppose that the current location of the river channel roughly corresponds to its location in the Bronze Age.

The research area was stratified into two distinct zones, one of which was surveyed intensely (0-500 m from the river), while the other (500-2000 m from the river) was systematically sampled based on the following considerations. Previous research illustrated that in the arid environments of the Southern Urals, Bronze Age sites are usually located close to permanent water sources. For instance, aerial photography data (Zdanovich et al. 2003) indicates that an overwhelming majority of Bronze Age habitation sites in the Kizilskiy District of the Chelyabinsk Oblast' are located not farther than 1 km from the currently flowing rivers (93% ± 3% at an 80% confidence level). Johnson's (2014) systematic surface collection concluded that territories located 1000-2000 m away from present-day rivers were sparsely occupied (0.14% of occupied vs. 99.86% of unoccupied land).

Such low-density occupation expectations were confirmed during the summer of 2014, when the author carried out a pilot survey of a 10 km^2 portion of the study area. The pilot survey was conducted within a 1 km buffer along the Zingeyka River and included 4.7 km^2 located within 500 m from the river and 5.3 km^2 located 500-1000 m away from the river. Only 3 discrete 1 ha blocks of land located within the 500-1000 m buffer contained evidence of prehistoric occupation (0.6%). For comparison, 70 discrete 1 ha blocks of land located within the 0-500 m buffer (13%) contained traces of prehistoric occupation. Such proportions of occupied vs. unoccupied land indicated that a random sample of 41 1 ha blocks from the 500-2000 m buffer zone could tell us with a 90% confidence ± 2% error range what proportion of this zone was occupied (Drennan 1996b:142-143).

In order to spread the 41 1 ha blocks fairly evenly in space, the survey area was first divided into a grid of 1 km^2 squares. Those 1 km^2 squares that encompassed previously uninspected areas were each divided into 100 1 ha squares. A random sample of 2 1 ha quadrats from each 1 km^2 square was selected by using a random number generator in Excel. Each 1 ha quadrat was then inspected using standard survey methodology. In total, 45 1 ha quadrats located 500-2000 m from the river were inspected (Figure 4). The "dummy" squares in Figure 4 fell either beyond the 2 km limit or within previously inspected areas and therefore were not investigated. In sum, 16.5 km^2 were inspected completely, while the remaining 23.5 km^2 were investigated via sampling.

Two methods, shovel probes and surface collections, were employed in tandem over the entire survey zone, regardless of visibility. There were a few exceptions that involved collection units that spread over a modern quarry, around 1 m deep, in which only surface collection could be performed (Figures 14 and 20). In regional settlement pattern studies, systematic surface collection is a common method used in investigations of prehistoric human occupation. This method is generally preferred for its expedience and cost efficiency. However, surface visibility and geomorphological considerations, discussed in more detail below, suggested that systematic sub-surface testing may be a more effective method to employ in the Zingeyka valley. Since prior to our survey systematic shovel probing has never been employed in the region, both methods were used in tandem to compare their effectiveness.

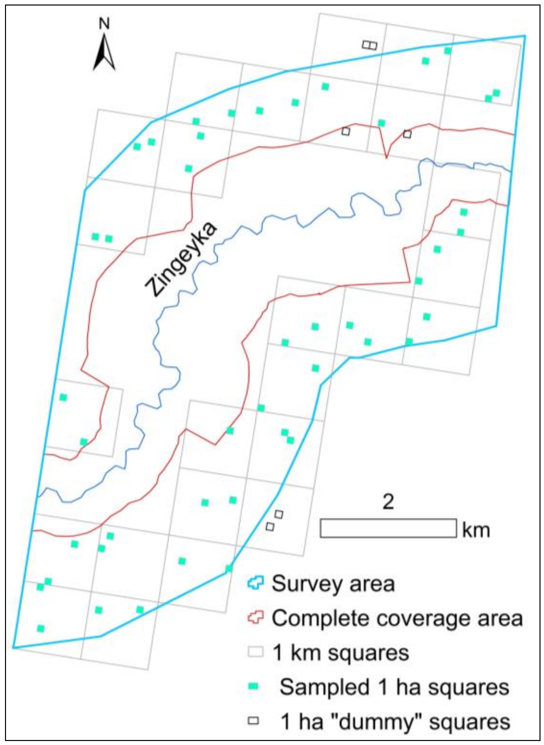


Figure 4: Zingeyka survey sampling strategy.

2.1.1 Surface collections

Survey team members walked back and forth across the landscape and visually scanned the surface. The transects followed cardinal directions that were most perpendicular to the Zingeyka river channel. The surveyors were spread 40 m apart, as such intervals approximated the size of the smallest sites previously detected in the region. Upon the encounter of artifacts, such as ceramics, slag, or flaked stones, an intensive (transects spaced 3 m apart) collection strategy was extended over a 100 m x 100 m square, with the initially encountered artifact at the center. Each such surface collection became a 'collection unit' associated with a specific area of 1 ha or less. If artifacts spread farther than the borders of 1 ha block, then an intensive coverage of another 1 ha block was initiated in the direction of the spread of the artifacts.

Each find within the 1 ha lot was recorded using a handheld GPS device. Considering the relatively low density of Bronze Age artifacts in the Southern Urals, which can be as low as a few artifacts per 1 ha, such detailed recording was not very time consuming. Artifacts located within few meters of each other were recorded under a single waypoint. The borders of collection units were determined based on the outer-most GPS points. There were a few collection units characterized by high artifact densities (i.e., sherds numbering in hundreds). These high density collection units were located in recently plowed fields and in and around a modern quarry. In these cases, all of the artifacts were collected and pulled to the closest pin-flag, which were set up in a 20 m x 20 m grid. The coordinates of pin-flags were recorded using a GPS device.

2.1.2 Shovel probes

Survey crew members, spread 40 m apart, walked across the landscape and excavated a shovel probe every 40 meters (Figure 5). The shovel probes were 40 cm x 40 cm x 40 cm. The depth of shovel probes was based on the average soil accumulation rate for the Southern Ural steppes (Levit 2005:63), which indicated that Bronze Age surfaces are covered by no more than 20 cm of soil, on average.

If a shovel probe produced cultural material (e.g., ceramic, lithic, burnt or cut bone, slag), anywhere from 12 to 32 additional shovel probes spaced 10 m apart were excavated between it and other regularly-spaced probes. First, 12 additional probes, 3 in each cardinal direction (N, E, W, S), were excavated around the initial positive one (Figure 6). If any of the 12 probes were positive, 12 more probes, 3 in each intercardinal direction (NE, NW, SE, SW) were excavated, bringing the total of additional probes to 24 (Figure 7). Probes in all of the directions (cardinal and intercardinal) were continued until the encounter of 2 negative probes in a row. This was done to determine the borders of the occupation area with maximum precision. That way, the number of additional intercardinal direction probes could add up to 20, 5 in each direction, to cover the 57 m $[(40^2+40^2)^{0.5}]$ diagonal of a 40 x 40 m square (Figure 8).

In sum, in a hypothetical 80 m x 80 m (.64 ha) square each positive probe could be accompanied by 12 to 32 additional ones. If areas around such square were occupied and the probes on the outer edges turned out to be positive, the maximum number of probes in a .64 ha square could increase to 65 (Figure 9), meaning that a densely occupied 1 ha area could contain as many as 96 probes.

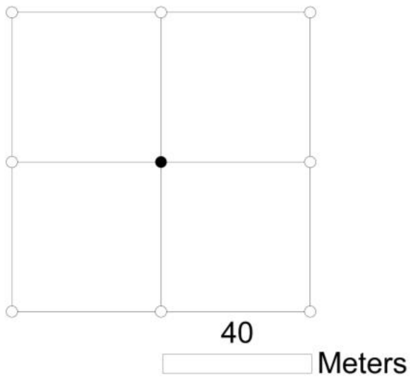


Figure 5: A grid of shovel probes. Circles denote shovel probes. Black circle denotes a positive shovel probe.

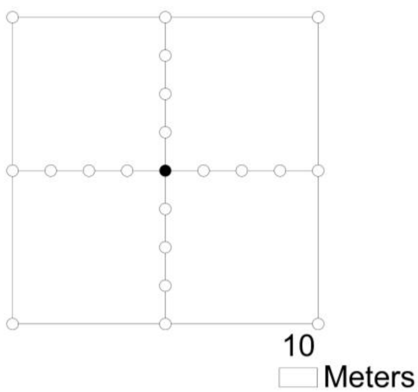


Figure 6: Phase 1 of ‘intensive’ shovel probing. Circles denote shovel probes. Black circle denotes the initial positive shovel probe.

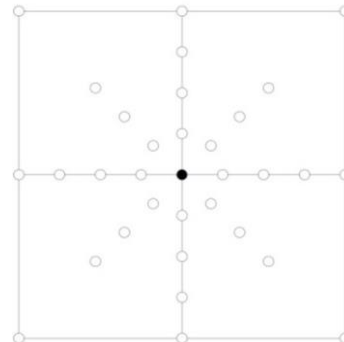


Figure 7: Phase 2 of ‘intensive’ shovel probing. Circles denote shovel probes. Black circle denotes the initial positive shovel probe.

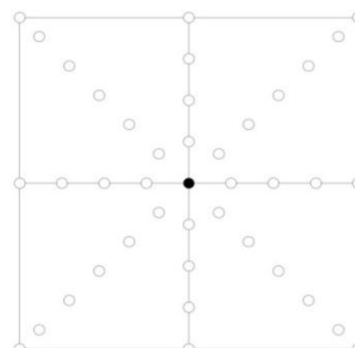


Figure 8: Maximum number of additional shovel probes in a given 80 x 80 m survey square. Circles denote shovel probes. Black circle denotes the initial positive shovel probe

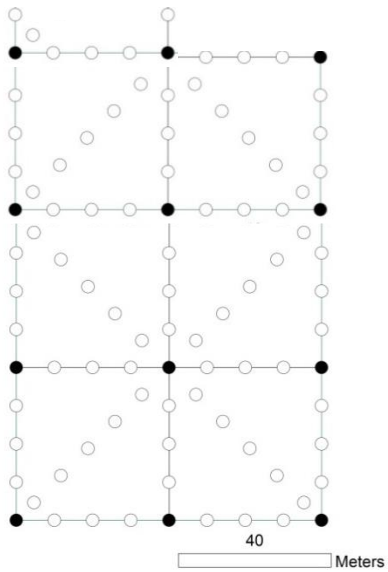


Figure 9: Maximum number of shovel probes in a hypothetical 1 ha survey area. Circles denote shovel probes. Black circles denotes the initial positive shovel probes.

```
Stem and Leaf Plot: N=23

Minimum        :    10.000
Lower Hinge    :    18.000
Median         :    22.000
Upper Hinge    :    30.000
Maximum        :    54.000

            1   0444
            1 H 7888
            2 M 122233
            2   668
            3 H 23
            3   8
            4
            4   6
*  *  *  Outside  Values  *  *  *
            5   34
```

Figure 10: A stem-and-leaf plot of percentages of shovel probes within collection units that contained ceramics. The median value of 22% seems to represent the center of this batch of numbers fairly well.

Such high density of shovel probes was dictated by the desire to obtain sample numbers large enough to allow answering the posed research questions in a low density artifact environment. Minimum target sample size was set at 20 diagnostic sherds per collection unit of 1 ha or less, which would make it possible to speak of proportions of sherds of different periods with error ranges of some ± 10% at 66% confidence level (Drennan et al. 2003:136).

Within positive clusters of shovel probes, like the one depicted in Figures 8 and 9, some probes contained ceramics while others did not. Figure 10 illustrates that within collection units, on average, 22% of shovel probes contained ceramics. Figure 11 illustrates that out of all shovel probes that contained ceramics, a vast majority contained only one sherd. In other words, in order to extract 20 sherds from a 1 ha occupation area, one would need to excavate 91 shovel probes. The numerical parameters outlined in Figures 10 and 11, to a large degree, became apparent during the initial stages of fieldwork and the methodology was adjusted accordingly, ultimately resulting in the method depicted in Figures 5-9. In order to comply with Russian regulations, no shovel probes were excavated over housing depressions or other visible archaeological features. Each “central” positive shovel probe was recorded using a handheld GPS device.

<u>Stem and Leaf Plot: N=295</u>

Minimum	:	1.000
Lower Hinge	:	1.000
Median	:	1.000
Upper Hinge	:	2.000
Maximum	:	90.000

```
             1 M 00000000000000000000000000000000000000000000000000000000000000000000*
             1
             2 H 0000000000000000000000000000000000000000000000000000000000000000000
             2
             3   000000000000000000000000000
    * * * Outside Values * * *
             4   000000000000000000
             5   00000
             6   000000
             7   000000
             9   0
            10   00
            11   00
            13   00
            40   0
            90   0
```

Figure 11: Stem-and leaf plot of the number of sherds per probe in all shovel probes from the survey zone that contained ceramics.

2.2 POPULATION PROXIES: AREA-DENSITY INDEX

Advocates of the area-density approach to paleodemography often rely on *the area-density index* as a population proxy (Berrey 2014; Peterson and Drennan 2011; Houle 2010). This index combines the density of artifacts, the area over which these artifacts are distributed, and the length of the period that is being researched (Drennan et al. 2003b; Peterson and Drennan 2011). The following section outlines how the data collected in the field was transformed into area-density indexes.

2.2.1 Phase 1: the initial delineation of collection units

A total of 35 collection units of 1 ha or less were identified in the 40 km^2 survey zone. These collection units contained cultural materials that were obtained from: 1) both shovel probes and surface collections, 2) shovel probes only, or 3) surface collections only. At the initial stage of the analysis, collection units were delineated based on the maximal spread of artifacts, regardless of which method produced them. Namely, in cases of shovel probes, the borders of collection units were delineated by connecting the outer-most blank shovel probes. In cases where individual artifacts were collected from the surface, collection units were delineated by connecting the outer-most GPS points that marked artifact locations. In a few cases of high density surface collections, the borders of collection units were delineated by connecting the outer-most GPS points plus half the distance to the next blank collection pin-flag, which were set 20 m apart (see Figure 17 for an example of all three types of delineations). All types of prehistoric arti- and eco- facts (burnt/cut bone, metal slag, lithics, ceramics) that appeared to date the Bronze Age participated in forming the outline of a collection unit. The collection units had to be 1 ha or less and they grouped artifacts separated by a gap not exceeding 100 meters. Table 1 summarizes some basic information about all of the collection units from the survey. Turning these assemblages of artifacts into meaningful population proxies required completing the analytical steps described below.

2.2.2 Phase 2: eliminating low density collection units

Within the survey zone, there were a number of low-density collection units, i.e., areas of occupation of 1 ha or less that contained less than 20 sherds and thereby fell below the ‘low density threshold’, discussed in the preceding section. Some of these low density occupation areas were incorporated into the analysis of Bronze Age settlement patterns, while others were ignored completely. Table 2 summarizes the reasoning behind why some (mostly single-sherd) collections were ignored while others were not.

Table 1: Basic information about all collection units from the survey. The ones highlighted in yellow were eliminated due to low occupation densities; ones highlighted in green were eliminated due to the absence (or near absence) of positive shovel probes.

C.U. #	C.U. name	Area (ha)	Visibility conditions	S=surface collection; P=shovel probe	Sherds from surface collection	Sherds from shovel probes	Notes regarding visibility
1	katsbah 1 1	1.00	Good	S	102	0	Modern quarry and near it
2	Katsbah 1 2	0.91	Patchy	S+P(limited)	204	6	Modern quarry and near it
3	Katsbah 1 3	0.47	Poor	S+P	0	36	
4	Katsbah 1 4	0.67	Patchy	S+P(limited)	63	0	Modern quarry and near it
5	Katsbah 2 1	0.56	Poor	S+P	12	29	
6	Katsbah 2 2	0.13	Poor	S+P	0	2	
7	katsbah 4	0.27	Poor	S+P	0	5	
8	Leb 1 1	0.73	Good	S+P	216	40	Recently plowed field.
9	Leb 1 2	0.37	Poor	S+P	0	24	
10	Leb 4 1	0.37	Good	S+P	293	0	Recently plowed field.
11	Leb 4 2	1.11	Good	S+P	692	47	Recently plowed field.
12	Leb 4 3	0.50	Good	S+P	4	0	Recently plowed field.
13	Zarya 1 1	0.16	Poor	S+P	1	6	
14	Zarya 1 2	0.68	Poor	S+P	0	26	
15	Zarya 1 3	0.55	Poor	S+P	0	56	
16	Site 614	0.88	Poor	S+P	8	33	
17	Nonesite 5	0.58	Poor	S+P	0	7	
18	Nonesite 4	0.22	Poor	S+P	0	7	
19	SarySakly1 South	0.95	Poor	S+P	0	27	
20	SarySakly2	1.00	Poor	S+P	0	51	
21	SarySakly3 North	0.94	Poor	S+P	0	28	
22	SarySakly4 North	0.38	Patchy	S+P	3	1	Road and near it
23	Zarya 11	1.20	Poor	S+P	22	31	
24	Leb 6 1	0.79	Patchy	S+P	38	19	Included road, river bank, an area of previous excavations
25	Leb 6 2	0.96	Poor	S+P	10	49	Incorporated some road
26	Leb 6 3	1.00	Poor	S+P	16	74	Incorporated some road
27	Leb 6 4	1.00	Patchy	S+P	35	8	Incorporated road, some plowed field
28	Leb 6 5	0.74	Patchy	S+P	3	4	Incorporated road, some plowed field

Table 1 (continued).

C.U. #	C.U. name	Area (ha)	Visibility conditions	S=surface collection; P=shovel probe	Sherds from surface collection	Sherds from shovel probes	Notes regarding visibility
29	Katsbah 6	0.71	Poor	S+P	0	120	
30	NonesiteLot 2	0.01	Patchy	S+P	5	0	Incorporated river bank
31	c452	n/a	Good	S+P	1	0	
32	c493	n/a	Good	S+P	2	0	
33	c559	n/a	Poor	S+P	1	0	
34	c583	n/a	Patchy	S+P	1	0	
35	c23	n/a	Patchy	S+P	1	0	

2.2.3 Phase 3: eliminating units that did not produce positive shovel probes

One of the objectives of the survey was to establish the size of Bronze Age occupations and determine how dense they were with prehistoric material. Although two methods (surface collections and shovel probes) were used in tandem, shovel probing was determined to provide a better measure of both area and density of prehistoric material for the following reasons. 1) As Table 1 illustrates, out of 30 collection units that remained after Phase 1 elimination, there were 12 in which sherds were not found on the surface but were found in shovel probes (sometimes in substantial quantities). This observation emphasizes the negative impact of dense vegetation cover and geomorphological processes on surface collections (Figure 12). 2) Out of 30 collection units, only 5 were characterized by good surface conditions, i.e., were in the middle of recently plowed fields and modern quarries. Most surface collections, however, were made over exposed or eroded patches of land, such as roads, eroded river banks, corners of plowed fields. The results of surface collections were thereby more susceptible to the inconsistencies in ground conditions. 3) Repeated plowing likely transported materials some distance away from their original location, thereby inflating the area component of the area-density measure (see Figure 16, collection unit #8 for an example of this). Shovel probes would be less prone to this bias than surface collections. Therefore, shovel probes seemed to provide a more reliable measure of both area and density of premodern sherds. Areas that produced no positive shovel probes were ignored in the analysis, bringing the total number of collection units used in the analysis to 26 (Table 1, Table 2).

Table 2: Low density collection units. The ones highlighted in yellow were eliminated due to low occupation densities; ones highlighted in green were eliminated due to the absence of positive shovel probes.

C.U. #	Sherds from surface	Sherds from shovel probes	Why these collection units were counted as occupation areas or ignored
6	0	2	Associated with a housing depression, which showed up on aerial photos. Found more ceramics in a test pit. Also found bones and lithics. A northward extension of a larger Bronze Age occupation area.
7	0	5	Associated with a housing depression, which showed on aerial photos. Found more ceramics in a test pit. Also found bones and lithics. Just a truly low density occupation area.
12	4	0	Included during Phase 1 as a northward extension of a larger Bronze Age occupation area. Eliminated during Phase 2 due to not producing any positive shovel probes.
13	1	6	Associated with a housing depression, confirmed by aerial photos. Found more ceramics in a test pit. Also found bones and lithics.
17	0	7	Associated with 2-3 housing depressions, confirmed by aerial photos. Found more ceramics in a test pit. Also found bones and lithics.
18	0	7	Associated with what appeared as a housing depression. Found more ceramics in a test pit. Also found bones and lithics.
22	3	1	Included during Phase 1 due to it being just over 100 m north of a Bronze Age site. Other types of artifacts (lithics) were also found. Eliminated during Phase 2 due to producing only 2 positive shovel probes, one of which contained ceramics.
28	3	4	Westward extension of a large (5ha) bronze Age occupation area. Lithics and bones were also found.
30	5	0	Included during Phase 1 due to it being located just over 100 m from a .8 ha Bronze Age occupation area. In a likely occupation area (river terrace). Eliminated during Phase 2 due to not producing any positive shovel probes. No other artifacts were found.
31	1	0	An isolated (>100 m apart from anything else) LBA sherd. It was found in the middle of a recently plowed field. If it was an occupation area, we would have found something else there, i.e., bones, lithics, slag, housing depressions. Chose to ignore as a non-occupation area. The area where we found it was not a characteristic occupation area (i.e., far from river).
32	2	0	Two isolated (>100 m apart from anything else) sherds: one LBA, one undetermined. They were found in the middle of a recently plowed field. If it was an occupation area, we would have found something else there, i.e., bones, lithics, slag, housing depressions. Chose to ignore as a non-occupation area.
33	1	0	One MBA sherds. A piece of slag was also recovered nearby (20 m) in a shovel probe. The place is characteristic for a settlement (a river terrace). The area was probed fairly intensively. No bones or other artifacts were found. Chose to ignore as a non-occupation area.
34	1	0	One MBA sherd. A lithic was also found nearby (10 m). Nothing else around. Chose to ignore this area in the analysis.
35	1	0	A totally isolated (>100 m from anything esle) MBA sherd. Chose to treat as a non-occupation area.

Figure 12: Visibility conditions in 'bad visibility' collection unit #9. The picture on the right depicts a trowel that was thrown on the ground and the handle of it can barely be seen in thick grass.

A visual summary of 26 collection units that remained after all of the elimination steps and that were used in the subsequent EBA-LBA demographic analysis is provided in Figure 13. APPENDIX A provides visual summaries of each collection unit. What is worth noting is that all of the collection units tend to cluster around the Zingeyka River. The sampled 1 ha squares located in the 500-2000 m buffer (see Figure 4, if needed) did not produce any EBA, MBA, or LBA material. This is due to the lack of permanent water sources in those areas that would be necessary for human habitation and livestock grazing. The temporary streams and puddles that are present beyond 500 m from the river tend to be seasonal, i.e., they dry up after the spring thaw period is over. Presently, these areas are only used for commercial agriculture, cutting down hay, logging, or occasional horse herding.

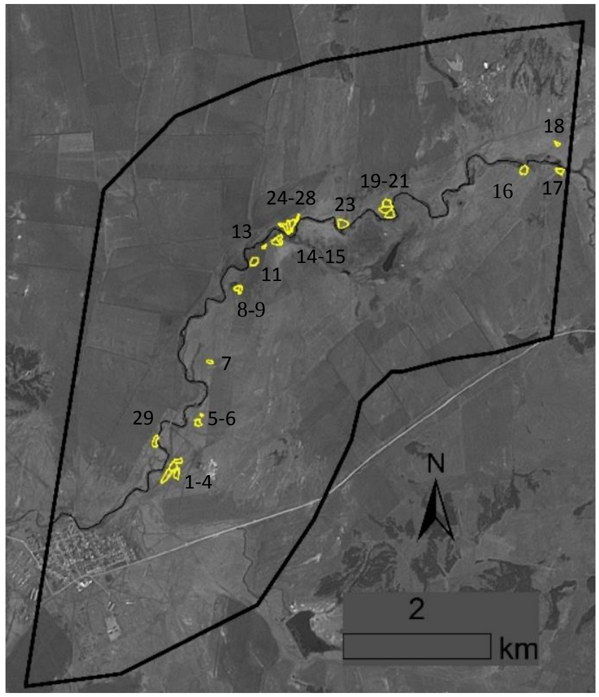


Figure 13: The 40 km^2 survey area, outlined in black, with 26 collection units derived from shovel probes, outlined in yellow. The collection units are not numbered in a strict sequence since some of them were left out of the analysis.

2.2.4 Phase 4: attributing surface densities to time periods

When deciding how to divide the overall sherd density measure within a given collection unit between time periods, it is important to note that low artifact densities increase the chances of missing Bronze Age occupations dating to different sub-periods altogether. In order to address this issue, the results of surface collections and shovel probes were combined when establishing the proportions of MBA and LBA occupation in a given collection unit.

It was important to first examine whether one method was biased over the other in recovering sherds of different periods. For example, archaeologists sometimes voice a concern that earlier period sherds may be underrepresented in surface collections, since they are supposed to generally occupy stratigraphically lower positions. Table 3 below lists collection units in which both methods (shovel probes and surface collections) were used simultaneously, and from which sherds of both MBA and LBA periods (LBA proportions can be calculated as [*1.0 - % of MBA sherds]* in most cases) were recovered. This table illustrates that there is no obvious bias in one method showing preference for sherds of one period over the other: out of 9 total cases, 4 surface collections yielded higher proportions of MBA sherds and 5 shovel probe collections yielded higher proportions of MBA sherds. Frequent cases of "hit-or-miss" (i.e., 0% of MBA sherds recovered), resulting from low sample numbers, further emphasize the need to combine both sources of information in order to obtain more accurate occupation proportions.

Table 3: Proportions of MBA sherds in those collection units from which materials of both periods were recovered. N is the total number of identifiable sherds.

Collection unit #	Proportion of MBA sherds in surface collections	Proportion of MBA sherds in shovel probes
2	2% (N=45)	0% (N=5)
5	0% (N=7)	20% (N=20)
8	19% (N=53)	26% (N=19)
11	10% (N=48)	0% (N=37)
16	0% (N=5)	13% (N=24)
23	0% (N=19)	20% (N=15)
24	4% (N=27)	0% (N=15)
25	14% (N=7)	0% (N=16)
26	0% (N=13)	2% (N=41)

In summary, both area and density measures of Bronze Age occupations were obtained from the results of the shovel probes. However, the resulting density values were then distributed between different time periods based on cumulative percentages of sherds of different periods obtained from both surface collections and shovel probes over a usually larger collection unit area outlined during Phase 1 (see Figure 21 and read the section that precedes it for an example of how this is done).

2.2.5 Phase 5: incorporating the quarry area into the analysis

There were three collection units of 1 ha or less over which shovel probes could not be excavated due to the surface being badly damaged by an extensive (~ 1.5 ha), 1 – 1.5 m deep modern quarry (Figure 14). Therefore, only surface collections were made in these good visibility collection units. To incorporate these occupation areas into the regional analysis, it was necessary to establish a conversion rate that would make possible comparing the area-density indexes from shovel probes and surface collections. Good visibility collection units located in freshly-plowed fields in which both shovel probes and surface collections were conducted, provided a logical starting point. There were two such occupation areas in the survey zone.

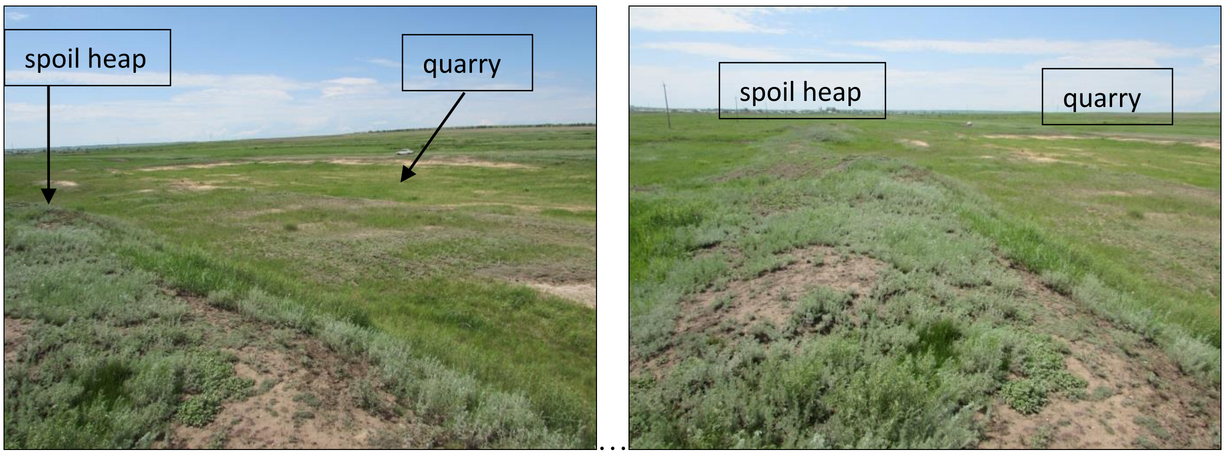


Figure 14: Modern shallow quarry partially covering collection units #1, 3, and 4. View from NE. Sparse vegetation grew over the quarry since the time it was originally excavated.

First, let us consider collection unit #8 in Figure 15 below. If we couldn't excavate shovel probes and could only perform a surface collection, the area of the collection unit would have been 0.68 ha (Figure 16). If in that same area only shovel probes were excavated, the area of the collection unit would have been 0.36 ha (Figure 16).

Same logic was applied to another, larger occupation area, consisting of three collection units, all located within a recently plowed field. Three collection units in Figure 17 were directly adjacent to one another and were therefore combined for the purposes of comparing the areas of collection units produced by shovel probes and surface collections. If we couldn't excavate shovel probes and only performed a surface collection, the area of the collection unit would have been 1.74 ha (Figure 18). If in that same good visibility area only shovel probes were excavated, the area of the collection unit would have been 0.78 ha (Figure 18).

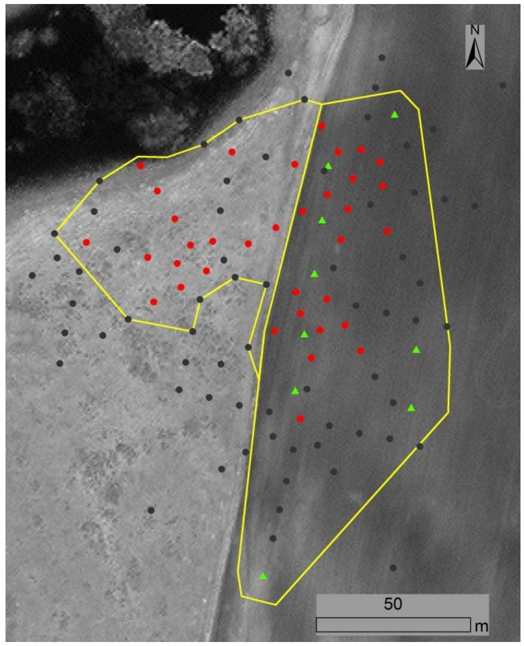


Figure 15: Collection units #8 (right) and #9 (left). Triangles denote surface collections (centers of 20 m x 20 m squares to which all artifacts were pulled). Red circles denote positive shovel probes; black circles denote blank shovel probes. Images in Figures 15-18 are courtesy of the DigitalGlobe Foundation.

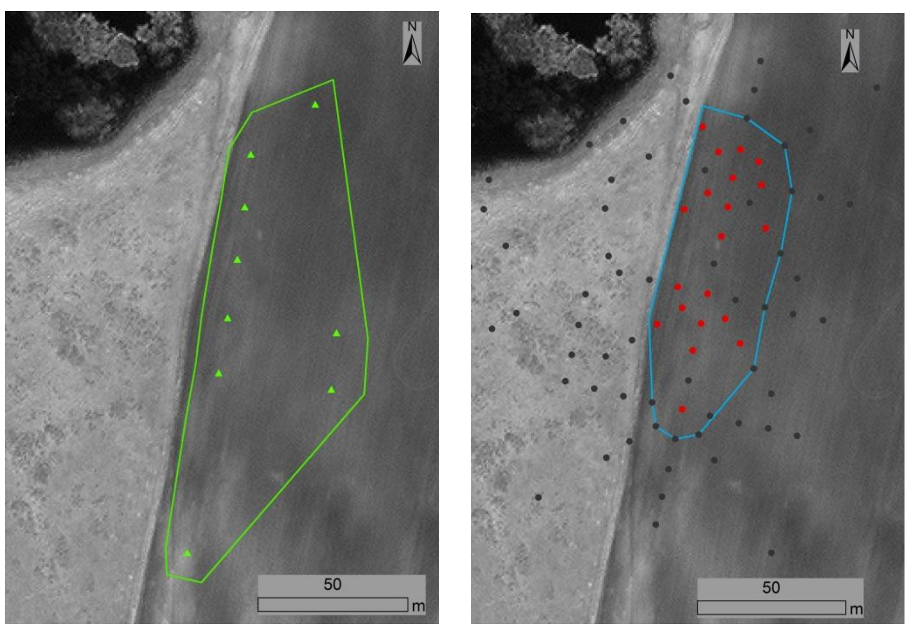


Figure 16: How collection unit #8 would have looked like if we only performed surface collections (left) or if we only dug shovel probes (right). Red circles denote positive shovel probes; black circles denote blank shovel probes.

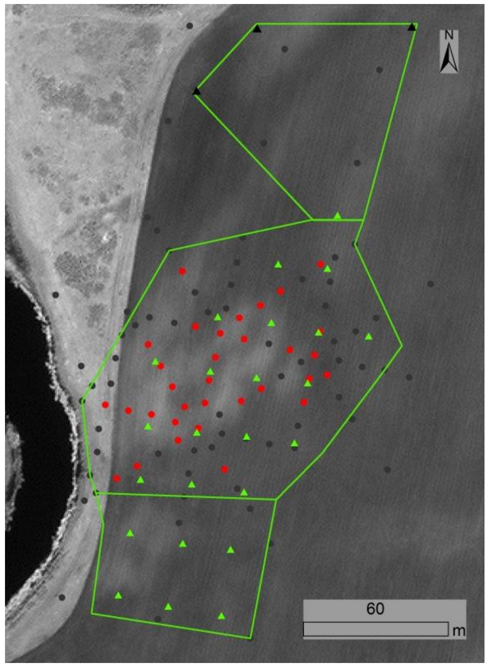


Figure 17: Collection units 10, 11, 12, numbered from south to north. Green triangles denote surface collections (centers of 20 m x 20 m squares to which all artifacts were pulled). Black triangles denote single artifact finds. Red circles denote positive shovel probes; black circles denote blank shovel probes.

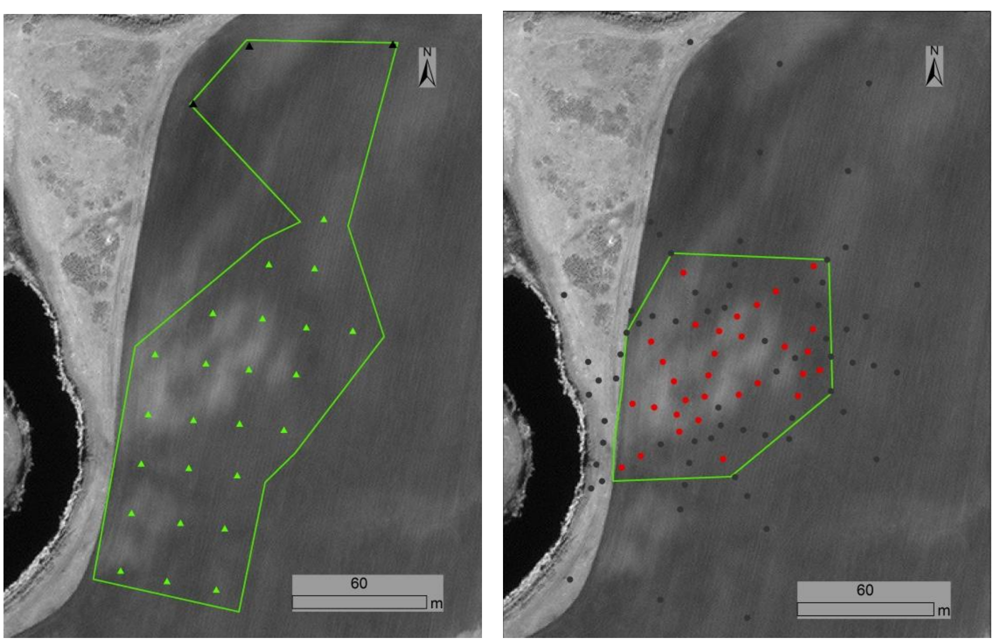


Figure 18: How a conglomeration of collection units #10, 11, and 12 would have looked like if we only performed surface collections (left) or if we only dug shovel probes (right).

Although based only on two cases, we can see that the spread of artifacts on the surface in good visibility, highly disturbed contexts is roughly 2 times the area produced by shovel probes (Table 4). Therefore, by dividing the area over which a surface collection was made in the quarry area by 2, we can estimate the area of a concentration of positive shovel probes.

Table 4: Comparing areas of surface collections with areas of positive shovel probe concentrations in good visibility areas.

	Area (ha) obtained from surface collection	Area (ha) obtained from shovel probes	Conversion rate=surface area / shovel probe area
Case 1: collection unit #8	0.68	0.36	1.9
Case 2: conglomerate of collection units #10, 11, 12	1.74	0.78	2.2

Next, we need to determine what density of sherds we should assign to the "would be" shovel probe concentrations. Below is a table listing sherd densities in positive shovel probe concentrations (Table 5). Out of 26 collection units, 23 were associated with such concentrations, since 3 were in a modern quarry area. Figure 19 depicts shovel probe densities (sherds/ m^2) as a stem-and-leaf plot. The median value of 3 sherds/ m^2 seems to be the appropriate measure of centrality of this batch of numbers.

Figure 20 below illustrates the field conditions in and around the quarry that prevented the excavations of shovel probes in collection units #1, 2, and 4. Although some shovel probes were excavated in collection units #2 and #4, they were limited to the undamaged green grass patches. Dividing the areas over which surface collections in units 1, 2, and 4 extended by the 2.0 conversion factor, we get the "would be" shovel probe areas of .5 ha (1 ha/2), .46 ha (.91 ha/2), and .34 ha (.67 ha/2), respectively. All three of these "would be" shovel probe areas were assigned the "would be" density of 3 sherds/ m^2. In the population proxy calculations that are discussed in the following section, the area and density measures derived above will be used for these three occupation areas.

Table 5: Densities of sherds, derived from shovel probes, in 23 collection units.

C.U. #	C.U. name	Areas (ha) of shovel probe concentrations	Total number of shovel probes dug	Number of probes with cultural material	Number of probes with ceramics	Density (sherds/ m^2) based on shovel probes
3	Katsbah 1 3	0.47	43	29	14	5.2
5	Katsbah 2 1	0.55	52	28	24	3.5
6	Katsbah 2 2	0.09	10	9	1	1.3
7	katsbah 4	0.27	28	24	4	1.1
8	Leb 1 1	0.36	36	17	19	6.9
9	Leb 1 2	0.37	31	23	8	4.8
11	Leb 4 2	0.84	69	47	22	4.3
13	Zarya 1 1	0.16	18	14	4	2.1
14	Zarya 1 2	0.68	55	43	12	3.0
15	Zarya 1 3	0.55	43	37	6	8.1
16	Site 614	0.88	72	52	20	2.9
17	Nonesite 5	0.58	51	44	7	0.9
18	Nonesite 4	0.22	22	18	4	2.0
19	SarySakly1 South	0.95	73	60	13	2.3
20	SarySakly2	1.00	85	67	18	3.8
21	SarySakly3 North	0.94	72	56	16	2.4
23	Zarya 11	1.20	95	73	22	2.0
24	Leb 6 1	0.31	26	20	6	4.6
25	Leb 6 2	0.76	61	38	23	5.0
26	Leb 6 3	0.61	52	24	28	8.9
27	Leb 6 4	0.51	36	30	6	1.4
28	Leb 6 5	0.18	17	14	3	1.5
29	Katsbah 6	0.71	66	49	17	11.4

Stem and Leaf Plot: N=23

Minimum	:	0.900
Lower Hinge	:	2.000
Median	:	3.000
Upper Hinge	:	4.900
Maximum	:	11.400

```
          0   9
          1   1345
          2 H 001349
          3 M 058
          4 H 368
          5   02
          6   9
          7
          8   19
* * * Outside Values * * *
         11   4
```

Figure 19: Sherd densities (sherds/m^2) obtained from shovel probes in 23 collection units depicted as a stem-and-leaf plot. The median value is 3.0.

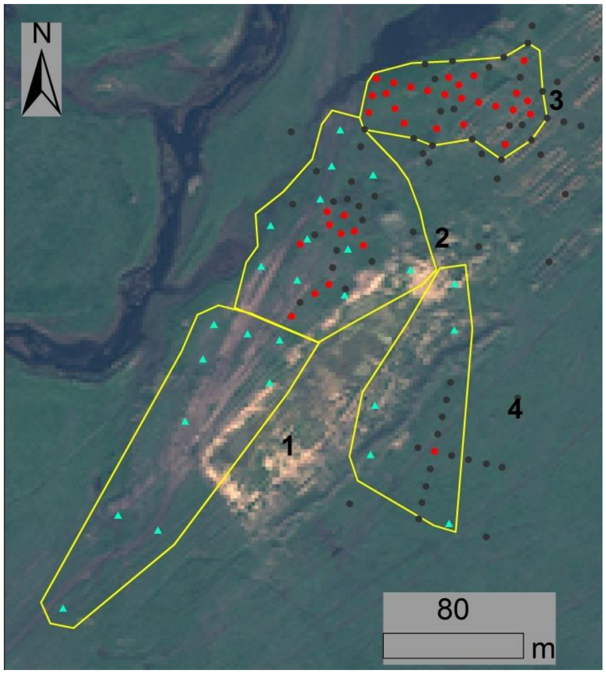


Figure 20: Field conditions in and around the quarry that prevented the excavations of shovel probes in collection units #1, 2, and 4. Green triangles denote surface collections (centers of 20 m x 20 m squares to which all artifacts were pulled). Red circles denote positive shovel probes; black circles denote blank shovel probes. Images in Figures 20 and 21 are courtesy of the DigitalGlobe Foundation.

2.2.6 Final result: area-density indexes

Table 6 summarizes the calculations of *density*, *area-density index*, and *area-density index per century* values for all (26) collection units. Some of the potentially confusing steps of the calculation process are best illustrated through an example of collection unit #11 (highlighted in yellow in Table 6 and depicted in Figure 21). The area outlined in green is the overall collection unit area of 1.1 ha (second column from the left in Table 6). The area marked in red is the area obtained from shovel probes (0.84 ha). The area and density measures in Table 6 are based solely on the shovel probe material coming out of the red area. The proportions of sherds, however, are derived from a collective pool of determinable sherds from both shovel probes and surface collections contained within the green area. This similar logic is used for all of the collection units, where sherds were recovered using both surface collections and shovel probes.

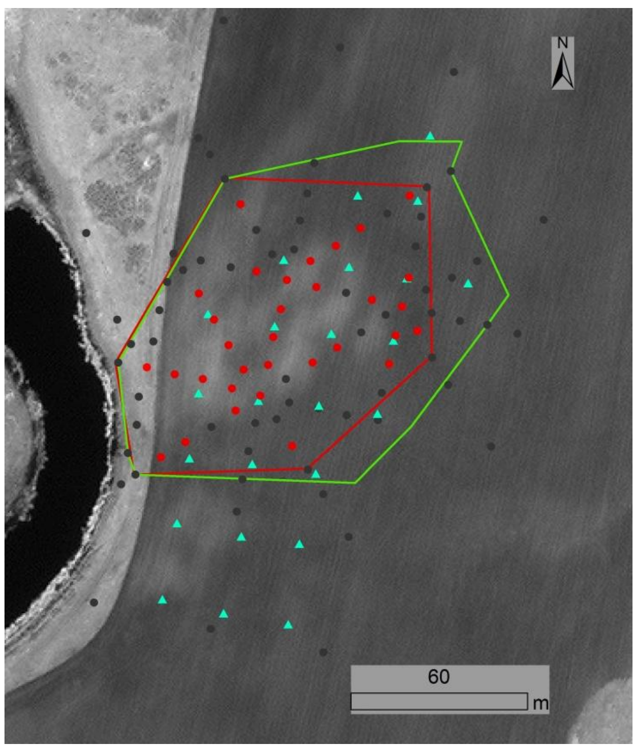


Figure 21: Example of a collection unit (#11), where sherds were derived from both surface collections and shovel probes. The overall collection unit area is outlined in green; the area obtained from shovel probes is outlined in red. Green triangles denote surface collections (centers of 20 m x 20 m squares to which all artifacts were pulled). Red circles denote positive shovel probes; black circles denote blank shovel probes.

Table 6: Density, area-density index, and area-density index/century calculations for all (26) collection units. The collection unit highlighted in yellow is depicted in Fig 16. All proxies were calculated for the FBA as well, but were left out of this table.

C.U. #	Area (ha) obtained from surface and shovel probes (SP)	Area (ha) obtaine d from SPs only	Density (sherds/ m^2) obtained from SPs	All determinable sherds within larger CU, obtained from both SP and surface coll-ns	Percent of MBA sherds	Percent of LBA sherds	Density attributa ble to MBA	Density attributa ble to LBA	MBA area-density index	MBA area-density index/# of centuries	LBA area-density index	LBA area-density index/# of centuries
1	1.00	0.5	3.0	49	4%	82%	0.1	2.4	0.061	0.017	1.224	0.408
2	0.91	0.5	3.0	50	2%	72%	0.1	2.2	0.028	0.008	0.994	0.331
3	0.47	0.5	5.2	27	0%	30%	0.0	1.5	0.000	0.000	0.724	0.241
4	0.67	0.3	3.0	53	2%	94%	0.1	2.8	0.019	0.005	0.962	0.321
5	0.56	0.55	3.5	27	15%	78%	0.5	2.7	0.284	0.081	1.491	0.497
6	0.13	0.09	1.3	2	0%	100%	0.0	1.3	0.000	0.000	0.113	0.038
7	0.27	0.27	1.1	5	0%	100%	0.0	1.1	0.000	0.000	0.301	0.100
8	0.73	0.36	6.9	72	21%	79%	1.4	5.5	0.521	0.149	1.979	0.660
9	0.37	0.37	4.8	9	11%	78%	0.5	3.8	0.199	0.057	1.392	0.464
11	1.11	0.84	4.3	85	6%	94%	0.3	4.0	0.210	0.060	3.366	1.122
13	0.16	0.16	2.1	7	0%	100%	0.0	2.1	0.000	0.000	0.333	0.111
14	0.68	0.68	3.0	13	15%	85%	0.5	2.5	0.309	0.088	1.700	0.567
15	0.55	0.55	8.1	46	26%	74%	2.1	6.0	1.168	0.334	3.309	1.103
16	0.88	0.88	2.9	29	10%	90%	0.3	2.6	0.261	0.075	2.260	0.753
17	0.58	0.58	0.9	6	17%	83%	0.1	0.7	0.083	0.024	0.415	0.138
18	0.22	0.22	2.0	7	0%	100%	0.0	2.0	0.000	0.000	0.438	0.146
19	0.95	0.95	2.3	10	100%	0%	2.3	0.0	2.196	0.627	0.000	0.000
20	1.00	1.00	3.8	20	100%	0%	3.8	0.0	3.750	1.071	0.000	0.000
21	0.94	0.94	2.4	9	56%	44%	1.4	1.1	1.269	0.363	1.015	0.338
23	1.20	1.20	2.0	34	9%	91%	0.2	1.9	0.216	0.062	2.231	0.744
24	0.79	0.31	4.6	42	2%	83%	0.1	3.8	0.034	0.010	1.180	0.393
25	0.96	0.76	5.0	23	4%	91%	0.2	4.6	0.166	0.047	3.484	1.161
26	1.00	0.61	8.9	54	2%	91%	0.2	8.1	0.100	0.029	4.923	1.641
27	1.00	0.51	1.4	30	0%	100%	0.0	1.4	0.000	0.000	0.708	0.236
28	0.74	0.18	1.5	3	0%	100%	0.0	1.5	0.000	0.000	0.265	0.088
29	0.71	0.71	11.4	109	0%	100%	0.0	11.4	0.000	0.000	8.068	2.689

2.3 ABSOLUTE POPULATION ESTIMATES

At a number of Bronze Age settlements in the Southern Urals and the adjacent regions, large areas have been exposed by excavations or geophysical prospection. The following section uses counts of residential structures at such sites to generate population density estimates for the Zingeyka survey area. Counts of structures at previously excavated sites provide a range of population densities (people per ha) observed in the Southern Urals, while the area-density indexes provide a range of population density proxies observed in the Zingeyka valley. The following section illustrates how these two sets of numbers were aligned in order to convert the area-density index values into absolute population estimates.

In the Southern Urals, the term “settlement site” generally means an area within which detectable evidence of structures is found. For instance, for the MBA period, site boundaries are often delineated based on the outlines of fortified walls, while for the LBA period, site boundaries are often drawn around clusters of adjacent structural depressions visible on aerial photographs. The Zingeyka survey population proxies, on the other hand, were based on the parameters of artifact scatters, which usually extend beyond “site” borders. In order to align the results of previous excavations with the area-density index proxies obtained from the Zingeyka survey, we need to know the areas of artifact scatters surrounding previously excavated sites. Since such information has rarely been recorded in the Southern Urals, it is necessary to approximate what the area of an artifact scatter surrounding each previously excavated site would be.

2.3.1 Approximating the areas of Bronze Age sherd scatters

Figure 22 depicts the MBA settlement of Sarym-Sakly, examined as part of the Zingeyka survey. No additional depressions, extending beyond the circular area in Figure 22, were detected within the general area either by aerial photography readings or visual inspection. The results of the survey point to the existence of three collection units, with the total area of 2.9 ha (1 ha+1 ha+.9 ha). One would have to surround the 1 ha settlement *site* (as it is traditionally defined in the Southern Urals) with a ring of about 40 m to obtain the 2.9 ha area of the artifact scatter.

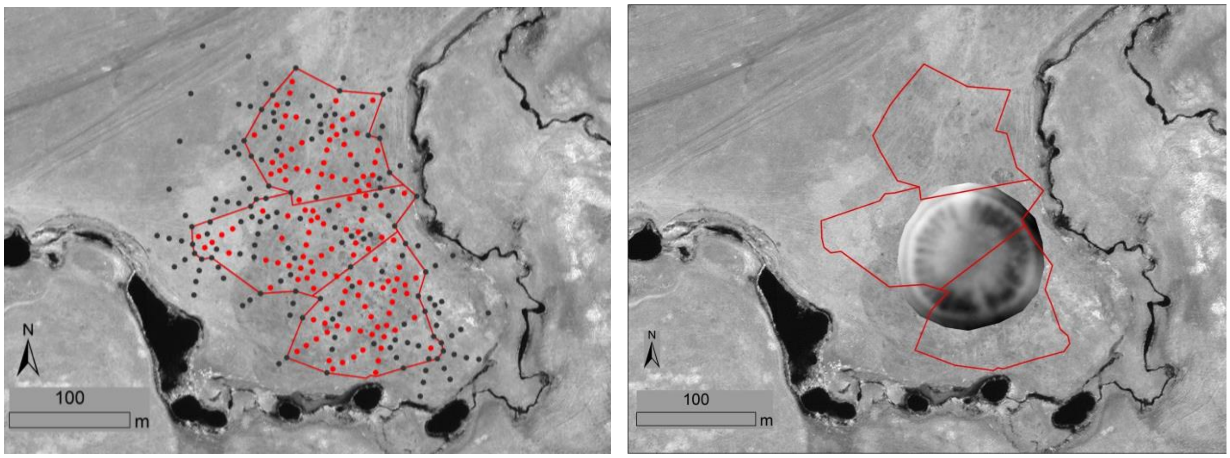


Figure 22: Collection units # 19, 20, 21 (from south to north). Red dots denote positive shovel probes; black dots denote blank shovel probes. No surface finds were recovered. Topographic plan of Sarym-Sakly is visible in the background. Image courtesy of the DigitalGlobe Foundation.

Figures 23 and 24 depict the LBA settlement of Lebyazhye-6. Five adjacent collection units, with the total area of 2.4 ha (.3 ha+.8 ha+.6 ha+.5 ha+.2 ha) were identified during the survey. No additional depressions, extending beyond the area over which microtopographic survey was performed, were detected within this general area by either aerial photography readings or visual inspection. One would have to surround the 1.4 ha settlement *site* (as it is traditionally defined in the Southern Urals) with a ring of about 20 m to obtain the 2.4 ha area of the artifact scatter.

Based on the results of the Zingeyka survey, the artifact scatters at all of the extensively excavated Bronze Age settlements, discussed below, were estimated to extend by 30 m beyond *site* borders (as traditionally defined in the Southern Urals). The 30 m figure is the average radius of Lebyazhye-6 and Sarym-Sakly artifact scatters [(20+40)/2)].

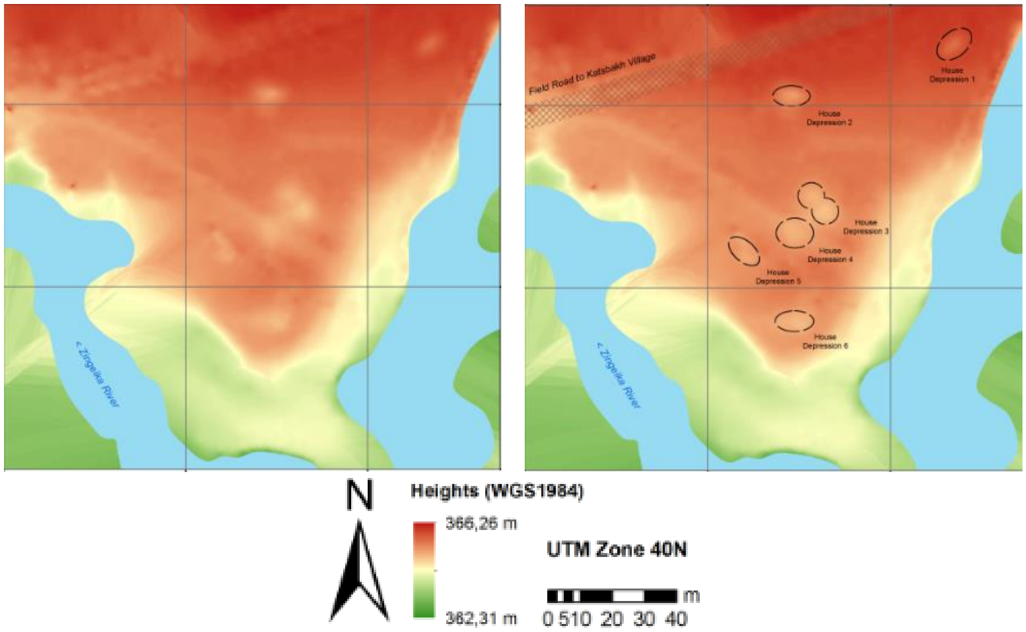


Figure 23: Microtoporgaphic plan of Lebyazhye-6, showing 6-7 structural depressions.

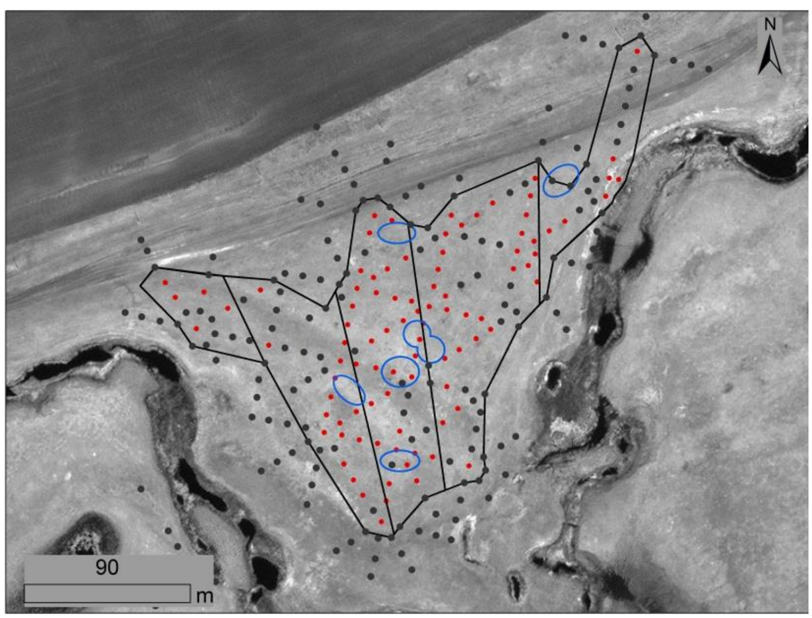


Figure 24: Results of the microtopographic survey combined with the results of systematic shovel probing at Lebyazhye-6. Positive probes are depicted as red dots; blank probes are depicted as black dots. The housing depressions are depicted as blue ovals. Image courtesy of the DigitalGlobe Foundation.

2.3.1.1 LBA period A relatively small quantity of LBA sites in the Southern Urals and the adjacent regions have been excavated extensively. One of these settlements is Atasu-1. Although this site is located in the neighboring Kazakhstan, it belongs to the same LBA archaeological cultures, sherds of which were found at LBA sites in the Zingeyka valley. The settlement was occupied during two periods: FBA and LBA. Figure 25 shows eight rectangular LBA structures recovered in the excavated area of 3588 m2 (Kadyrbaev 1983; Zdanovich 1984:6). Let us imagine that: 1) the two excavation areas in Figure 25 are adjacent to one another; 2) the 3588 m2 excavated area is the entire LBA settlement. Using the 30 m artifact scatter estimate, the total area of the artifact scatter surrounding the Atasu-1 settlement site (as traditionally defined in the Southern Urals) would be 1.2 ha.

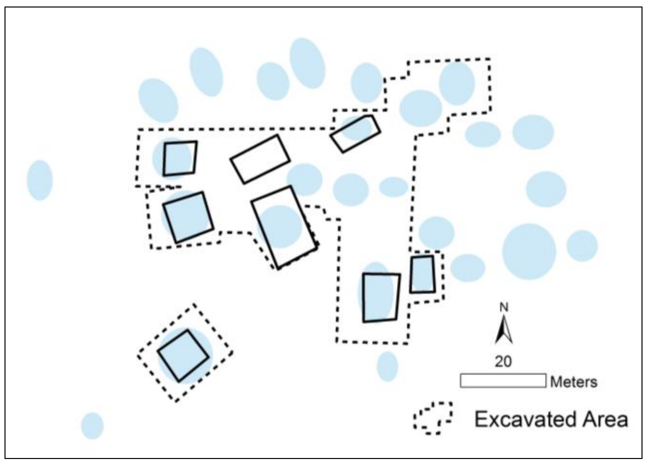


Figure 25: Excavation plan of the Atasu-1 settlement. Round depressions, associated with FBA houses are depicted as blue ovals. Excavated LBA structures are depicted as black rectangles. Adapted from Kadyrbaev (1983:136).

Another LBA settlement that was excavated fairly extensively is Mirnyi-4. It is located in the Southern Urals. The authors identified three houses (ж1, ж2, ж3 in Figure 26) in the excavated area of 1527 m^2. If we go through the same logical steps as we did for the Atasu-1 settlement, we will arrive at the total artifact scatter area of .8 ha.

The rest of the LBA settlements in the Southern Urals were excavated on a yet smaller scale, and therefore were not used to estimate population densities. In these excavations archaeologists usually targeted one or two housing structures and did not excavate much of the inter-house space. Even in the excavations of Mirnyi-4 and Atasu-1, the archaeologists tended to target central areas that contained structures. Still, these excavations provide an idea about the amount of inter-house space in such central areas of LBA sites. In other words, although Mirnyi-4 or Atasu-1 were not excavated in their entirety, assuming that the unexcavated portions of these sites possessed the same residential densities as the excavated ones allows us to use data from these LBA sites in generating absolute population estimates. For instance, if doubling the excavated area at Mirnyi-4 or Atasu-1 would simply double the number of exposed structures, our estimates of structures/ha values on which the people/ha values are ultimately based, would remain the same.

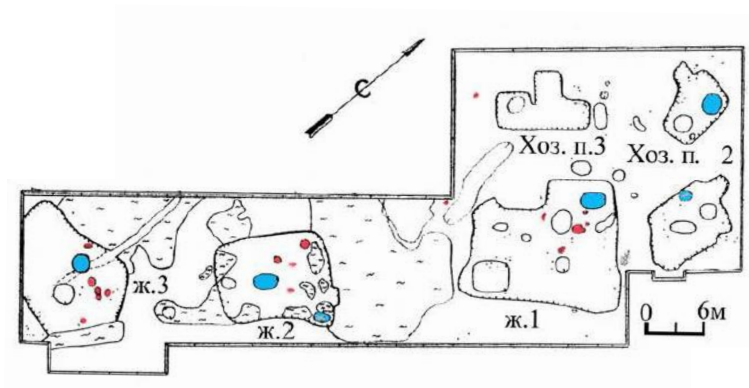


Figure 26: LBA settlement of Mirnyi-4. Wells are depicted in blue; hearths are depicted in red. The remaining two structures were interpreted as non-residential by the authors (Alaeva 2015:140; Chemyakin 1974).

2.3.1.2 MBA period Based on the results of geophysical prospection, Krause and Koryakova (2013:349) estimate the MBA settlement of Konoplyanka to contain 21 houses (Figure 27). This unexcavated settlement is considered to be single-phased. It measures 120 m x 60 m, enclosing an area of .72 ha. The borders of this MBA settlement, as well as all of the MBA settlements discussed below, are delineated based on the borders of the fortified walls. If we picture a 30 m buffer of artifacts surrounding the fortified wall, the total artifact scatter area would be 1.9 ha.

Based on the results of geophysical prospection and a few seasons of excavations, Krause and Koryakova (2013:350) suppose that the number of “coeval” houses at the settlement of Kamennyi

Ambar could have been 42 (Figure 28). The fortified area is 1.8 ha, while the reconstructed area of the artifact scatter (based on a 30 m buffer) is 3.4 ha.

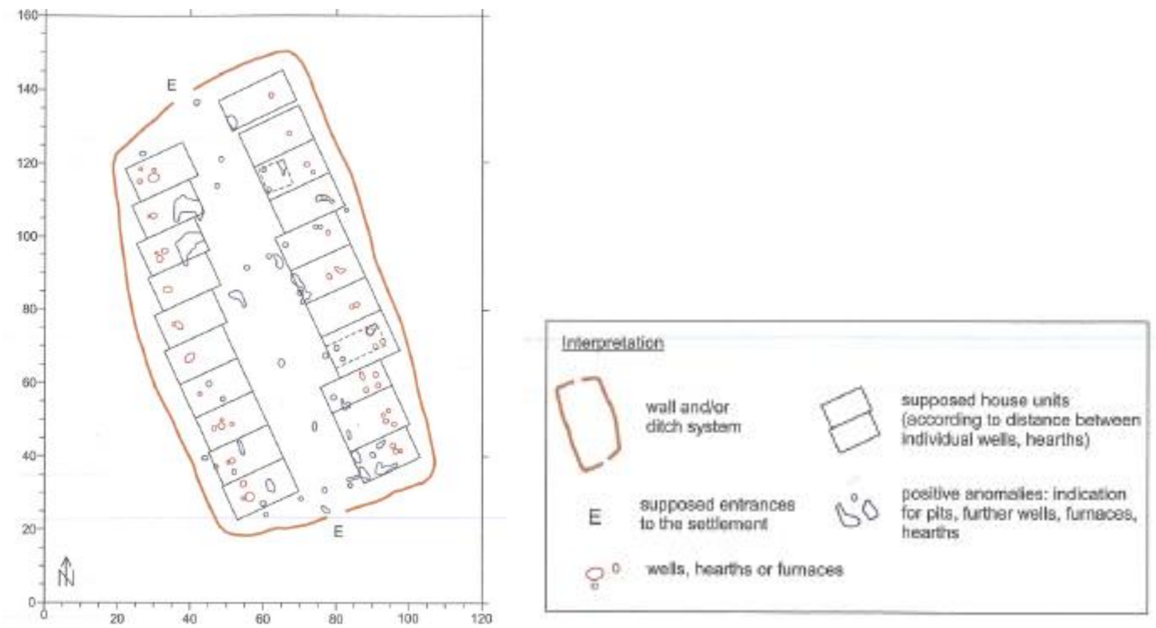


Figure 27: Results of a geomagnetic survey of the MBA settlement of Konoplyanka (Patzelt 2013:64).

Based on limited geophysical prospection, Krause and Koryakova (2013:62) reconstruct 20 to 30 individual buildings at the MBA settlement of Zhurumbai (Figure 29). The area contained within the fortified walls is 1.5 ha. The reconstructed area of the artifact scatter surrounding the fortified wall, based on the 30 m buffer, is 3 ha.

Based on the results of geophysical prospection of the MBA site of Ust'ye, Hanks et al. (2013:399-402) reconstruct at least 25 structures, in addition to 7 previously excavated ones (Vinogradov 2011:98), bringing the total to 32 in an area of 2.3 ha (Figure 30). Based on a 30 m buffer, the reconstructed area of the artifact scatter that surrounds the fortified walls is 4.1 ha.

Roughly one half of the MBA settlement of Sintashta was excavated (Figure 31). Gening et al. 1992 identified 27 structures in total. If we extrapolated the results of the excavated half to the unexcavated half, we will get 56 (28x2) structures in a fortified area of 1.5 ha. Based on a 30 m buffer, the reconstructed area of the artifact scatter that surrounds the fortified walls is 3 ha.

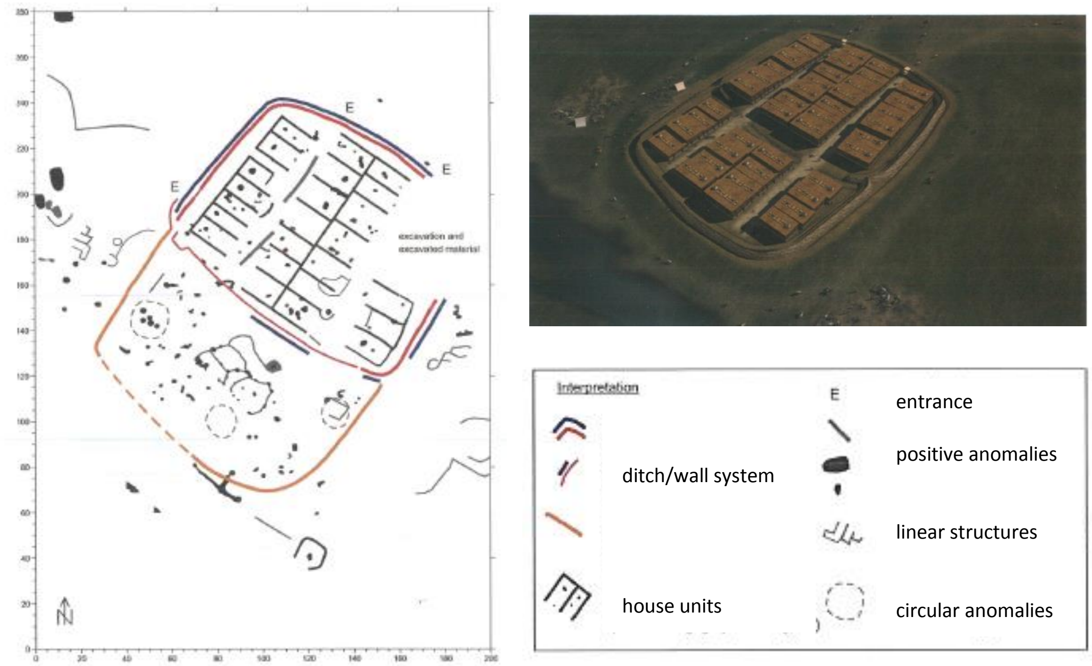


Figure 28: Results of a geomagnetic survey and excavations of the MBA settlement of Kamennyi Ambar (Krause and Koryakova 2013).

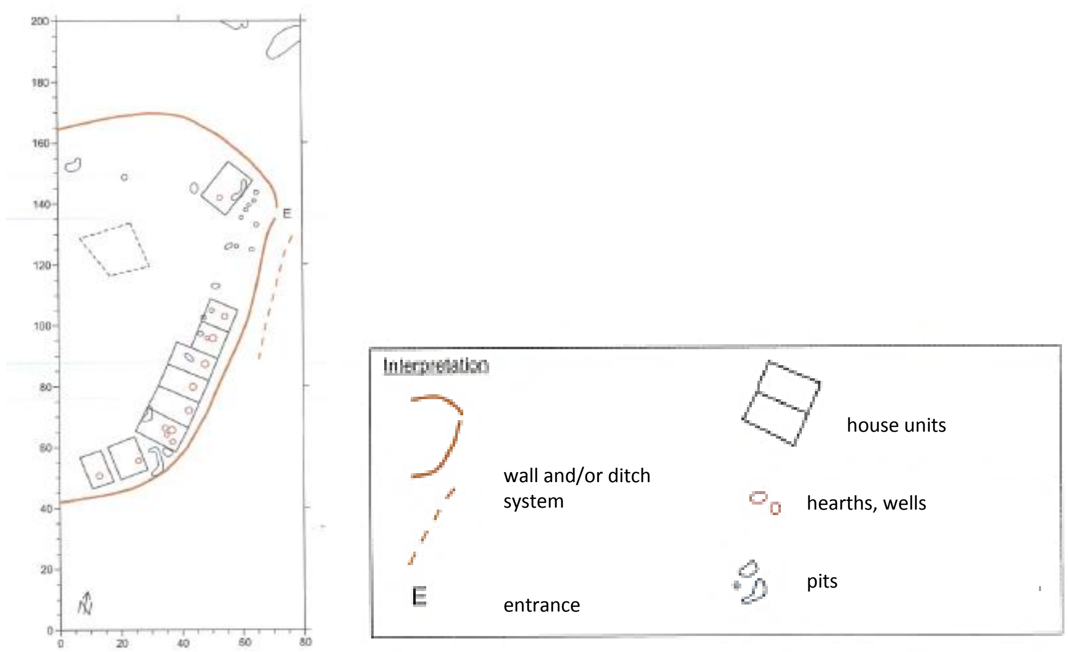


Figure 29: Results of a geomagnetic survey and excavations at the MBA settlement of Zhurumbai (Patzelt 2013:61).

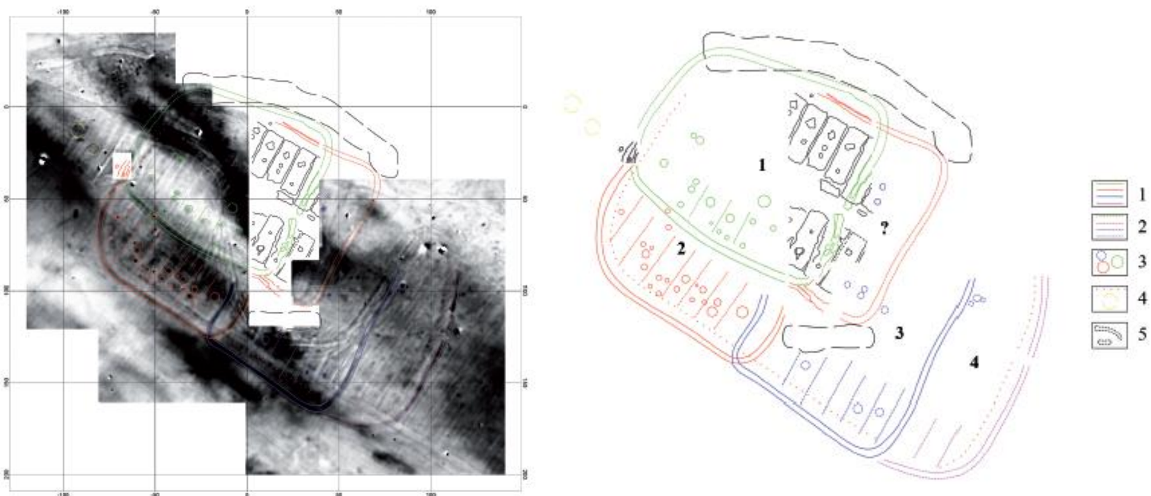


Figure 30: Results of excavations and geophysical prospection at the MBA settlement of Ust'ye. 1 – structures; 2 – probable structures; 3 – thermal and hydrological features; 4 – features of an unclear function; 5 –spoil heaps (Hanks et al. 2013).

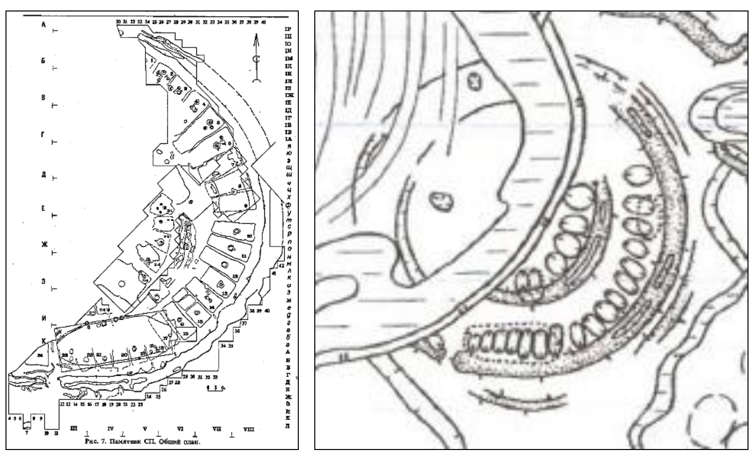


Figure 31: Settlement plan (right) and excavation plan (left) of the MBA Sintashta settlement (Gening et al. 1992; Zdanovich and Batanina 2007).

At the MBA settlement of Andreevskoye, the results of geophysical prospection point to the existance of 50 contemporaneous structures in a fortified area of 1.6 ha (Figure 32). Based on a 30 m buffer, the reconstructed area of the artifact scatter that surrounds the fortified walls is 3.2 ha.

There are two other MBA settlement sites that have been excavated extensively: Petrovka-2 and Novonikolskoe-1. Both of them are located in northern Kazakhstan. At these sites, 2700 m^2 and 3400 m^2

have been excavated, respectively. However, these settlements are multi-phased and some FBA and LBA structures are superimposed on top of the MBA ones, making obtaining reliable estimates of number of structures per ha for each period problematic.

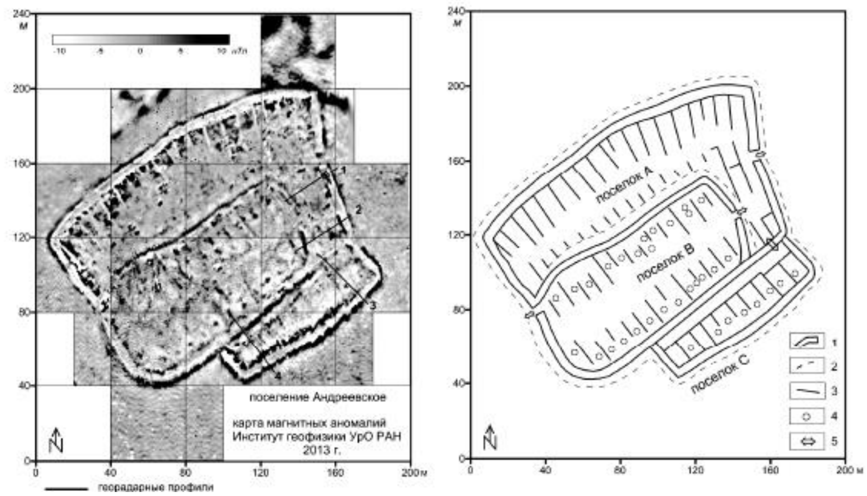


Figure 32: Geophysical prospection of the MBA settlement of Andreevskoye. *Left*: plan of geomagnetic anomalies. *Right*: interpretative settlement plan. 1 – fortified walls; 2 – ditch; 3 – inner walls; 4 – wells; 5 – settlement entrances (Noskevich et al. 2014:76).

It is usually assumed that at the MBA settlements people only lived within the fortified walls. Although there is a possibility that people lived just outside of the fortified walls as well, it does not make a principal difference at this point of our analysis, since the figures outlined above are only used to get a rough idea of the rate of human packing (people/ha densities) prevalent at these types of settlements.

2.3.2 Population densities at previously excavated sites

MBA and LBA housing structures are similar in both size and the presence of features, such as hearths (also referred to as *ovens* or *furnaces* in regional literature), storage pits, and indoor wells. Alaeva (2015:41), when summarizing the results of previously excavated LBA settlements in the Southern Urals, emphasizes the fairly standard size of housing structures. These structures are fairly large: 15 x 8.5 m (~130 m^2), on average (Alaeva 2015:141). Koryakova and Epimakhov (2007:72) note the similarity among the MBA houses sizes as well. Numerous geophysical investigations and excavations point to the MBA structures being of a bit larger average size of 160 m^2.

Such fairly large houses are quite common for the greater Eurasian steppe / forest-steppe region during the 2nd millennium BC. Kuzmina (1994:87) associates them with a “central Eurasian” house type which, she believes, accommodated extended patriarchal families. Based on archaeological and ethnographic evidence, she believes three generations of relatives could have lived under one roof in such structures. As opposed to a nuclear family (parents and their unmarried children), extended patrilocal families would include 12 to 15 people: an older couple (2) + their sons (2 or more) with their wives (2) and children (6 or more).

There is a notion that only portions of Sintashta structures were used as living quarters (Epimakhov 1996; Koryakova and Epimakhov 2007:73; Vinogradov 2011), with the rest of the space dedicated to metal or other craft production; storage; and “perhaps keeping small domestic livestock during the harsh winter months” (Johnson and Hanks 2012:361). This notion has allowed Johnson (2014), for example, to place as few as 3 people in each Bronze Age structure.

The perception of only a portion of houses being used as living space is based on a few considerations. One is partitioning, which is evident by the patterns of postholes, and is well-illustrated in artistic reconstructions of MBA houses in Figure 33. Such partitioning, to some, suggests an economic, rather than purely occupational, function of these large dwellings. It is important to note that partitioning is a well-established indicator of high population densities (Dohm 1990). Oftentimes, people reduce the negative effects of crowding, such as noise and the loss of privacy by erecting walls, dividing structures into rooms, constructing additional closets, courtyards, etc.

The proponents of dividing the Sintashta houses into a living half and an economic half state that people kept animals indoors during winters. Ethnographic record shows that Turkic-speaking Bashkir populations of the Southern Urals, who dealt with similar environments and also relied quite heavily on animal herding for subsistence kept animals in separate structures and not in the same buildings in which they lived (Shitova 1984:201). So did Kazakh populations (Margulan et al. 1959), who occupied not only Kazakhstan but parts of the Southern Urals steppes as well. Even for new-born cows and sheep born out of season during harsh winter months, Bashkirs built separate structures with limited heating (Shitova 1984:201). When these animals were kept in house, it was for a short period of time. However, there are other ethnographic observations in central Eurasia, where a milking cow, a calf, or a number of young sheep could be kept indoors for months at a time (Andreev 1953).

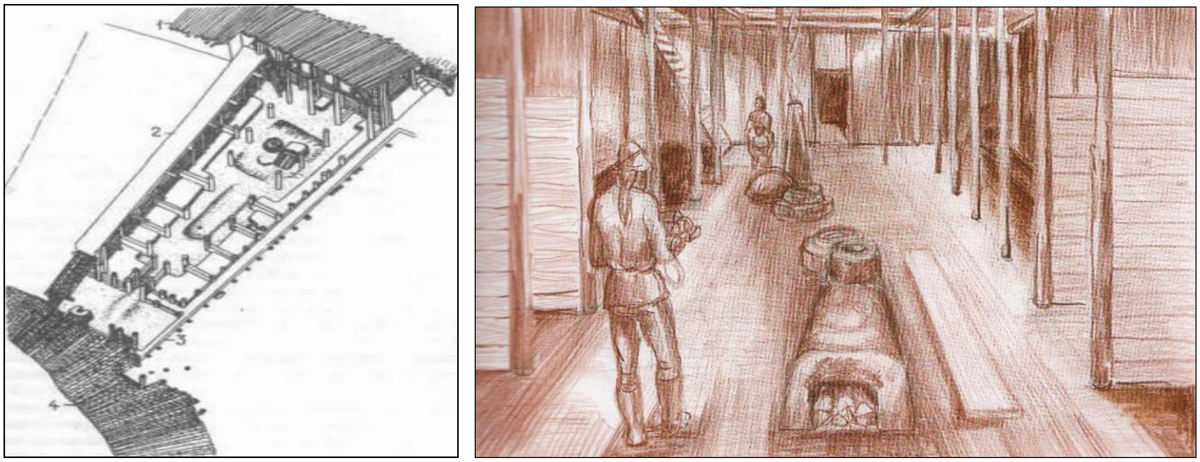


Figure 33: Reconstructions of MBA houses. Based on the excavations of the Arkaim settlement (left) (Zdanovich 1995:7). Based on the excavations of the Alandskoye settlement (right) (Malutina and Zdanovich 2013:11).

Researchers, advocating the economic function of Bronze Age structures, cite the presence of metal slag and large hearths (also referred to as ovens or furnaces) in which metal (copper and arsenical bronze) would occasionally be smelted, creating a potentially harmful environment for humans. Firstly, the scale of metal production was found to be "household", i.e., relatively small, amounting to 4-12 smelts per year in a given settlement (Hanks et al. 2015). Secondly, in central and northern Eurasia, where winters are harsh and long; large, complex thermal structures are quite common. For example, in a traditional Russian peasant house, the furnace took up anywhere from one quarter to one fifth of roofed living space (Chizhikova 1999).

To summarize, from a comparative perspective, Bronze Age Southern Urals hardly presents a unique case of a prehistoric society, where craft production, storage, and other economic activities took place inside of domestic structures (Hirth 2009; Schelach 2006). In other prehistoric cases, however, archaeologists do not tend to reduce the available living space and the resulting population estimates when observing such activities.

It is interesting to note that ethnographically, only a few groups in central Eurasia have similar houses, i.e., large rectangular semi-subterranean structures, clearly divided into sections. From the western part of the Eurasian steppe it is the Osetins of the northern Caucuses; and from the eastern part of central Eurasia it is the Tadjics of the Cis-Pamir region (Andreev 1953; Kaloev 2004). In both cases, such structures are occupied by large extended patriarchal families. It is not uncommon for these patriarchal families to consist of 40-50 members and include as many as 80 to 100 members (Andreev 1953; Kaloev 2004). While the exact data on the sizes of the Osetin houses is unavailable, the dwellings of the Cis-Pamir Tadjiks, due to the presence of numerous partitions, shelves and bunk-beds provide as little as 2 m^2 of living space per person. In the larger central and northern Eurasia region, Tadjic homes represent a rare ethnographic parallel to the Southern Urals Bronze Age structures in terms of each having an indoor well.

To summarize, thus far researchers have placed anywhere from 3 to 30 people in each Bronze Age structure (Epimakhov 1996; Johnson 2014; Johnson and Hanks 2012; Krause and Koryakova 2013). Given the considerations outlined above, going with at least 10 to 15 people per structure seems more appropriate.

The other path to estimate the range of population densities at Bronze Age Southern Urals sites is to take the *roofed space per person* approach. From a comparative perspective, the value of 6.1 m^2 of living space per person, derived from Brown's (1987) residential density study of 38 societies (including hunter-gatherers, horticulturists, agriculturists, and pastoralists) is frequently used in arriving at absolute population estimates for pre-industrial societies (Schelach 2006:333). 'Naroll's formula' (1962) of 10 m^2 per resident, based on a smaller (18 cases) cross-cultural ethnographic sample is another commonly used ratio.

The climate of the Southern Ural steppes is continental, characterized by hot summers and cold winters, with the average January temperatures being -22˚C (Chibilyov 2002). In cold climates it is logical to minimize the dwelling space as much as possible in order increase heating efficiency (Porcic 2012:75). For example, traditional 17th-19th century '*izba'* dwellings of Russian peasants, who had to deal with similar climate conditions, allowed 5 m^2 of roofed space per person (Chizhikova 1999; Vlasova 1999). This long-term average incorporates more than two centuries of observations in various areas of Russia, including the Middle/Lower Volga region, lying just to the west of the Southern Urals. As already mentioned, the dwellings of Cis-Pamir Tadjiks of Central Eurasia, who had to adapt to long (6-8 month) winters and large amounts of snow, provided as little as 2 m^2 per person. To summarize, since harsh climates may lead to greater residential crowding in the winter, using lower living space per person ratios of 5 m^2 per person seems more appropriate.

Assuming that one half of every Bronze Age dwelling was indeed economic, the average amount of roofed living space would be 65 m^2 (130/2) for the LBA and 80 m^2 (160/2) for the MBA houses. Such amounts of roofed living space could house 13 (65/5) people per house in the LBA and 16 (80/5) people per house in the MBA, which coincides with the 10-15 people per structure figure, mentioned above.

Table 7 summarizes the results of the discussion up to this point and lists the areas of sherd scatters and population estimates for previously excavated (or examined by geophysics) Bronze Age sites.

Table 7: Population density estimates for excavated sites.

Period	Settlement name	Exposed, i.e., excavated / geophys. area (m^2)	Estimated artifact scatter area (ha)	Number of houses	People per 1 ha of artifact scatter. Low estimate.	People per 1 ha of artifact scatter. High estimate.
LBA	Mirnyi-4	1,527	0.8	3	37	55
LBA	Atasu-1	3,588	1.2	8	65	97
MBA	Konoplyanka	7,200	1.9	21	113	170
MBA	Kamennyi Ambar	18,000	3.4	42	122	183
MBA	Zhurumbai	15,000	3.0	25	83	124
MBA	Ust'ye	23,000	4.1	32	78	116
MBA	Sintashta*	15,000	3.0	56	185*	278*
MBA	Sarym-Sakly	10,000	2.9	27	92	139
MBA	Andreevskoye	16,200	3.2	50	157	235

2.3.3 Converting area-density indexes into absolute populations

The next step of the analysis involves converting the *area-density index/century* values from the survey into absolute occupation densities based on previously excavated MBA and LBA sites. The residential density at the site of Andreevskoye seems about as high as one would find in the Southern Urals MBA settlements (Table 7). Table 8 shows the distribution of MBA sherd densities from the Zingeyka survey. The collection units highlighted in grey were eliminated from the analysis because these collection units produced a single MBA sherd each, making area-density reconstructions problematic. The top of the Zingeyka survey sherd density values for the MBA period is 3.75 sherds/m^2. Let us take 3.75 sherds/m^2 to represent a residential density between 157 and 235 persons per ha observed at Andreevskoye. A collection unit of 1.0 ha with surface density of 3.75 MBA sherds per 1 m^2 would yield a relative population index of 1.07 (3.75 divided by 3.5 centuries' duration of the MBA period) and this would represent the average population of 157-235 people throughout these 350 years. This population index

*Only a portion of this site has been excavated, and the rest of the site was reconstructed based on the principles of symmetry. Since there is a possibility of less or no structures being contained in the unexcavated half, this rather high value is excluded from being lined up with the area-density indexes.

is 147 times the relative population index for the minimum value and 220 times the relative population index for the maximum value (1.07*147=157 and 1.07*220=235).

The residential density at the site of Mirnyi 4 seems about as low as one would expect to find in the Southern Urals LBA settlements (Table 7). Table 9 illustrates the distribution of LBA sherd densities from the Zingeyka survey. We can place a settlement like Mirnyi-4 at the lower end of the distribution of LBA sherd densities. Let us take the bottom value of the Zingeyka survey sherd densities for the LBA period of .71 sherds/ m^2 to represent a residential density between 37 and 55 persons per ha. A collection unit of 1.0 ha with surface density of .71 LBA sherds per 1 m^2 would yield a relative population index of .24 (.71 divided by 3 centuries' duration of the LBA period) and this would represent the average population of 37-55 people through these 300 years. This population index is 154 times the relative population index for the minimum value and 229 times the relative population index for the maximum value (.24*154=37 and .24*229=55).

The factors that we obtained from lining up two sets of residential densities from previously excavated sites with the *sherd/* m^2*/century* values from the Zingeyka survey are comparable. In other words, applying either of these sets of factors (147, 220 or 154, 229) to the *area-density/century* index measures would produce similar ranges of population estimates.

Table 10 is a summary of reconstructed population parameters based on multiplying the area-density indexes (*area* x *density* / *# of centuries*) from each collection unit by the factors derived above in order to obtain the minimum and maximum numbers of persons occupying each area. This table uses the average of these two factors, i.e. 151 (the average of 147 and 154) and 225 (the average of 220 and 229) to obtain the minimum and maximum populations, respectively. The use of the same conversion factors for both the MBA and the LBA implies that the rate of accumulation of human garbage remained constant throughout these two periods. As previously mentioned, the collection units highlighted in grey were eliminated from the analysis because these collection units produced a single MBA sherd each, making area-density reconstructions problematic.

Table 8: MBA sherd densities from the Zingeyka survey. Highlighted collection units produced a single MBA sherd each.

CU#	CU name	MBA density (sherds/m^2)
4	Katsbah 1 4	0.06
2	Katsbah 1 2	0.06
24	Leb 6 1	0.11
1	katsbah 1 1	0.12
17	Nonesite 5	0.14
26	Leb 6 3	0.16
23	Zarya 11	0.18
25	Leb 6 2	0.22
11	Leb 4 2	0.25
16	Site 614	0.30
14	Zarya 1 2	0.45
9	Leb 1 2	0.52
5	Katsbah 2 1	0.54
8	Leb 1 1	1.35
21	SarySakly3 North	1.45
15	Zarya 1 3	2.12
19	SarySakly1 South	2.31
20	SarymSakly2	3.75

Table 9: LBA sherd densities from the Zingeyka survey.

CU #	CU Name	LBA density (sherds/m^2)
17	Nonesite 5	0.71
21	SarySakly3 North	1.08
27	Leb 6 4	1.12
3	Katsbah 1 3	1.25
23	Zarya 11	1.39
7	katsbah 4	1.47
28	Leb 6 5	1.54
14	Zarya 1 2	1.86
2	Katsbah 1 2	1.99
16	Site 614	2.08
18	Nonesite 4	2.16
5	Katsbah 2 1	2.45
1	katsbah 1 1	2.50
9	Leb 1 2	2.57
13	Zarya 1 1	2.71
4	Katsbah 1 4	2.83
8	Leb 1 1	3.76
6	Katsbah 2 2	3.81
11	Leb 4 2	4.05
25	Leb 6 2	4.58
24	Leb 6 1	5.50
15	Zarya 1 3	6.02
26	Leb 6 3	8.07
29	Katsbah 6	11.36

Table 10: Reconstructed populations in the Zingeyka survey area.

CU #	CU name	Area (ha)	MBA a.-d. index (a.*d. / centuries)	Minimum MBA population based on a factor of 151	Maximum MBA population based on a factor of 225	LBA a.-d. index (a.*d. / centuries)	Minimum LBA population based on a factor of 151	Maximum LBA population based on a factor of 225
1	katsbah 1 1	0.5	0.017	n/a	n/a	0.408	62	92
2	Katsbah 1 2	0.46	0.008	n/a	n/a	0.331	50	75
3	Katsbah 1 3	0.47	0.000	-	-	0.241	36	54
4	Katsbah 1 4	0.34	0.005	n/a	n/a	0.321	48	72
5	Katsbah 2 1	0.55	0.081	12	18	0.497	75	112
6	Katsbah 2 2	0.09	0.000	-	-	0.038	6	8
7	katsbah 4	0.27	0.000	-	-	0.100	15	23
8	Leb 1 1	0.36	0.149	22	33	0.660	100	148
9	Leb 1 2	0.37	0.057	9	13	0.464	70	104
11	Leb 4 2	0.84	0.061	9	14	1.133	171	255
13	Zarya 1 1	0.16	0.000	-	-	0.111	17	25
14	Zarya 1 2	0.68	0.088	13	20	0.567	86	128
15	Zarya 1 3	0.55	0.334	50	75	1.103	167	248
16	Site 614	0.88	0.075	11	17	0.753	114	170
17	Nonesite 5	0.58	0.024	n/a	n/a	0.138	21	31
18	Nonesite 4	0.22	0.000	-	-	0.146	22	33
19	SarySakly1 South	0.95	0.627	95	141	0.000	-	-
20	SarySakly2	1	1.071	162	241	0.000	-	-
21	SarySakly3 North	0.94	0.363	55	82	0.338	51	76
23	Zarya 11	1.2	0.062	9	14	0.744	112	167
24	Leb 6 1	0.31	0.010	n/a	n/a	0.393	59	88
25	Leb 6 2	0.76	0.047	7	11	1.161	175	261
26	Leb 6 3	0.61	0.029	4	6	1.641	248	369
27	Leb 6 4	0.51	0.000	-	-	0.236	36	53
28	Leb 6 5	0.18	0.000	-	-	0.088	13	20
29	Katsbah 6*	0.71	0.000	-	-	2.689	288*	430*
			TOTAL	460	685		2,042	3,043

.

*This collection unit was a high outlier in terms of sherds/m^2 density due to one shovel probe landing into a pot that consisted of 90 fragments. Therefore, the population estimates that are displayed in the table were based on the population density parameters (persons/ha) from the next highest collection unit (i.e., CU# 26) in terms of sherds/m^2 density.

2.3.3.1 Cross-check One way to see if the reconstructed population estimates in Table 10 make sense is to incorporate other lines of evidence into the analysis. At the settlement of Sarym-Sakly, located within the survey zone, geophysical and microtopographic prospections point to the presence of 27 structures, 18 m x 7.5 m each, on average (Figure 34) (Chechushkov 2015; Fedorova et al. 2013). If we place 10 to 15 people in each structure, we arrive at 270 to 400 people living in this area.

Let us imagine that the microtopographic and geophysical prospections were never performed in this area and all we had to go by were the Zingeyka survey results. The results of the Zingeyka survey allow us to associate this general occupation area with 3 collection units, #19, 20, 21 (Figure 22). The reconstructed total number of people occupying these areas in the MBA is between 311 and 464 (Table 10), which is a rough match with the 270-400 numbers, assuming about 40 to 60 people could have lived immediately outside of the fortified walls.

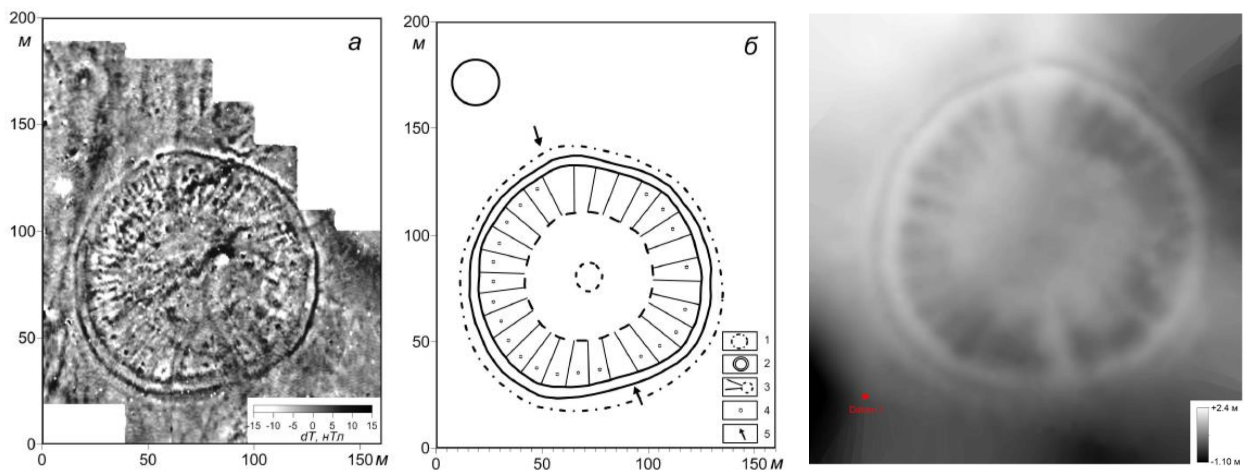


Figure 34: Structures at Sarym-Sakly. Results of geophysical prospection (left and middle) (Fedorova et al. 2013). Microphotographic plan of Sarym-Sakly (right) (Chechushkov 2015).

The 40 km^2 survey area covered the territory lying between and including 2 modern villages: Katsbakhskoye and Zarya. As of 2015, total population of these settlements was around 800 people, while in 1935, the total number of people residing in the survey area was 711 (Epaneshnikov 2011:68). The 1918 census counted 2,326 people in the survey zone (Epaneshnikov 2011:33). The subsistence system relied on by the villagers at that time can be characterized as pre-industrial agro-pastoral. These figures are cited to illustrate that the 100-year census parameters (700 – 2,300 people) fit comfortably within the range of estimated ancient populations in Table 10 (460-3,040 people). Certain factors related to land carrying capacity may have kept populations within such broadly similar ranges in the Zingeyka valley over the long term.

2.4 CONCLUSION: METHODOLOGICAL ADVANCES AND PITFALLS

Nearly all regional Bronze Age demographic reconstructions in the Southern Urals have relied on the results of aerial photography (Epimakhov 2002a; Grigoryev 1999; Masson 2000; Johnson 2014; Johnson and Hanks 2012; Kohl 2007; Epimakhov 2009; Zdanovich and Zdanovich 2014:103). In particular, counts of housing depressions visible from the air have been used to estimate how many people lived in a given area. The results of the Zingeyka survey point to a number of issues associates with using ground depressions as a paleodemgraphic proxy.

Firstly, the results of the Zingeyka survey pointed out instances when the quantities of housing depressions could not be used to estimate the number of ancient structures. One occupation area that illustrates this issue fairly well is the Lebyazhye-6 settlement, located within the Zingeyka survey zone. First of all, the number of depressions identified at this settlement ranges from 16 to 4, depending on what method was used in their identification (Figure 35). Such wide range in estimates is related to the fact that these depressions are fairly shallow, .1-.4 m deep (Petrova 2004:181; Zdanovich et al. 2003). Besides making the depressions difficult to identify, low depth makes them more susceptible to anthropogenic factors that cause surface erosion.

Even if ground depressions could be identified confidently with maximum precision, as they were during a microtopographic survey conducted by the author and I. Chechushkov in 2015, they still cannot be used to estimate the number of ancient structures. Figure 36 shows the results of geophysical prospection conducted over a part of the Lebyazhye-6 settlement by the author and N. Noskevich in 2015. This figure illustrates the presence of at least 2 structures that are not associated with ground depressions in the southern portion of the site.

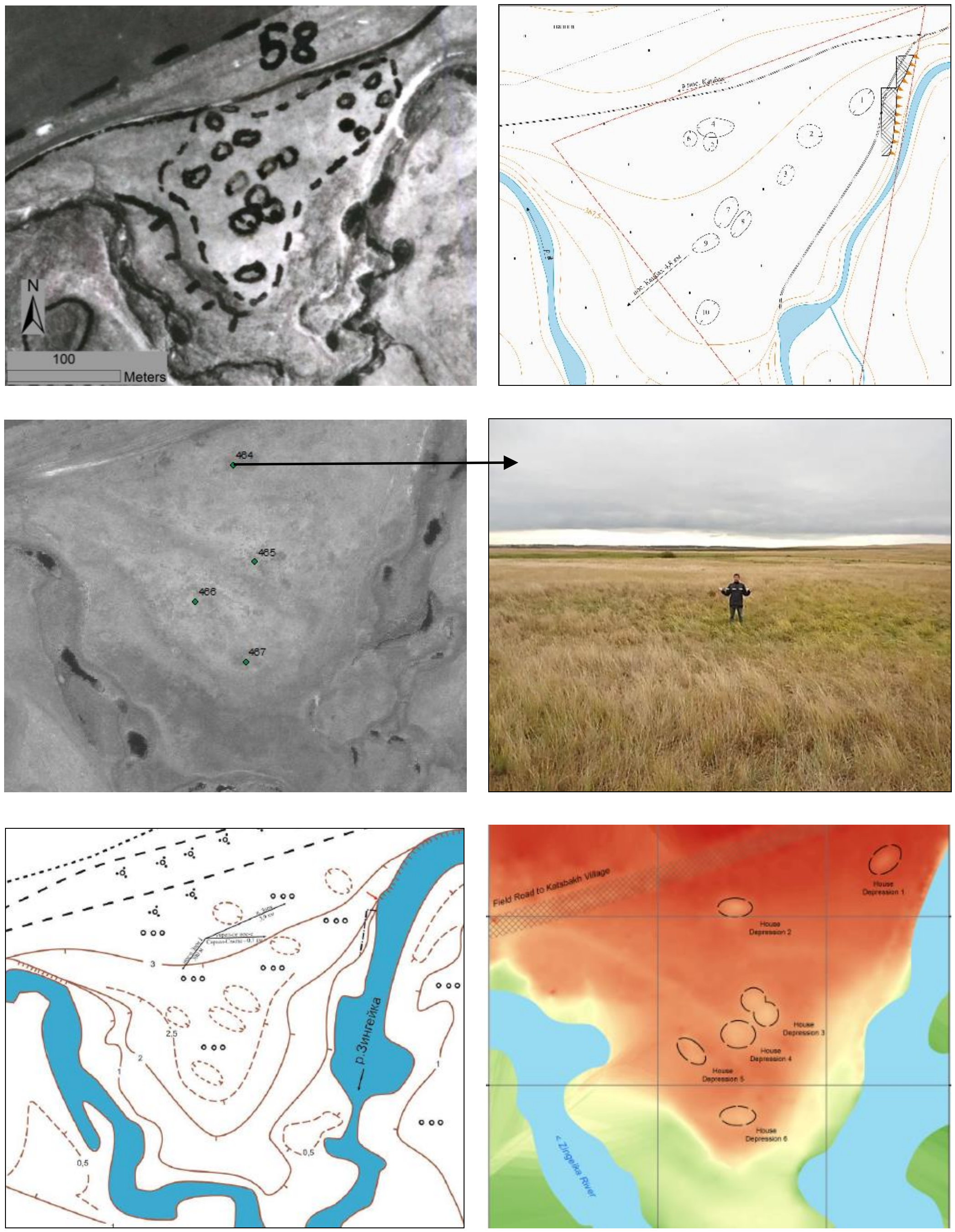


Figure 35: Structural depressions at the site of Lebyazhye-6. *Top left*: air photo taken in 1956 in which borders of 16 housing depressions were delineated by I. Batanina based on stereoscopic analysis. *Top right*: Petrova (2004:181), who conducted small-scale excavations at the site, identified 8-10 depressions. *Center right and left*: in 2014 the author was able to visually identify 4-5 depressions, centers of which are marked by GPS points. *Bottom left*: a topographic plan of the area conducted in 1988 showing 7 depressions (Gutkov 1989; Slyadnev 2013). *Bottom right*: a 2015 microtopographic survey of the area, using a total station, identified 6-7 structural depressions.

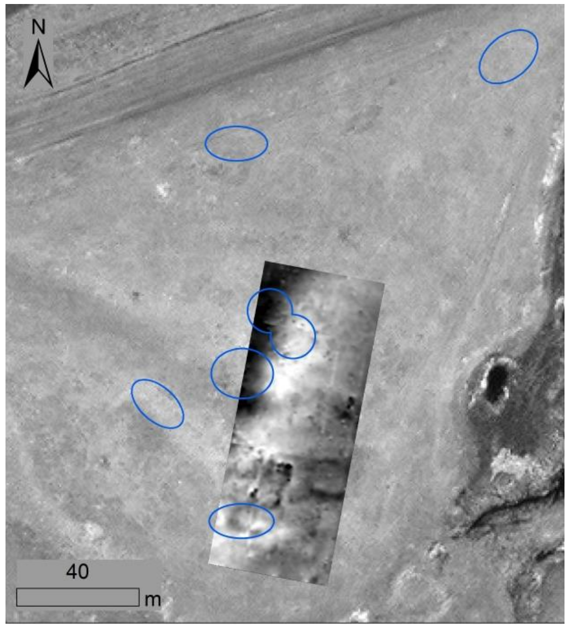


Figure 36: Results of geophysical prospection at Lebyazhye 6. Depressions identified through the microtopographic survey are outlined in blue. Geophysical survey transect indicates the presence of at least 2 additional structures in the southern portion of the site. Background image courtesy of the DigitalGlobe Foundation.

The above issue is further emphasized by the excavations of the LBA/FBA settlement of Bersuat-18 in the Southern Urals (Malutina et al. 2006). The area of the site contained a total of five shallow ground depressions. The authors placed their 21 x 24 m excavation on top of the eastern-most depression. The excavations revealed an entire house and portions of what looked like two more structures, which all fused into one ground depression (Figure 37). The results of the excavations show that these structures were first occupied during the LBA and then rebuilt and occupied again in the FBA periods.

Another issue with using ground depressions as a paleodemographic proxy became apparent when the results of the Zingeyka survey pointed out instances in which the presence of ground depressions could not be linked to human occupation. Figure 38 depicts the area surrounding the settlement of Lebyazhye-4. The analysis of aerial photographs has identified 11 depressions. Since this area has been plowed, failure of either surface collection or shovel probes to identify a single artifact near 5 of the southernmost "housing depressions" point to the fact that the presence of ground depressions cannot always be associated with Bronze Age occupation.

Figure 37: LBA/FBA settlement of Bersuat-18. Housing depressions (above) and excavations (below). The excavations revealed one structure and parts of 2 other structures that apparently all fused into one depression (Malutina et al. 2006).

The results of the Zingeyka survey also produced instances when the absence of housing depressions could not be linked to absence of human occupation. The survey was conducted in the Kizilskiy district, which has been systematically inspected on the presence of Bronze Age occupation through the stereoscopic analysis of aerial photos and pedestrian surveys (Zdanovich et al. 2003). Three previously unknown occupation areas have been identified during the course of the survey: collection units #16, 17, 18 (Figure 39). These findings point to the fact that the absence of depressions cannot be linked to the absence of human occupation. Since these areas have also been previously inspected by pedestrian surveys (Gutkov 1989; Epimakhov 1985), the results of the Zingeyka project highlight the advantage of a systematic methodology, in which every land patch within the survey area has an equal chance of being inspected.

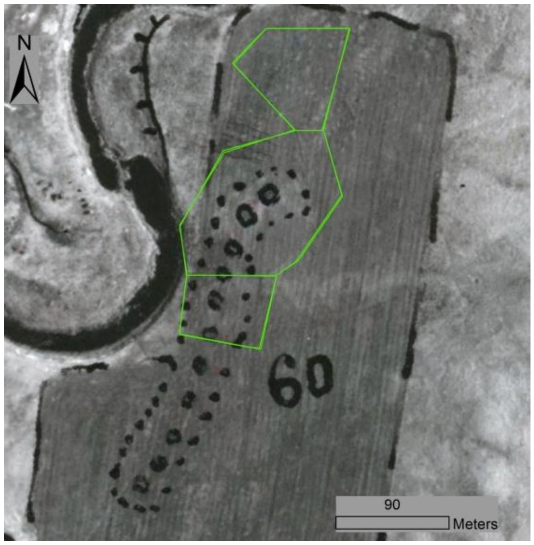


Figure 38: The settlement of Lebyazhye-4, as identified by aerial photos (in black) or through surface collections and shovel probes (in green).

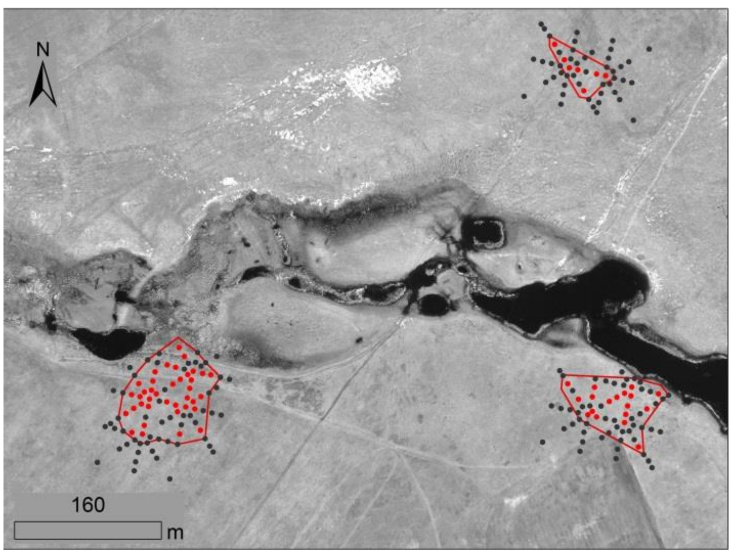


Figure 39: Occupation areas identified during the survey that were previously unknown. Image courtesy of the DigitalGlobe Foundation.

Besides a number of issues with using the results of aerial photography in paleodemographic reconstructions, it is worth discussing a methodological issue related to relying on surface collections to identify Bronze Age occupations. Previously in the Southern Urals, attempts have been made to use systematic surface collection to reconstruct Bronze Age demography (Johnson 2014). The results of the Zingeyka survey point to numerous instances when this method was ineffective in establishing the parameters of Bronze Age occupation areas. Employing both shovel probes and surface collections simultaneously provided a unique opportunity to compare the effectiveness of these two methods. Table 1 indicates that out of 26 collection units that yielded significant traces of human occupation, 12 (46%) would have been missed altogether if shovel probes were not excavated.

3.0 CHRONOLOGY AND ARTIFACT TYPOLOGIES

The following chapter explains how the primary data collected in the field was placed into the existing regional chronological framework.

3.1 ENEOLITHIC LITHICS

Prior to the emergence of Sintashta nucleated fortified settlements in the MBA, the Southern Trans-Ural steppe zone was associated with two archaeological traditions: Early Bronze Age (EBA) Poltavka (late Yamnaya variant) (3500 – 2000 BC) and Eneolithic Surtandy (4500-2200 BC) (Table 11) (Epimakhov 2010a:459; Grigoryev 2000:151; Koryakova and Epimakhov 2007:52; Mosin 1996:98 Mosin 2004:90; Mosin et al. 2014:48). The pre-MBA chronological picture is complicated by a few factors. Firstly, the chronological overlap between the Eneolithic (Copper Age) and the EBA is somewhat unusual. These two time periods are supposed to represent different stages in technological development, with the former usually (at least in a number of other world regions) preceding the latter. This observation may in turn be stemming from the fact that virtually no C-14 dates have been obtained from the EBA or Eneolithic sites located in the Trans-Ural steppe zone. Therefore, dates from the surrounding regions are cited and used in this study. While a more localized C-14 dating program could perhaps clear up the uncertainties associated with the EBA/Eneolithic chronological overlap, at this point, it is assumed that these two archaeological traditions co-existed in the Southern Urals.

Since EBA/Eneolithic populations were fairly mobile and relied on little to no ceramics in their daily lives, it is difficult to confidently identify occupation sites dating to these periods. Only a handful of occupation sites in the Southern Urals steppe zone produced Eneolithic ceramics or diagnostic EBA material, like ceramics or characteristic bronze items (Mosin 1996; Potemkina and Degtyareva 2007; Vinogradov et al. 2008). The Zingeyka River valley was no exception to this regional trend, with the survey producing no EBA/Eneolithic ceramics. However, a number lithic artifacts dating to the Eneolithic period have been recovered. Since one of the research objectives was to identify pre-MBA occupation within the survey zone, it is worthwhile to briefly describe the recovered Eneolithic items.

Table 11: Pre-MBA chronological phases of the Southern Urals steppe zone.

Time period	Archaeological culture	Dates of archaeological culture	Dates of the time period	References
Eneolithic	Surtandy	n/a	4500-2200 BC	Mosin 2004; Mosin et al. 2014
Early Bronze Age	Poltavka (late Yamnaya variant)	3500-2200 BC for the Cis-Urals late Yamnaya	Dates vary: 2600-2000 BC for Trans-Urals forest zone; 3300 – 2600 BC for Trans-Urals / Western Siberia	Epimakhov 2007; Koryakova and Epimakhov 2007; Mosin et al. 2014

Two bifacial willow-leaf (*ivolistnyi*, Rus.) stemmed projectile point finds were recovered in the course of the survey (Figure 40). Such narrow-bladed projectile points, only without the stem, have been recovered from Eneolithic sites in the Southern Urals, e.g., from Agapovka-1 (Mosin 2000:157,160). Presence of a stem is an attribute of later, MBA Sintashta lithic projectile points. Therefore, the c924/1L and c1016/1L stemmed willow-leafed projectile points recovered from the Zingeyka survey territory were dated to the later part of the Eneolithic period (per A. Strahov, Chelyabinsk State Regional Studies Museum).

Other finds that could be attributed to the Eneolithic period based on their morphology and overall parameters are projectile point preform #s1047nw1/1L and projectile point #c1186/1L (per A. Strahov; cf. Mosin 2000:167) (Figure 41). Since similar items have been encountered at some MBA settlements (Arkaim and Kuysak), regional specialists extend their chronology to include the MBA period as well (F. Petrov and A. Strahov, pers. comm.).

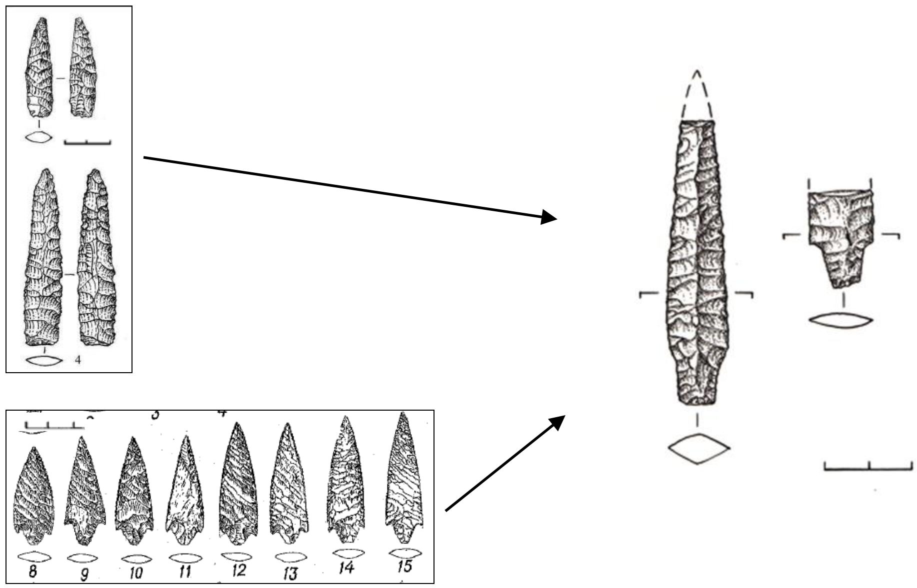


Figure 40: Eneolithic projectile points. *Top left*: willow-leaf projectile points from the Eneolithic site of Agapovka-1 (Mosin 2000:160). *Bottom left*: stemmed projectile points from a MBA Sintashta-type burial (Gening et al. 1992:134). *Right*: stemmed willow-leafed projectile point #c924/1L and projectile point fragment #c1016/1L, recovered in the course of the Zingeyka survey.

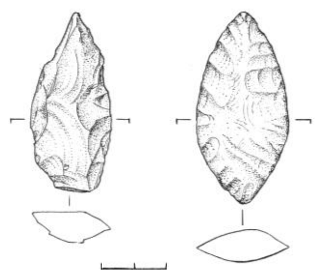


Figure 41: Projectile point preform #s1047nw1/1L and projectile point #c1186/1L. Both of these artifacts date to the Eneolithic-Bronze Age period.

Other indicators of human presence in the Zingeyka valley during the Eneolithic period came from collection unit #8 (Leb 1 1). In addition to containing Bronze Age material, this collection unit contained a group of lithic artifacts that were assigned into a broad Mesolithic-Eneolithic (8000-2000 BC) chronological window. One of these finds is an unworked pebble stone #c187/1a (Figure 42). Although this pebble does not display traces of flaking, similar stones found at the Eneolithic settlement of Botai in Kazakhstan were interpreted as weights for *bolas* (throwing weapons) (Zaibert et al. 2007:102). It is important to note that a number of authors point to the existence of a broad Eneolithic cultural horizon spanning over the territories of the Southern Urals and northern Kazakhstan (Kalieva and Logvin 1997:125; Zaharov 2010). For example, Matyushin (1982) assigns the Botai settlement into the Surtandy culture, mentioned above. Therefore, drawing comparisons between the Zingeyka valley and Botai material culture assemblages seems appropriate. Collection unit #8 (Leb 1 1) also contained a lithic artifact interpreted as a pick-axe, which was assigned into the Eneolithic-Bronze Age chronological window (per D. Zdanovich) (Figure 43). Recovering both of these items in a single collection unit points to the possibility of Eneolithic habitation at this locale.

It is worth noting that Eneolithic artifacts described above came from collection units located some distance apart (Figure 44). Rather than indicating the presence of an episodic Eneolithic hunting camp, this observation allows to speak of a longer period exploitation of this territory by pre-MBA populations.

Figure 42: Pebble stone c187/1a, recovered during the course of the Zingeyka survey (left). Similar stones were recovered from the Eneolithic site of Botai, located in Kazakhstan (right) (Zaibert et al. 2007:102).

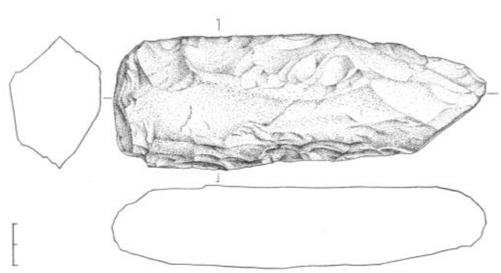


Figure 43: Lithic artifact #c184/2L, interpreted as a pick-axe. It was assigned into the Eneolithic-Bronze Age chronological window (per D. Zdanovich).

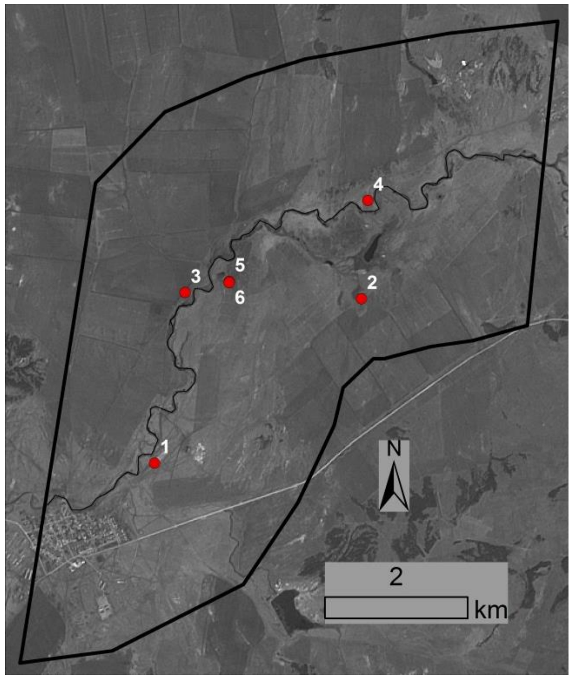


Figure 44: Spatial distribution of Eneolithic artifacts within the survey zone. 1 – c924/1L; 2 – c1016/1L; 3 – c1186/1L; 4 – s1047nw1/1L; 5 – c184/2L; 6 – c187/1a.

3.2 MIDDLE AND LATE BRONZE AGE CERAMICS

Ceramics sherds are durable, abundant, and usually identifiable to a specific time period. These qualities make them a good proxy for determining how people distributed themselves throughout the landscape during different time periods. For these reasons, regional population estimates outlined in chapter 2 were in large part based on the quantities of ceramic sherds that ancient populations left behind. During the course of the Zingeyka survey, ceramic sherds used in paleodemographic reconstructions were, for the most part, collected without a stratigraphic context and without association with absolute dates. Therefore, the ability to accurately assign individual sherds to specific time periods was essential for answering the posed research questions.

Table 12 summarizes how ceramic types encountered during the Zingeyka survey fit into the regional chronological scheme of the Southern Urals. This chronological framework is based on stratigraphic observations and radiocarbon dates from numerous archaeological sites within and near the Southern Urals region. As in other world regions, certain periods (and their associated ceramic complexes) are better documented by a larger number of radiocarbon dates than others. For the lists of actual sites and radiocarbon samples, one should view the corresponding cited publications.

Table 12: MBA/LBA chronological phases and ceramic types of the Southern Urals.

Time period	Ceramic types	Dates of ceramic types	References	Dates of time periods
MBA	Sintashta	2050 – 1700 BC	Epimakhov 2010a; Hanks et al. 2007	2050 – 1700 BC
	Petrovka	1950 – 1700 BC	Epimakhov 2010a; Hanks et al. 2007	
	Early Alakul MBA	1950 – 1700 BC	Koryakova and Epimakhov 2007	
	Early Srubnaya MBA	1950 – 1700 BC	Epimakhov 2010a; Hanks et al. 2007; Koryakova and Epimakhov 2007	
LBA	Srubnaya*	1700 – 1400 BC	Epimakhov 2010a; Hanks et al. 2007; Epimakhov 2007	1700 – 1400 BC
	Alakul*	1700 – 1450 BC	Epimakhov 2010a; Hanks et al. 2007; Koryakova and Epimakhov 2007	
	Srubno-Alakul (mixed type)	1700 – 1400 BC		

Quite a bit has been written about the morphological, decorative, and technological characteristics of regional ceramic types listed in Table 12. Summarizing the results of these studies is beyond the scope of present work. However, a few aspects are worth drawing attention to. Firstly, ceramic manufacturing techniques did not change greatly throughout the Bronze Age in the Southern Urals. For example, both Middle and Late Bronze Age pots were hand-formed, with a substantial degree of overlap with respect to color, temper, and paste composition. Similarly, there were no striking changes in the average vessel volume, shape, or ornamentation techniques between the two periods.

Taphonomic conditions of the area are characterized by regular freezing and thawing, as well as domestic livestock regularly stomping out the surfaces of archaeological sites. These conditions resulted in a large proportion of ceramic sherds being small and heavily weathered, making them difficult to distinguish (Figure 45).

* In addition to Srubnaya LBA and Alakul LBA, some single out Early Alakul LBA and Early Srubnaya LBA ceramic types. However, not enough C-14 dates exist to place these slightly earlier types into the existing chronological scheme.

Figure 45: Examples of small weathered sherds.

The factors outlined above made it necessary to design a rigorous ceramic analysis codification scheme that would maximize the chance of assigning even small, heavily worn sherds to a time period. Ceramics were analyzed under the guidance of Dr. Irina Alaeva, who applied her decades of experience with the archaeological ceramics of the Southern Urals to the analysis of over 2500 sherds recovered in this research. Sherds were coded according to 17 major categories. These categories included various attributes dealing with vessel morphology, production technology, and ornamentation. In the resulting database, each ceramic sherd was evaluated according to as many as 85 criteria, a lot of which were presence/absence variables. In the end, such rigorous classification scheme allowed to assign 76% of ceramics recovered during the survey to various Bronze Age sub-periods. While the remaining 24% of sherds did not show characteristics that could be used to link them to a specific period, they still dated to the Bronze Age based on characteristics such as temper, firing technique, and paste type.

Since our approach was different from how Bronze Age ceramics are usually analyzed in the Southern Urals, a few aspects of this stage of post-field data analysis need to be discussed. Firstly, the fact that we had to work with broader time periods vs. specific archaeological cultures made the percentage of distinguishable/determinable sherds greater than normally expected. For example, there were instances when a sherd could not be assigned into a specific archaeological culture, but yet we knew it more likely belonged to one of the MBA cultures rather than to one of the LBA cultures. A certain degree of uncertainty was also allowed when classifying sherds onto time periods. For example, there were instances when we could not rule out that a certain sherd belonged to either of the time periods. However, such sherd could still be assigned into a period it *more likely* belonged to based on the presence/absence of a certain feature(s).

Rather than discussing numerous similarities between the MBA and LBA ceramics, Table 13 and the accompanying illustrations focus on the attributes that are unique to each ceramic type. The following discussion, therefore, summarizes the basic mechanisms relied on by us to assign relative dates to the ceramic sherds recovered in the course of the survey. It is worth noting that some of the more subtle aspects of sherd classification relied on by Dr. Alaeva, such as various permutations of 200 ornamental motifs, are not discussed here. The ceramic analysis was, for the most part, visual and required no special equipment. Cross-sections were created with pliers, when necessary, to analyze temper inclusions and/or determine true colors of heavily weathered fragments.

Labels used for vessel anatomy subdivisions may vary among authors residing in different countries. Since a number of distinguishing characteristics of MBA and LBA ceramics listed in Table 13 are based on morphological attributes of pots, it is worthwhile to clarify what names were used by us to refer to different vessel components (Figure 46).

Table 13: Distinctive characteristics of MBA and LBA ceramic types.

Time period/ ceramic type	**Paste type**	**Temper / inclusions**	**Color**	**Morphology**	**Ornamentation**	**Technology**	**References**
MBA / Sintashta	Silty clays (i.e., clays associated with water body bottoms)	Presence of shell (Figure 47)	Dark colors, i.e., black, brownish-black, grayish-brown prevail (Figure 48).	Presence of an inverted rib or ridge on the inside of the pot	Presence of horizontal and vertical "pine tree" (*elochka*) ornament (Figure 49). Ornament elements that create relief are common, e.g., grooves (Figure 50, left). Wide grooves (*zhelobki*) in the upper portion of vessels (Figure 50, right). Wide variability in motifs and patterns.	Difference in weaving techniques of textiles that covered model pots (Figure 51, left). Namely, imprints on Sintashta pottery are characterized by lower thread density compared to later periods pots (Figure 51, right).	Grigoryev 2000; Gutkov 1995; Gutkov 2002:117; Vinogradov and Alaeva 2013:163; Tkachev 2007a; Tkachev and Havanskiy 2006
MBA / Petrovka		Presence of shell		Presence of a 'collar' (*vorotnichek*) or thickening underneath the rim on the outside of the vessel (Figure 52, left). 'Truncated cone' - shaped body (Figure 52, right).			Gutkov 2013; Vinogradov and Alaeva 2013
MBA / Early Srubnaya	Silty clays (i.e., clays associated with water body bottoms)	Presence of shell		Sharply-angled vessel profile (Figure 53). Some vessels have biconical shape.			Alaeva 2015:134; Grigoryev 2000; Muhametdinov and Bahshieva 2015

Table 13 (continued).

LBA / Alakul				Presence of a small ledge (*ustupchik*) on the shoulder (Figure 54). Roundish body profile (Figure 55).	Presence of an unornamented/ blank strip (*svobodnaya polosa*) in the lower part of the neck. Ornamentation is structured, i.e., decorated and undecorated zones alternate (Figure 55).		Alaeva 2015; Grigoryev et al. 2009; Rutto 2003:32
LBA / Srubnaya					"Careless"/unsystematic ornamentation patterning. Presence of striations left by scraping (*raschesy*) on the outer surface (Figure 56).		Rutto 2003:32
LBA / Srubno-Alakul				Presence of a smoothed ledge (*peregib*) on the shoulder (Figure 57).	Substantial proportion of vessels is unornamented. Striations left by scraping (raschesy) on the outer surface.		Alaeva 2015
Other MBA vs. LBA distinctions		Quartz temper becomes common in the LBA (Figure 58). High density of talk (>30%) accompanied by no other inclusions is a feature of MBA pottery (Figure 59).		MBA vessels have shorter necks compared to LBA vessels. The ratio of neck/body increases through time (Figure 60). The profile of the body becomes more roundish with time. Beveled rim (*kosoi srez*), a rim that has a sloping edge on the inside, is a MBA feature (Figure 61).	LBA has larger proportion of unornamented ceramics compared to the MBA	The method of how the neck was secured to the body becomes different. In the LBA the upper (neck) coil is always secured on the inner side of the vessel relative to the lower (body) coil.	Aleva 2015; Alaeva, pers. comm.; Grigoryev 2000; Kupriyanova 2003; Vinogradov and Alaeva 2013; Vinogradov and Muhina 1985

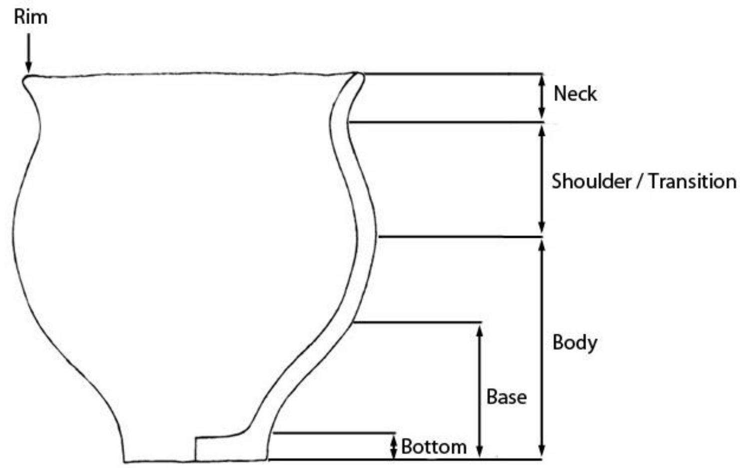


Figure 46: Vessel anatomy classification used in the analysis of ceramics collected in the course of the Zingeyka survey. Based on Tkachev and Havanskiy (2006:13) and Gening (1973).

Figure 47: Examples of crushed shell temper. *Left*: sherd s1118ne3/2 extracted from collection unit #26 (Leb 6 3). *Right*: sherd s698/3 extracted from collection unit #8 (Leb 1 1).

Figure 48: Examples of grayish-black MBA sherds w247-30/11,15 extracted from collection unit #14 (Zarya 1 2) (left). Example of a grayish-brown LBA sherd w691-30/14 extracted from collection unit #8 (Leb 1 1) (center). Examples of reddish-brown undet. sherds w691-30/26,27 (right). Sherds on the right and center are provided for contrast.

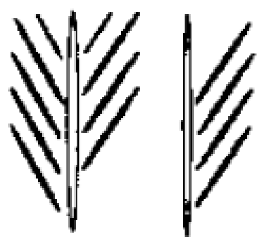


Figure 49: Pine tree (elochka) ornamental motif (Tkachev and Havanskiy 2006:46).

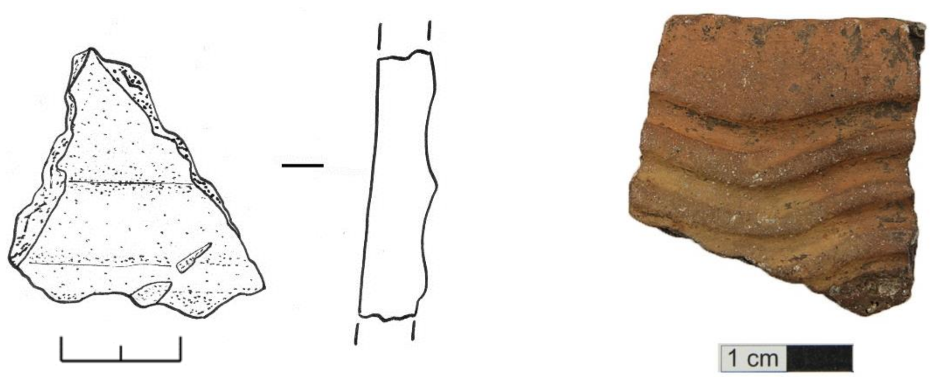


Figure 50: MBA ornamental techniques. Example of relief on a MBA sherd s1050/3, extracted form collection unit #20 (SarymSakly) (left). Example of a grooves (*zhelobki*) ornamentation technique on a MBA rim sherd s712/48, extracted from collection unit #15 (Zarya 1 3) (right).

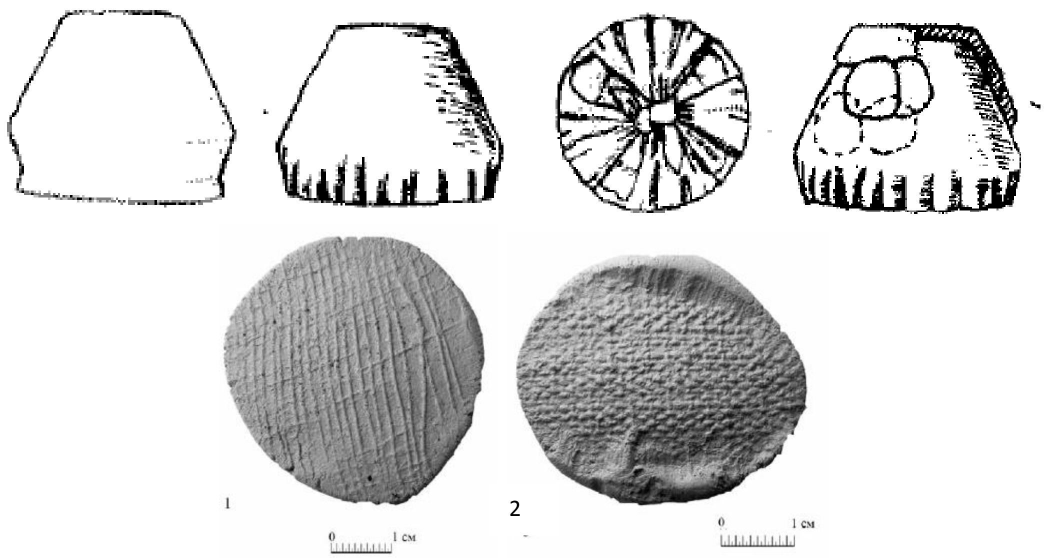


Figure 51: Cloth impressions on Bronze Age pottery. *Above*: illustration of how pots were formed on top of model pots covered with cloth (adapted from Vinogradov and Muhina (1985)). *Below*: imprints of inner walls of Bronze Age pots. 1 - cloth type characteristic of earlier, MBA Sintashta pots; 2 - cloth type more characteristic of later period pots. Adapted from Medvedeva (2015).

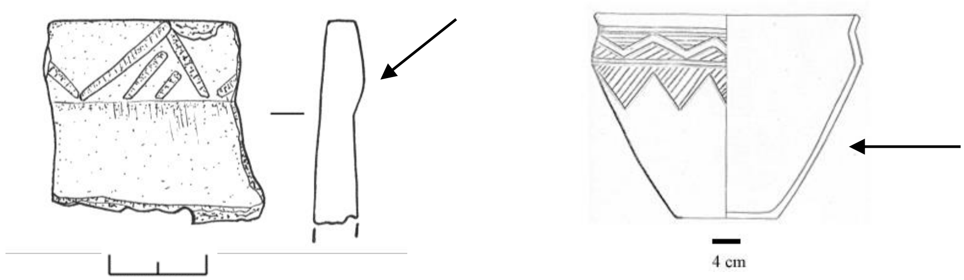


Figure 52: Petrovka ceramics. Left: MBA Petrovka rim sherd w691-40/61 with a collar (*vorotnichek*) feature extracted from collection unit #8 (Leb 1 1). Right: example of a MBA Petrovka pot with a characteristic 'truncated cone' body shape (Vinogradov 1982:71).

Figure 53: Early Srubnaya ceramics. *Left*: MBA Early Srubnaya shoulder/body sherd s701w2/1 extracted from collection unit #9 (Leb 1 2), showing a sharply angled vessel profile. *Right*: examples of sharply angled (some approaching bi-conical shape) Early Srubnaya pots (Alaeva 2015:190).

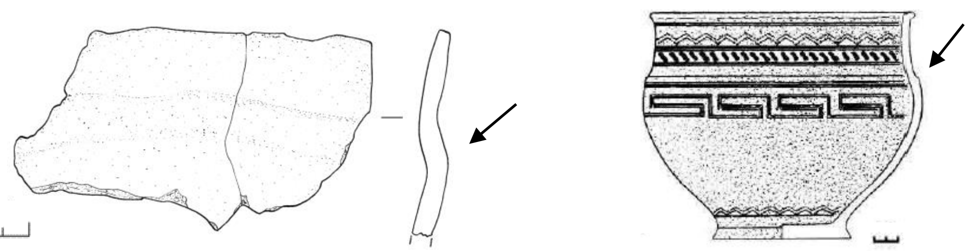


Figure 54: Ledge (ustup) type of shoulder. *Left*: LBA Alakul rim/neck/shoulder sherd w691-30/1 extracted from collection unit #8 (Leb 1 1). *Right*: a typical LBA Alakul pot (Grigoryev 2000:306).

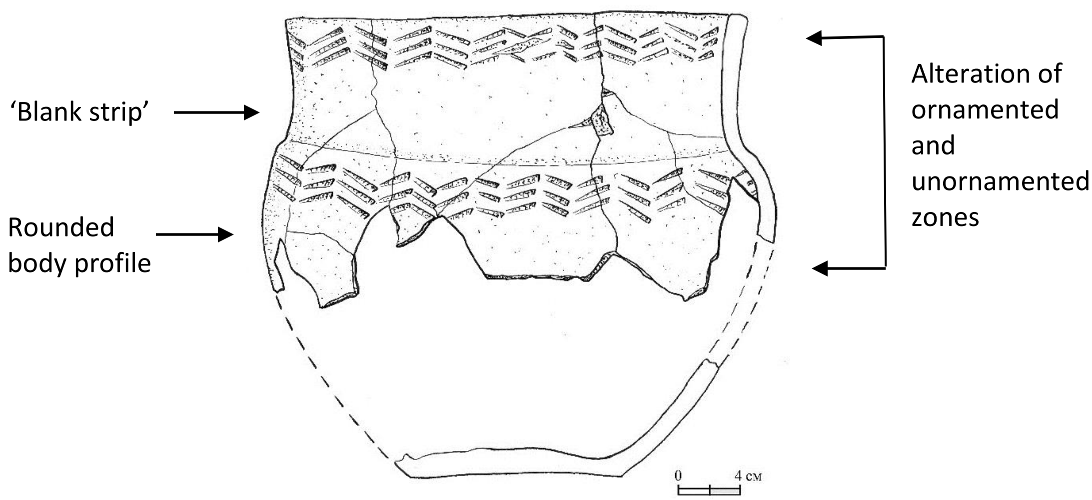


Figure 55: A reconstructed LBA Alakul pot extracted from collection unit #29 (Katsbah 6). Its Alakul features include a rounded body profile, presence of a blank/unornamented strip in the lower part of the neck, and alteration of ornamented and unornamented zones.

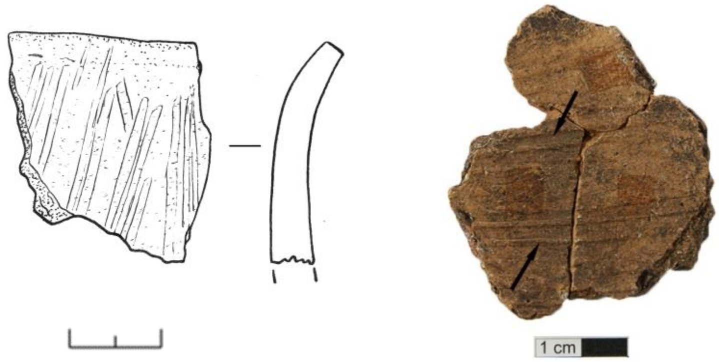


Figure 56: Examples of striations left by scraping (*raschesy*) on sherds from the Zingeyka survey. *Left*: LBA Srubnaya rim sherd w937-85/1 extracted from collection unit #3 (Katsbah 1 3). *Right*: sherds 712/5-7 extracted from collection unit #15 (Zarya 1 3).

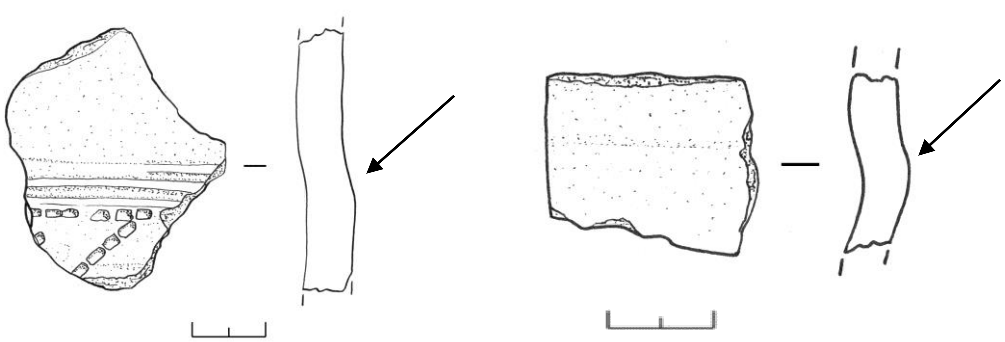


Figure 57: Examples of smoothed ledge (peregib) type of shoulder. *Left*: LBA Srubno-Alakul sherd w1125-30/10 extracted from collection unit #24 (Leb 6 1). *Right*: LBA Srubno-Alakul sherd w1123-10/1 extracted from collection unit #23 (Zarya 11).

Figure 58: Examples of quartz temper. *Left*: undet. sherd w699-40/8 from collection unit #8 (Leb 1 1). *Right*: LBA Srubno-Alakul rim sherd s1118e3/5 from collection unit #26 (Leb 6 3).

Figure 59: Examples of high density talk temper. Talk is seen as white speckles in the MBA sherds s1052sw2/3 (left) and s1052sw2/1(right) recovered from collection unit #19 (SarymSakly 1).

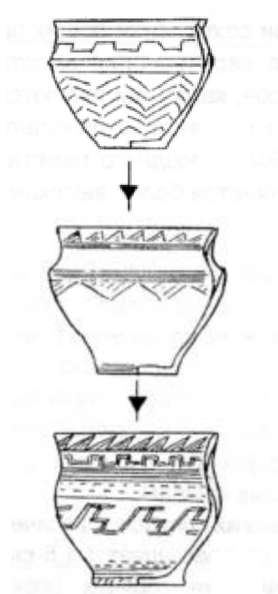


Figure 60: 'Evolution' of Bronze Age pots from the MBA Sintashta to the LBA Alakul types. The neck/body ratios increase, necks become longer, and body profiles become more rounded. Adapted from Kupriyanova (2003:58).

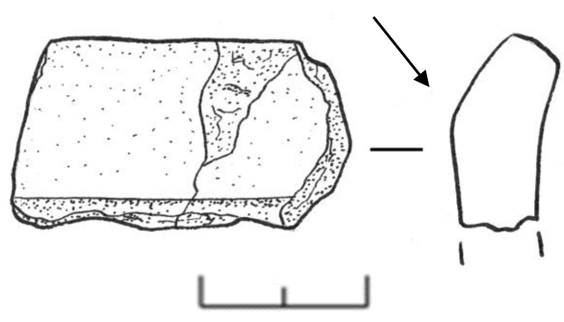


Figure 61: MBA beveled type of rim (kosoi srez) sherd. The figure depicts sherds w691-30/57 and w691-10/11 (glued together) from collection unit #8 (Leb 1 1).

4.0 SETTLEMENT, DEMOGRAPHIC, AND COMMUNITY PATTERNS

4.1 METHODS FOR DELINEATING COMMUNITIES

As discussed in chapter 1, the goal of this study is to trace the changes in the spatial and demographic size of Bronze Age communities. Although communities can be broadly defined as groups of people who have something in common, e.g., interests, identity, values, goals, etc., in the present work communities are defined based on the principles of interaction. More specifically, the distance-interaction logic suggests that people interact more intensely with individuals that are physically closer and less intensely with individuals that are physically farther away. This approach is especially applicable to prehistory, when modern communication and transportation technologies were non-existent (Peterson and Drennan 2011:80).

This study relied on two basic types of analytical units to investigate the development of socio-political complexity in the Southern Urals. Firstly, Murdock's (1949) classical definition of community - a group of people that interact face-to-face on a virtually daily basis - was used to define 'local communities'. Same principles of interaction were then used to delineate 'supra-local communities', defined as distinct clusters of small local communities, inside of which people interact more intensely than outside (Peterson and Drennan 2005).

Methodologically, both local and supra-local communities were delineated according to the procedure outlined by Peterson and Drennan (2005). Namely, for each archaeological period, the survey area was represented as a raster with a cell resolution of 1 ha (100 m by 100 m). Each cell that spatially corresponded to an individual collection unit or a group of contiguous collection units was assigned a *z-value* equal to the mean absolute population estimate. All cells without any occupation for a given period received a value of 0.0. The resulting rasters were used to generate continuous elevation surfaces via an Inverse Distance Weighing (IDW) interpolation method, with the powers of 4, 2, 1, 0.5, 0.25, and .001 (from less to more smooth). The resulting surfaces were then used to identify the patterns in the intensity of human interaction across space. The details of how the local and supra-local communities were delineated for each period are incorporated into the following discussion.

4.2 SEQUENCE OF CHANGE IN COMMUNITY STRUCTURE

4.2.1 EBA

The habitation sites of the EBA Poltavka archaeological culture (late Yamnaya variant), associated with the earliest kurgan burials in the Southern Urals, are limited to occasional isolated artifact finds (Mosin 1996; Potemkina and Degtyareva 2007; Vinogradov et al. 2008). The occupation evidence at Eneolithic sites in the Southern Urals is also limited: it includes artifact scatters, stone arrangements, hearths, and occasional housing depressions (Mosin 2000, 2004). Therefore, the fact that no pre-MBA ceramics were identified in the course of the Zingeyka survey is not surprising. However, a few lithic artifacts that can be dated to the Eneolithic period have been recovered. Also, previous excavations that transpired 11 km west of the Zingeyka survey zone revealed a Poltavka-period kurgan burial (Malutina and Zdanovich 1995:101). At the very least, these observations allow us to conclude that prior to the Sintashta development people lived (camped, hunted, conducted rituals, etc.) in the Zingeyka valley.

Since the MBA and LBA population estimates outlined in chapter 2 were based on ceramic sherd densities, incorporating pre-MBA materials into a direct demographic comparison with the former two periods would be extremely difficult. Nonetheless, let us attempt to estimate how many people could have lived in the Zingeyka valley prior to the Sintashta development. In regards to the Eneolithic component of pre-MBA occupation, to date, we know of only one site in the Southern Urals that yielded evidence, which can be readily used as a demographic proxy. It is the Eneolithic camp site of Surtandy-8, where Matyushin (1982:19) reconstructs 6-8 distinct dwellings, ~30 m^2 each. If we interpret this site as an occupation by a human collective that consisted of 6-8 nuclear families, 5 people each, we at least know that this nearby Eneolithic camp consisted of 30-40 people.

Populations associated with the Poltavka archaeological culture are traditionally viewed as mobile pastoralists (Koryakova and Epimakhov 2007). Therefore, it is useful to consider occupational densities among ethnographically recorded mobile pastoralists occupying similar ecological environments. The 19th century population density of pre-industrial mobile herder populations in the Ural'skaya Oblast of Kazakhstan (occupying a ~300,000 km^2 area), located just to the south-west of the Southern Urals was 1.3 persons per km^2 (Masanov 2011:550-565). At these population densities, the Zingeyka survey zone's 40 km^2 would contain about 50 people (40 x 1.3=52). To summarize, archaeological and ethnographic data outlined above suggest that some 30-60 people might possibly have lived in the survey zone during the pre-MBA period (4500-2000 BC

4.2.2 MBA

The first step to evaluating human interaction within the survey zone during the MBA period is to establish the quantity and size of local communities. Figure 62 is an IDW population density surface with the power of 4, in which contours were generated by connecting cells with identical values. In this map, the peaks in the face-to-face daily interaction are outlined by the contour line that is highlighted in green. This line was chosen as the appropriate cutoff for local communities because it defines a number of occupation clusters that range up to 1 km across – a maximum feasible area in which daily face to face interaction may occur. Higher contour lines would single out areas separated by distances too small to serve as obstacles for interaction, while lower ones would single out areas that are too large to interpret as local communities.

In the MBA, the Zingeyka valley survey area contained a total of 7 local communities that together housed anywhere from 460 to 690 people. Table 14 splits the MBA local communities into three arbitrary demographic estimate ranges. The purpose of this table is to show that the demographic size of local communities ranged from quite small (10-50 inhabitants), to average (80-120 people), to fairly large (mean estimate of 388 people). The aim of such 3-category allocation is not to identify tiers in a settlement hierarchy, but rather to establish the demographic context for daily socializing. Table 14 illustrates that 16% of regional population lived in very demographically small communities (10-50 people) which can be interpreted as single extended family homesteads or hamlets comprised of a few such families. Another 16% of regional population lived in a village that contained around 100 people. The majority (68%) of population within the survey zone lived in a single fortified nucleated village. The population of this largest local community was more than four times higher than that of the next largest one.

In order to investigate social structure at a larger, supra-local scale, it is useful to turn to the 3-D surfaces depicted in Figure 63. A single demographic center that dominates the entire survey area is easily discerned from looking at the density surfaces. Not surprisingly, this occupation peak incorporates the fortified settlement of Sarym-Sakly. The absence of other peaks of comparable heights suggests that MBA populations within the survey zone were integrated into one large supra-local entity.

In order to delineate the borders of this entity more precisely, it is useful to turn to the contour map of the smoothed density surface depicted in Figure 64. The appropriate contour line, which delineates a higher order MBA community, is highlighted in green. Choosing lower contour lines to delineate a supra-local community would incorporate too much unoccupied empty space. Alternatively, choosing a higher contour line would indicate the presence of small independent entities not integrated into a larger district, which seems very unlikely.

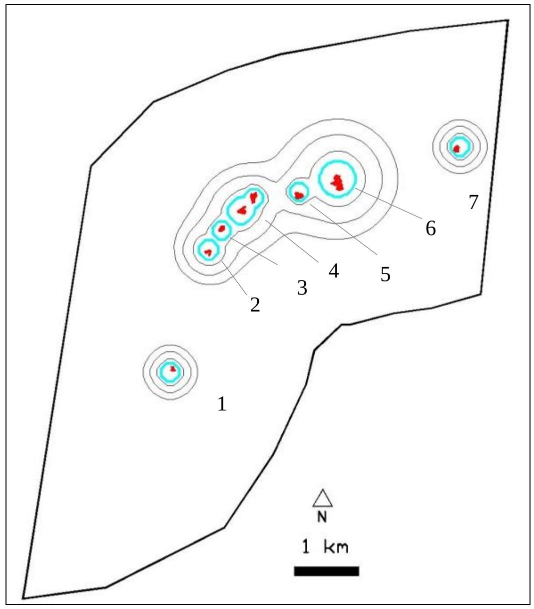


Figure 62: Contour map of the MBA occupational peaks in the Zingeyka survey zone. Collection units with MBA ceramics are outlined in red. Local communities are outlined in green and are numbered in sequence, from south to north. IDW power of 4, contours drawn at the elevations of .4, .07, .01, .003.

Table 14: MBA local communities split across three population size categories.

MBA local community (nominal number)	MBA population minimum	MBA population maximum	Corresponding social unit	% of regional population that lived in this type of settlement
3	9	14	Homesteads and hamlets containing from one to a few extended families	16%
5	9	14		
7	11	17		
1	12	18		
2	31	46		
4	75	112	A village	16%
6	311	464	A larger nucleated village	68%

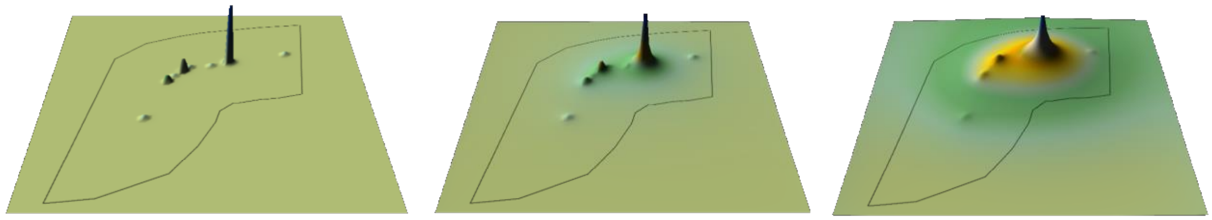


Figure 63: Smoothed occupation surfaces at powers of 4, 1, .25, from left to right.

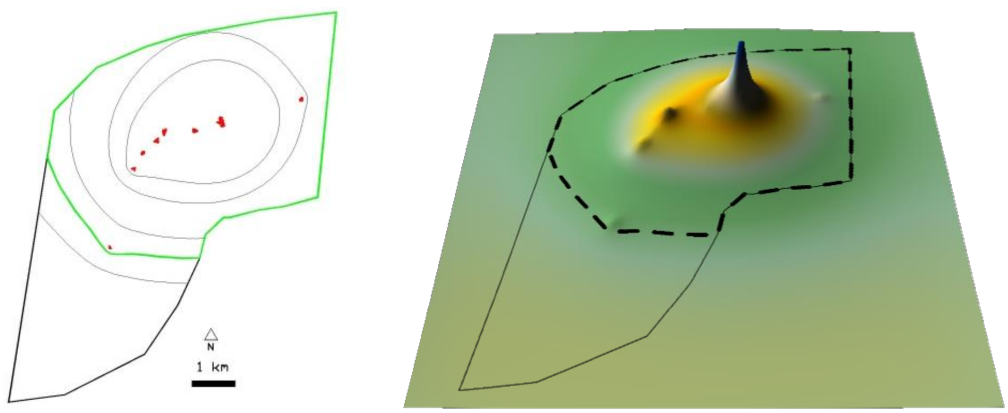


Figure 64: Contour map of the occupational peaks in the Zingeyka survey zone. Collection units with MBA ceramics are outlined in red. One supra-local community is outlined in green on the left and in black on the right. IDW power of .25, contours drawn at the elevations of .07, .066, .061, .059, .057.

The demographic center, visible in Figures 63 and 64, probably dominated some territory beyond the survey zone. Because so little is known at this point about the nature of MBA hinterland settlements, possible extrapolations beyond the survey zone (e.g., Figure 65), should be approached with caution. What Figure 65 does suggest, however, is that extrapolating the area of the MBA supra-local community beyond the survey zone would not alter the overall conclusions of this chapter to any significant degree. In other words, extending the survey further to the east may have added a few more small local communities to the district, but probably not many.

As mentioned in chapter 1, centralized regional organization is seen as a hallmark of early social complexity (Blanton 2004:226; Drennan and Peterson 2008:361; Tainter 1988:27). At regional scale, a common pattern of social interaction is for populations to be drawn toward centers (Gras 1922; McKenzie 1933). People could be drawn to the regional center by a desire to participate in ritual or mortuary activities, take advantage of public infrastructure, engage in trade, communicate, advance socially, defend against enemies, or other reasons. Such centrally-focused pattern of interaction usually results in multiple local communities converging into a larger social unit. Therefore, a number of social scientists have relied on the degree of demographic centralization to make inferences about the level of economic or political integration of the corresponding social systems (Auerbach 1913; Wright and Johnson 1975).

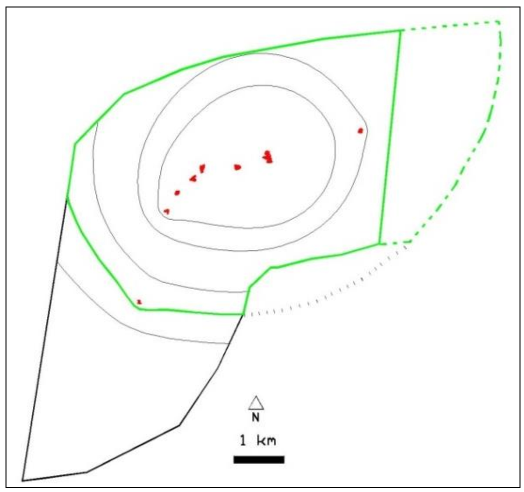


Figure 65: A possible additional area of the MBA district. The shape of the area outlined by a green dotted line is based on the direction of the Zingeyka River and continuation of the existing supra-local contour line.

One of the challenges for archaeologists lies in the effective measurement of demographic centralization. Usually, rank-size graphs are used to make inferences about the degree of a social system's political and/or economic integration. This method of analysis works well with extensive polities that provide large sample numbers of local communities (Peterson and Drennan 2011:87). The MBA supra-local community or district, outlined in Figure 64 is about 6 km across. It occupies a total area of 26.5 km^2 and contains a mean estimated population of 566 people, who distributed themselves across 7 local communities. For such small polities, rather than relying on rank-size graphs, using an alternative approach, outlined by Drennan and Peterson (2008) seems more appropriate.

According to this method, an area in which we want to measure the degree of demographic centralization is first divided into 12 rings, each containing 1/12th of the area of the polity (Figure 66).

Naturally, the fortified settlement of Sarym-Sakly, partially responsible for the high population peak visible in the 3-D surfaces, was viewed as a regional central place. Therefore, the geometric center of a circular shape that outlines Sarym-Sakly's fortification walls was used as the central point from which the 12 concentric rings were measured.

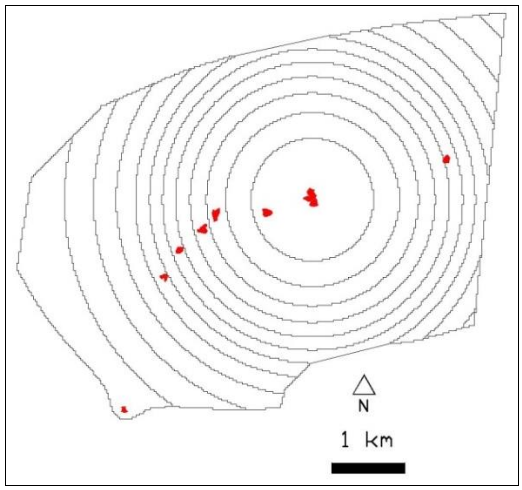


Figure 66: MBA District 1. MBA collection units are shown in red; circles indicate 12 concentric rings for centralization analysis.

The second step of the centralization analysis entails determining what proportion of regional population lived in each ring (Table 15). The third step entails examining the graph that depicts the resulting population proportions. In a demographically centralized polity, population proportions would be higher in the innermost ring and lower in the outer rings. In Figure 67, population proportions in the MBA District 1 are traced by the red line. The 90% error range, traced by the brown line, is based on using the total number of households in the district (numbering 13 people each) as the relevant sample size. The choice of households (vs. individuals or communities) is based on the notion that household were likely the primary decision-making units in regards to residential location. This graph shows that the proportion of the district's population in the innermost ring is quite high. The proportions of the district's population occupying successive rings is quite small except in ring 4, where the proportion increases, creating a bump in the graph. Overall, the degree of demographic centralization in this district is quite strong.

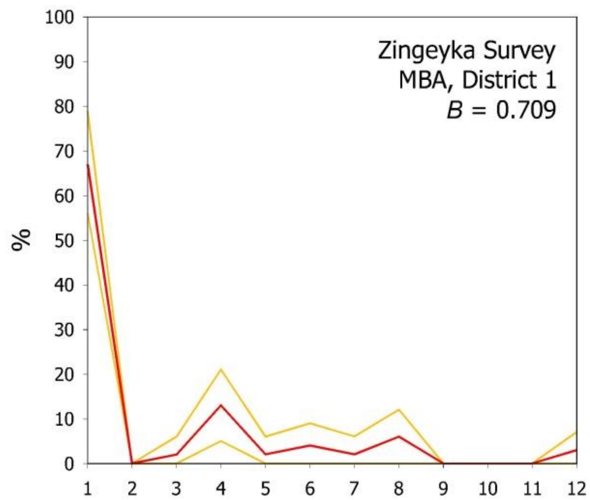


Figure 67: Graph of the distribution of MBA populations across 12 concentric rings within District 1 of the Zingeyka valley. The 90% confidence interval is traced in brown.

The degree of centralization can also be expressed numerically by calculating a *B index*. This coefficient is derived by adding up cumulative population proportions in each of the 12 rings; subtracting 650; and dividing the resulting value by 550 (Table 15). The B index for the MBA District 1 was calculated to be 0.709. Considering that this coefficient can range from 0 for a completely decentralized polity to 1 for an extremely centralized polity, the MBA District 1 represents an example of a highly centralized social formation. In this case, the high centralization index is a result of a single relatively large fortified settlement being surrounded by minimal hinterland populations.

At a third and yet larger scale of analysis that includes multiple Sintashta fortified villages, social interactions between chiefly centers were not frequent or intensive, as evidenced by considerable distances separating most of the fortified settlements (median nearest neighbor distance of 21 km). In the case of the Zingeyka valley, MBA occupation seems to fall off quite sharply in the direction of the Kuysak settlement, located 11 km to the west of District 1's boundary (see Figure 2). This observation suggests the presence of an unoccupied buffer between MBA settlement clusters, created by hinterland populations being drawn closer to the fortified villages (Figures 63 and 64). Further continuation of this empty buffer to the west, beyond the survey zone, would suggest a lack of intensive interaction between two MBA polities. Judging from the available data (Hanks et al. 2013; Koryakova and Epimakhov 2007; Krause and Koryakova 2013; Zdanovich and Batanina 2007), no one Sintashta fortified settlement stands out as an obviously larger center that could serve as an integration point of multiple

MBA districts. These observations point to the existence of a number of roughly demographically similar competing polities in the Southern Urals during the MBA. However, this hypothesis, based on the spatial parameters of individual settlements, needs to be further investigated at the level of districts.

Table 15: Calculation of B value for the MBA District 1.

Ring	Estimated population	Population Proportion	Cumulative proportion
1	394	67%	67%
2	0	0%	67%
3	14	2%	70%
4	74	13%	82%
5	1	2%	85%
6	26	4%	89%
7	5	2%	91%
8	35	6%	97%
9	0	0%	97%
10	0	0%	97%
11	0	0%	97%
12	17	3%	100%
Total	566	100%	1040%
B value	**0.709**		

4.2.3 LBA

The first step to evaluating human interaction within the survey zone during the LBA is to establish the quantity and size of local communities. Figure 68 is an IDW population density surface with the power of 4, where contours were generated by connecting cells with identical values. In this map, the peaks in the face-to-face daily interaction are outlined by the contour line that is highlighted in green. This line was chosen as the appropriate cutoff for local communities because it defines a number of occupation clusters that range up to 1 km across – a maximum feasible area in which daily face to face interaction may occur. Higher contour lines would single out areas that would be separated by distances too small to serve as obstacles for interaction, while lower ones would single out areas that are too large to interpret as local communities.

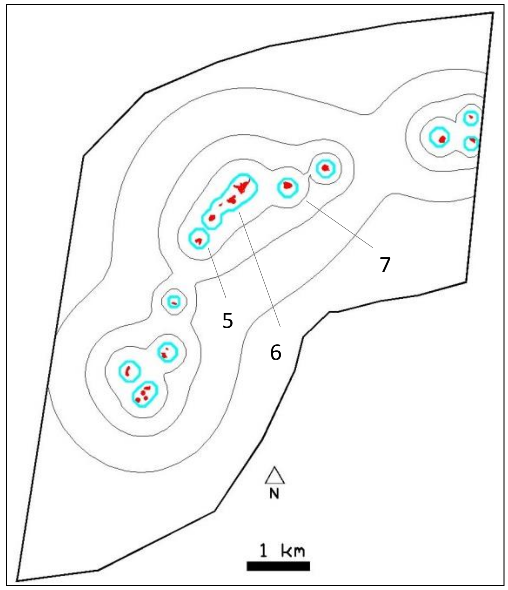


Figure 68: Contour map of the LBA occupational peaks in the Zingeyka survey zone. Collection units with LBA ceramics are outlined in red. Local communities are outlined in green and are numbered in sequence, from south to north; only a few selected ones are labeled. IDW power of 4, contours drawn at the elevations of 3, .1, .01, .001.

In the LBA, the Zingeyka survey area contained a total of 11 local communities that together housed anywhere from 2,000 to 3,000 people. Table 16 splits the LBA local communities into three arbitrary demographic estimate ranges. The purpose of this table is to show that some local communities were quite small (15-80 inhabitants), some were of the average demographic size (80-450 people), while one stood out as being fairly demographically large (mean estimate of 991 people). As mentioned in the previous section of this chapter, the aim of such 3-category allocation is not to identify tiers in a settlement hierarchy, but rather to establish the demographic context for daily socializing. Table 16 illustrates that only a trivial proportion of regional population (6%) lived in demographically small communities, which can be interpreted as homesteads or hamlets, consisting of one to a few extended families. The remaining regional population is fairly evenly split between living in villages, numbering in the 100's (52%) and living in one large village, the mean estimated population of which approaches 1,000 inhabitants (43%). It is worth noting that although the latter local community has been labeled a 'large village', its spatial layout is somewhat atypical for what is traditionally considered a village, i.e., it is comprised of a few discrete occupation clusters located fairly close (80-150 m) apart.

Table 16: LBA local communities split across three population size ranges.

LBA local community nominal number	Minimum population	Maximum population	Corresponding social unit	% of regional population that lived in this type of settlement
4	15	23	Homesteads and hamlets containing from one to a few extended families	6%
11	21	31		
10	22	33		
8	51	76		
3	81	120	A village	52%
7	112	167		
9	114	170		
5	170	253		
1	197	293		
2	288	430		
6	796	1186	A large village	43%

In order to investigate social structure at a larger scale, it is useful to turn to 3-D surfaces with various degrees of smoothing depicted in Figure 69. As the degrees of smoothing increase and the bases of occupational peaks expand, one can see larger community groupings forming around occupation peaks. In particular, at the IDW power of .5, we can see nearby small communities merging into two clusters. These clusters form around two peaks that are separated by a valley, i.e., a space that is almost completely void of occupation.

In order to delineate the supra-local communities more precisely, it is useful to turn to the contour map of the smoothed density surface with the power of 0.5, depicted in Figure 70. The appropriate contour line is highlighted in green. Choosing the next lower contour line to delineate one (vs. two) large supra-local community would ignore the interaction boundary visible in the 3-D image in Figure 70. Alternatively, choosing a higher contour line would cut through the single-peaked funnel-shaped entity visible in the center of the survey zone.

As mentioned above, contour lines, such as the ones depicted in Figure 70, delineate areas with similar degrees of human interaction. This approach assumes that higher peaks associated with larger populations radiate their influence further out into the landscape than smaller population peaks. Such logic resonates with Alden's (1979) comparison between the principles governing political interaction on the one hand and the law of gravity on the other. Namely, according to Alden, the level of political interaction between two units is directly proportional to their mass (or population) and inversely proportional to the physical distance between them. In Figure 70, these principles are manifested in the same-level (.365) contour line producing a larger circular shape around a higher population peak and a smaller circular shape around a lower peak.

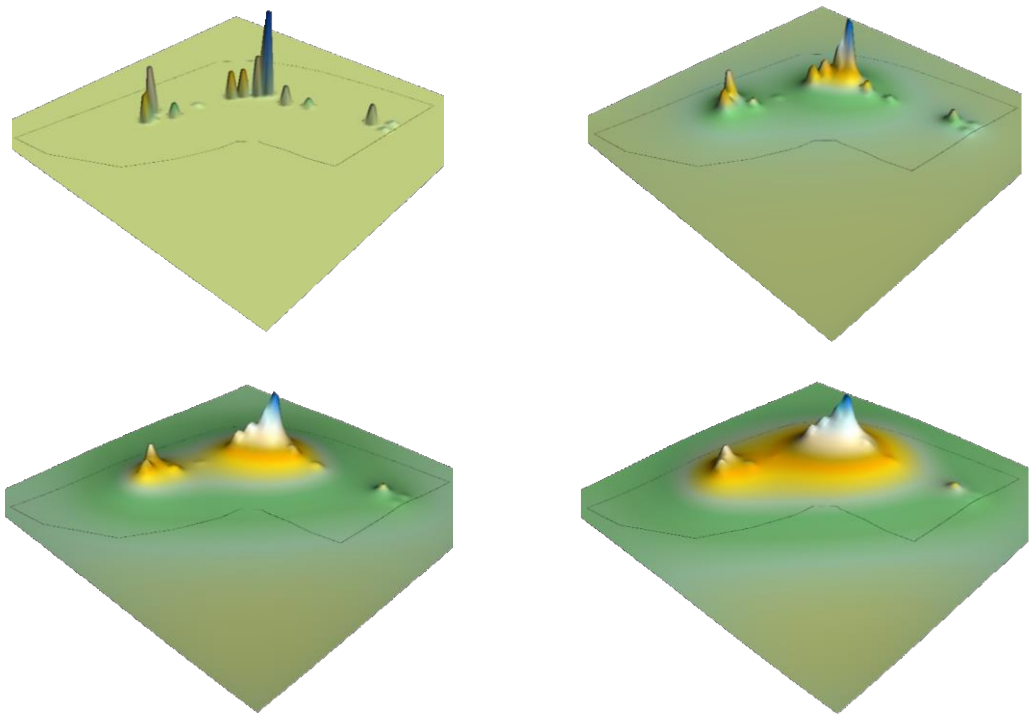


Figure 69: Smoothed LBA occupation surfaces at powers of 4 (upper left), 1 (upper right), .5 (lower left), .25 (lower right).

LBA supra-local Districts 1 and 2, outlined in Figure 70 are fairly small. District 1 measures 1.3 km across and occupies an area of 1.3 km^2. It is comprised of 3 local communities that together contain between 570 and 840 people. District 2, being slightly larger, measures 4 km across and occupies an area of 3.8 km^2. It is comprised of 4 local communities that together contain between 1310 and 1940 people. Just like for the MBA District 1, the centralization analyses for the LBA Districts 1 and 2 were carried out following the steps outlined in Drennan and Peterson (2008). It is important no note that the LBA local communities in both districts are not nucleated or compact. For example, a number of fairly demographically large local communities in the central cluster of District 2 (#5, 6, 7) are separated by relatively short distances (300 - 500 m). Therefore, these local communities do not obviously present themselves as separate entities. In addition to the reasons listed in the preceding section of the chapter, in such instances, B index presents itself as the most appropriate measure of demographic centralization (Peterson 2014:53).

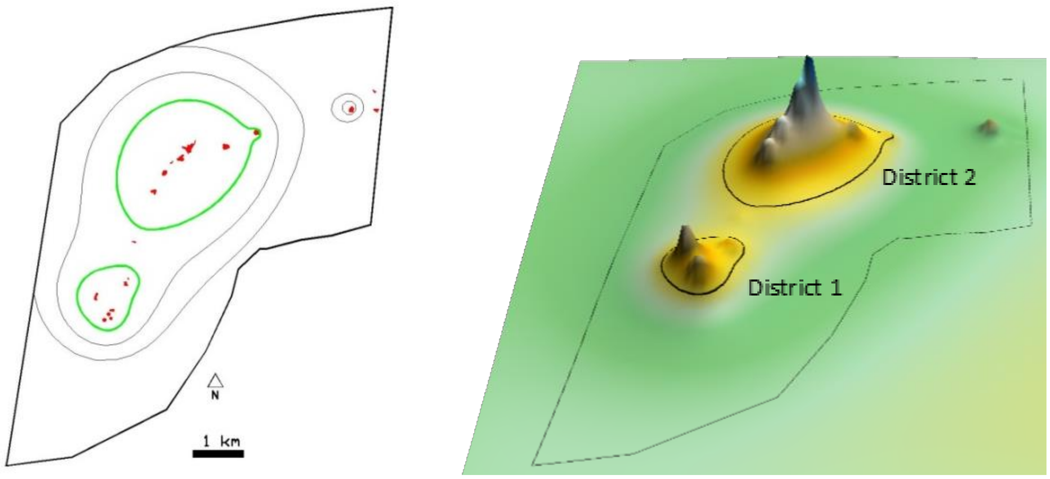


Figure 70: Contour map of the LBA occupational peaks in the Zingeyka survey zone. Collection units with LBA ceramics are outlined in red. Two supra-local communities are outlined in green on the left and in black on the right. IDW power .5, contours drawn at .365, .32, and .295.

For District 1, the high population density peak was caused by a single collection unit associated with the settlement site of Katsbah-6. This collection unit's centroid was therefore used as the central point, from which 12 concentric rings were measured. In Figure 71, population proportions in the LBA District 1 are traced by the red line, while the 90% error range is traced by the brown line. This graph illustrates that the proportion of the district's population in the innermost ring is quite high, but the populations located in rings 5 through 10 are also fairly large, creating substantial bumps before the populations finally taper off in the outer-most rings. Therefore, District 1's populations seem to be centralized, but only to a moderate degree. This observation is confirmed by a fairly moderate B index value of 0.434.

For District 2, the central point from which 12 concentric rings were measured off was the centroid of a polygon outlining a cluster of structural depressions identified near the center of the tallest population peak visible in the 3-D surface (the cluster of depressions is depicted in Figure 24, chapter 2). The centralization graph in the right portion of Figure 71 indicates that the proportion of the district's population in the innermost ring is quite high. The proportions of the district's population occupying successive rings are quite small except in ring 5, where the proportion increases, creating a bump in the graph. Overall, the degree of demographic centralization in this district seems to be moderate, yet more considerable than in District 1. The B index for District 2 was calculated to be 0.518.

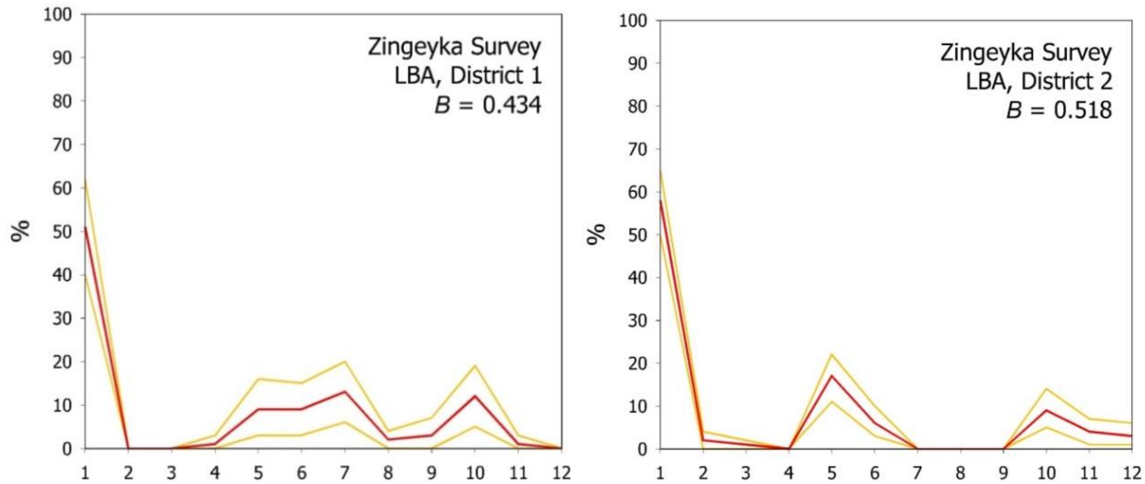


Figure 71: Graphs of the distribution of LBA populations across 12 concentric rings within Districts 1 and 2 of the Zingeyka valley. The 90% confidence interval is traced in brown.

During the LBA, the Zingeyka survey zone contained four small local communities that were not integrated into either of the two larger districts (Figure 70). All of these local communities have been interpreted as hamlets consisting of one or a few extended families. What needs to be noted about the concentration of 3 such small local communities in the northeastern portion of the survey zone is that according to the aerial photography data, there is a fairly large settlement site located immediately east of where the survey zone sections off. Although the results of aerial photography need to be taken with a grain of salt (as pointed out in chapter 2), the identification of 11 housing depressions and the recovery of what appeared to be Bronze Age material from the surface of this settlement (Zdanovich et al. 2003:154) may indicate that the 3 smaller communities in the northeastern sector possibly belong to a larger occupational cluster. If it is the case, the percent of population that lived outside of larger districts during the LBA is truly negligible.

In terms of selecting the appropriate central points for the MBA and LBA districts, it is worth mentioning the notion that ceremonial and social activities associated with ritual architecture played an integrative role for prehistoric societies of the Eurasian steppes (Allard 2009; Anthony 2007; Golyeva 2000; Houle 2009). The analysis of aerial photographs and pedestrian surveys indicate the presence of 12 kurgan complexes within the survey zone that have been preliminarily dated to the Bronze Age period (Zdanovich et al. 2003). Although these types of sites are difficult to date (aside from excavating them) Figure 72 points to the fact that the spatial relationship between settlements and ritual monuments in the Bronze Age was quite complex. At least at the scale of the Zingeyka survey, kurgan burials did not seem to act as central places for Bronze Age regional polities (with one possible exception of a kurgan located in the center of a large local community - Figure 72, left).

Figure 72: Bronze Age single kurgans and kurgan complexes, depicted as red triangles. MBA local communities (left) and the LBA local communities (right) are outlined in green.

4.3 SEQUENCE OF SOCIAL CHANGE

Although pre-MBA regional population densities can only be guessed at, the results of the Zingeyka survey are consistent with the notion that these populations were very small and mobile. The discovery of a Poltavka burial 11 km west of the survey zone indicates that kurgans, commemorating the death of selected individuals, were being erected in the Zingeyka valley as early as the EBA period. The sparseness of pre-MBA occupation evidence also suggests that the subsequent Sintashta chiefly polities were extremely fast to develop. EBA populations of the Southern Urals have traditionally been viewed as mobile hunter-gatherers and pastoralists who did not live in large communities, yet showed signs of social inequality in burials (e.g., Poltavka kurgans). Our findings largely confirm this view.

In the MBA we see the emergence of larger social entities that were integrated at a supra-local scale. During this period, the majority of the Zingeyka survey area was integrated into a single highly centralized district. The high level of this district's demographic centralization was a result of a single relatively large fortified settlement being surrounded by minimal hinterland populations. Although the calculated B index value is fairly high, low demographic parameters make it clear that Sarym-Sakly was not a highly developed central place of a powerful regional polity. Rather, what we see is a small nucleated fortified settlements drawing in even smaller hinterland populations from the nearby territory. The available data suggests that similar centralized settlement systems existed elsewhere in the Southern Urals during the MBA. Such social entities, albeit being demographically small, were similar to a number of their larger counterparts in other parts of the world in that they emerged concurrently with elaborate elite burials and high amounts of labor investments into public works. Additionally, the development of craft technologies, escalation of warfare (whether real or perceived), public feasts, and lavish animal sacrifices, all played part in shaping the Sintashta supra-local communities.

Central places are generally thought to be differentiated from hinterland settlements in terms of human activities. One such activity in the case of the Sarym-Sakly settlement may have been metal production. Table 17 summarizes the spatial distribution of slag – a refuse byproduct of metal smelting (Figure 73). In particular, Table 17 lists the *slags/sherds* ratios in those collection units where slag fragments were recovered from shovel probes. Assuming the quantity of ceramics is proportional to the length/intensity of human occupation, the slags/sherds ratios tell us what areas were associated with more metal smelting per person. Figure 74 explores the evidence of metal smelting in the Zingeyka valley further by depicting the slags/sherds ratios listed in Table 17 as a scatter plot

It is interesting to note that three collection units with the highest slags/sherds ratios (#19, 20, 21) are associated with the Sarym-Sakly settlement, i.e., these collection units incorporate portions of the fortified area (Figure 22). Therefore, data presented in Table 17 and Figure 74 make it clear that there was more metal smelting taking place at and near Sarym-Sakly than at other Bronze Age local communities, located some distance away. Some copper alloy items recovered from Bronze Age sites in the Southern Urals served utilitarian functions (e.g., fish hooks, sickles, needles, awls), while others could be characterized as display or prestige goods (e.g., axes with little use-wear, jewelry) (Bushmakin 2000; Gening et al. 1992; Hanks 2013; Koryakova and Epimakov 2007). It is not unreasonable to hypothesize that small hinterland communities may have acquired some metal goods produced at Sarym-Sakly. If it was the case, Figure 74 illustrates that craft technologies associated with metal smelting were among the centripetal forces that drew hinterland populations toward the fortified centers.

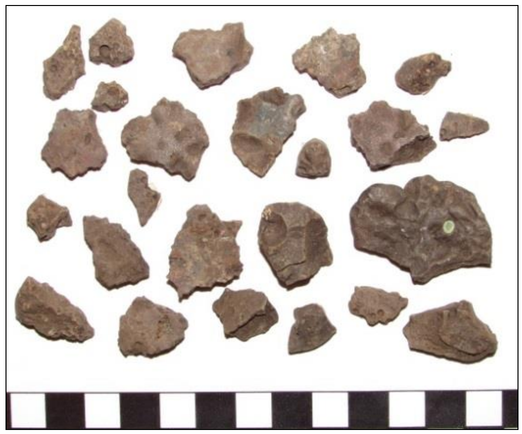


Figure 73: A sample of metal slag fragments recovered during the course of the Zingeyka survey.

Table 17: Slags/ceramics ratios for collection units in which slag fragments were recovered from shovel probes. Percentages of FBA sherds are left out, as elsewhere in this dissertation.

C.U. #	C.U. name	Area (ha) of C.U.	Number of Bronze Age sherds from Shovel Probes (SP's)	Total number of slag pieces recovered from SP's	Slags /sherds ratio	What proportion of shreds dated to the MBA?	What proportion of sherds dated to the LBA?
3	Katsbah 1 3	0.47	36	1	0.028	0%	30%
5	Katsbah 2 1	0.55	29	1	0.034	15%	78%
14	Zarya 1 2	0.68	26	4	0.154	15%	85%
15	Zarya 1 3	0.55	56	3	0.054	26%	74%
19	SarySakly1 South	0.95	27	7	0.259	100%	0%
20	SarySakly2	1.00	51	11	0.216	100%	0%
21	SarySakly3 North	0.94	28	12	0.429	56%	44%
26	Leb 6 3	0.61	74	1	0.014	2%	91%

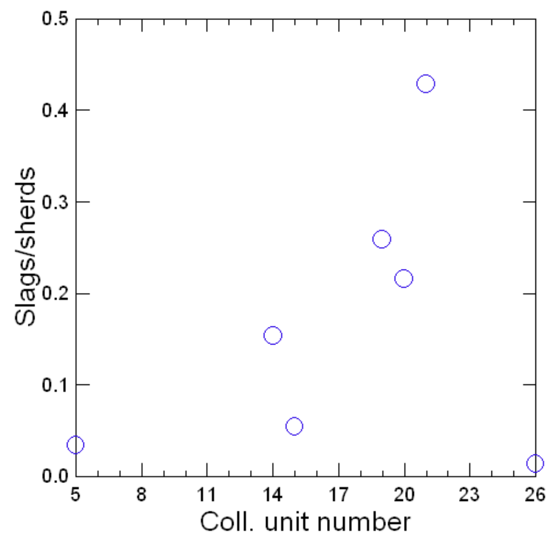


Figure 74: MBA slags/sherds ratios across 8 collection units from which slags have been recovered. Three highest values (coll. units #19, 20, 21) are associated with the Sarym-Sakly settlement.

One issue with interpreting the patterns identified in Table 17 and Figure 74 lies in the difficulty of dating individual slag pieces. Therefore, in collection units where sherds of both periods (MBA and LBA) have been recovered, it is difficult to tell during which period the smelting activities took place. Table 17 illustrates that out of the three collection units associated with the Sarym-Sakly settlement, two (#19 and #20) contained exclusively MBA materials, while the majority of the third collection unit's (#21) ceramics were also assigned into the MBA period. These observations suggest that the special concentration of metallurgical production at Sarym-Sakly occurred during the MBA period. Additionally, if we assume that at least some of the smelting activities in the remaining multi-layered occupation areas transpired during the LBA, the gap between Sarym-Sakly and other occupation areas in terms of metal production becomes even more pronounced.

What makes the Sintashta development interesting is that at least at the spatial scale currently available to us, it seems to be one of the demographically smallest societies that has been labeled as "chiefdom". From a comparative perspective, even some of the demographically smaller polities, such as the Cahuamarca of Peru, Sargat of the middle Trans-Urals, San Jose Mogote of Mesoamerica all contained populations greater than 1,000 people (Drennan et al. 2011; Matveeva 2002; Peterson and Drennan 2012; Wilson 1998). Many other chiefdoms numbered in the tens of thousands. For comparison, the estimates outlined in this chapter suggest that the supra-local entity centered around the Sarym-Sakly settlement contained between 460 and 690 people. Small demographic parameters of the MBA societies can, at least in part, be attributed to the generally low carrying capacity of the arid steppe environments. After all, historical population densities of the Eurasian steppes region have remained fairly low.

Judging from the Zingeyka survey sample, during the LBA, polities became more numerous, spatially smaller, and demographically larger. As populations grew four-fold, the degree of settlement nucleation decreased. In fact, distinct local communities became difficult to discern, as settlement areas separated by trivial distances formed large continuous clusters of occupation that stretched beyond 1 km. Occupation areas containing around 1,000 inhabitants, such as the LBA local community #6, would be labeled as towns, with no reservations, by most researchers. In fact, this number is often used as the 'urbanization' threshold (Blanton 2004; Kowalweski 1990). However, the unstructured use of space, evident in Figures 23 and 24 (chapter 2) as well as at other previously excavated LBA settlements, suggests that these occupation areas can be more readily interpreted as villages rather than towns. That way, rather than being concentrated around small nucleated fortified centers, supra-local interaction in the LBA became focused around large dispersed villages. B index values indicate that two LBA districts are substantially less centralized than the MBA polity. The fact that District 1, District 2, and what appear to be the outskirts of District 3 are separated from each other by maximum distances of 1.7 km suggests a rather high level of interaction between supra-local communities in the LBA.

One question that arises naturally is did the supra-local communities of the LBA possess the scale and the level of complexity characteristic of chiefdoms? If so, what was the political leadership grounded in? Just like in the preceding MBA period, the line of evidence that speaks of hereditary inequality, communal ceremonies, and labor investment into public works during the LBA are burial mounds. Graves of individuals buried under LBA mounds often included jewelry, weapons, and symbols of power (e.g., mace heads). Compared to the preceding MBA period, however, animal sacrifices became less lavish, with separate animal parts replacing the entire carcasses. Researchers characterize LBA grave artifact assemblages as being "poorer" than the MBA ones due to certain wealth items, such as chariots, no longer appearing in the LBA graves (Epimakhov 2010a:241; Koryakova and Epimakhov 2007). Burial evidence described above resonates well with the settlement patterns observed in the Zingeyka valley, i.e., LBA polities becoming spatially smaller and less demographically centralized. The disappearance of fortifications and reduced distances between districts can be interpreted as an indicator of the supra-local communities becoming less competitive and less hostile toward each other, compared to the preceding MBA period. In fact, since short distances would minimize transportation costs, we can speak of a possible economic nature of inter-district interaction in the LBA.

Based on shovel probe data, the level of metal production seems to decline in the LBA in the Zingeyka valley. For example, compared to the preceding MBA period, the slags/sherds ratios are much lower in either exclusively LBA collection units or in collection units in which most of the occupation can be attributed to the LBA (Table 17). Additionally, eighteen collection units that are not listed in Table 17 because no slags were recovered in shovel probes, were either exclusively or mostly associated with the LBA occupation (i.e., contained exclusively or the vast majority of LBA ceramics).

4.3.1 How representative is the sampled area?

It is difficult to say how similar or different the small district centered around Sarym-Sakly was to other social formations that existed in the Southern Urals during the MBA. However, we do know that there were other *supra-local* communities in the region, since outside of the Zingeyka survey zone a number of small unfortified MBA settlements have been identified in close proximity to the fortified sites (Batanina and Ivanova 1995; Gutkov 1999; Kupriyanova 2012; Malutina and Zdanovich 2012; Zdanovich and Batanina 2007; Zdanovich et al. 2003).

As mentioned in chapter 1, the Zingeyka survey area is a subset of a larger 4,400 km^2 region for which basic patterns of Bronze Age settlements and burials have been extracted from Soviet-era aerial photographs and pedestrian surveys (Zdanovich et al. 2003). Researchers have noted that within this region, which represents 1/7th of the Sintashta archaeological culture's territory, the Zingeyka River valley is characterized by an unusually high concentration of Bronze Age housing depressions (Johnson and Hanks 2012). Furthermore, it is possible that the proximity to the Bronze Age Vorovskaya Yama copper mine may have been a factor that drew these populations in (Figure 75). Firstly, Figure 75 shows that there are other areas within the Kizil'skiy district that are fairly packed with Bronze Age housing depressions. Secondly, since housing depression concentrations identified by Zdanovich et al. (2003) in other part of the Kizil'skiy District may contain MBA, LBA, and/or FBA materials, it is difficult to say which sub-period(s) the Zingeyka valley was more/less densely occupied in.

To summarize, in order to determine how representative the results of the Zingeyka survey are of the rest of the Southern Urals, we would need to survey other parts of the Sintashta territory using a methodology similar to the one presented in the current study. Existing data coming from outside of the

Zingeyka survey zone is subject to the same biases that this study was designed to overcome and therefore represent poor material for comparison.

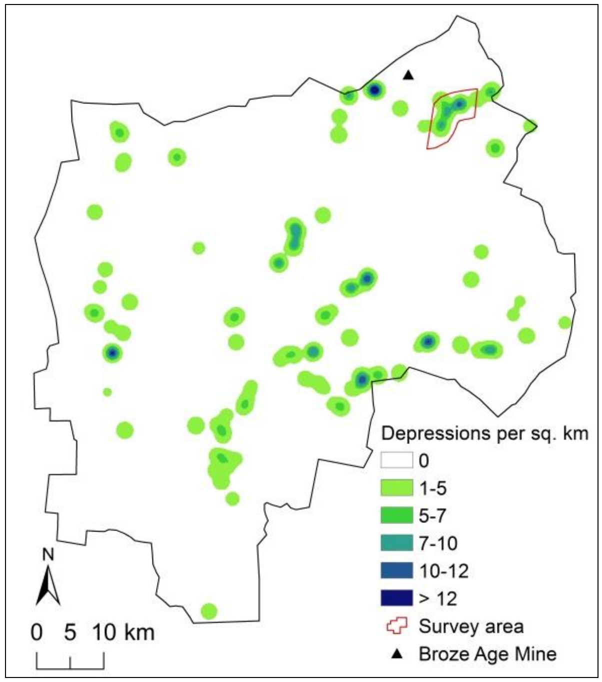


Figure 75: Kernel density (search radius distance of 2100 m) of Bronze Age housing depressions in the Kizil'skiy District. The Zingeyka survey area is outlined in red. Vorovskaya Yama open pit copper mine is depicted as a triangle. Settlement data is derived largely from the results of aerial photography (Zdanovich et al. 2003).

4.3.2 Broader regional significance

There is a notion that in the Eurasian steppes processes associated with the emergence of early regional polities worked differently than in other world regions. For example, Honeychurch and Amartuvshin (2007:56-58) in their analysis of early Mongolian polities came to a conclusion that the relationship between large walled towns and their hinterlands in the context of East Asian steppe environments was an "entirely novel form of central place". More specifically, the authors state that Iron Age period walled towns of the eastern steppes were impressive points of tether, rather than permanent residences. True political centers were not points in the landscape, but rather "polygons of pathways" along which the elite groups circulated. The authors attribute such a different pattern of center-hinterland integration to the "centrifugal nature" of pastoralist populations. These conclusions resonate well with Rogers's (2011:211) observation that pastoralist polities, in contrast to polities based on agriculture, built places that could qualify as urban centers reluctantly and abandoned them rapidly.

It is worth noting that centrifugal forces discussed by Honeychurch and Amartuvshin (2007) are not unique to pastoralist populations. For example, a number of researchers have highlighted ecological and economic factors that can cause farmers to locate their residences far apart, thereby pulling households away from each other (Brookfield 1972; Drennan 1988; Netting 1968; Stone 1993). For societies that specialize in herding, the economic and ecological forces that pull populations spatially apart tend to be even more pronounced, since it takes more land per person to sustain an extensive herding-based subsistence. Therefore, the fact that strong demographic centralization in a permanent/semi-permanent settlement context prevailed for centuries in the Southern Ural (Asian) steppes speaks of the strength of factors that pulled previously mobile and dispersed populations together. In other words, the considerations associated with proximity to a central place, discussed in the previous section of this chapter, seem to have been powerful enough to overcome the historically and ethnographically recorded tendency of the Eurasian steppe populations to be mobile and dispersed.

4.4 CONCLUSION

Regional-scale settlement study in the Zingeyka valley contributed to the documentation of social change through some 2,000 years in an area of 40 km^2. EBA regional population, while difficult to speak of confidently, was clearly non-numerous and mobile. Settlement evidence points to societies beginning to integrate into supra-local communities in the MBA. A small, nucleated, fortified, highly spatially organized village of Sarym-Sakly became central to even smaller hinterland populations. The existing evidence points to similar entities existing in a larger 30, 000 km^2 region of the Southern Urals. Based on the results of the Zingeyka survey, the socio-political integration during the MBA was on a scale of districts up to 8 km across with populations numbering in the hundreds. Conflict between such districts is evident in fortifications of substantial proportions and sparsely settled zones that separate the districts. Greater numbers of people recorded with the survey zone in the MBA, compared to the preceding EBA period, can be explained by a combination of population growth and concentration of previously mobile and highly dispersed populations in selected locales. Bronze metallurgy was highly developed and concentrated inside the fortified villages, probably contributing to regional populations being drawn to the emerging centers.

Population grew substantially during the LBA period. Regional populations were still organized into small separate polities, just like in the MBA period. However, in terms of spatial extent, the LBA supra-local communities were smaller than MBA ones (only a few km across) and contained much larger populations (some districts contained over 1000 people). These spatially smaller, more numerous, more populous units began infilling the landscape, including areas previously void of occupation. Evidence of fortifications waned and distances between the LBA polities became much shorter. These factors speak of greater levels of seemingly peaceful interaction coming to replace the apparently hostile relations between districts observed in the MBA. More uniform spacing between the LBA districts and their greater ubiquity points to the populations' tendency to concentrate in particular places becoming weaker. At the scale of the Zingeyka survey, permanent monumental commemoration of specific individuals was not the central focus of regional community organization in either the MBA or the LBA periods.

Overall, the EBA-LBA settlement patterns seem to change sharply, from non-numerous dispersed and mobile in the EBA, to highly nucleated and highly centralized in the MBA, to fairly numerous, dispersed and only moderately centralized in the LBA. Regional population seems to grow fast initially and continue to grow through the rest of the sequence. The fact that this growth coincides with the emergence of sedentary (or semi-sedentary) living in the Southern Urals is not surprising and is consistent with what archaeologists have documented in other parts of the world.

5.0 POPULATION MOBILITY

Bronze Age societies of the Eurasian steppe, including those that inhabited the Southern Urals in the MBA and LBA periods are often presented as mobile pastoralists in the archaeological literature (Frachetti 2009, 2012; Ventresca Miller 2013). Mobile pastoralists, in this context, are defined as "societies that rely on patterned (seasonal) migrations to support the health, socioeconomic prosperity, and political success of their population" (Frachetti 2012; Salzman 2002). Archaeological evidence points to the ubiquity of settlements in the Eurasian steppes that were comprised of semi-subterranean, fairly large (~200 m^2) housing structures, the excavations of which commonly yield evidence of post-holes, hearths, wells, and storage pits. Such structures, characteristic of the MBA and LBA archaeological cultures of Sintashta, Petrovka, Srubnaya, Alakul, and Fedorovo are encountered all over the Eurasian steppes, from the north of the Black Sea to eastern Kazakhstan. However, the interpretations of what these structures and settlements meant in terms of human mobility in the Eurasian steppes during the Bronze Age vary. Anthony and Brown (2007:393) refer to the LBA of the Eurasian steppes (roughly the 2nd millennium BC) as a period of "settling down". Other researchers (Frachetti 2008:16-17; Spengler et al. 2014), when discussing the LBA of the Eurasian steppes, repeatedly emphasize high levels of mobility and patterned movement of entire communities.

Although studies of social change in the Southern Urals in the MBA and LBA often incorporate discussions of mobile pastoralism (Johnson 2014; Ventresca Miller 2013), very few researchers have directly addressed the issue of population mobility in the above region with archaeological evidence. Establishing the level of mobility of populations that occupied the Zingeyka valley during the MBA has important implications for the interpretations of settlement patterns discussed in chapter 4. For example, Frachetti (2009:20-22) argues that since mobility precludes one from "circumscribing the geographic boundaries of participant communities", traditional models of interaction and social complexity, developed in the context of settled societies, cannot be applied to the Bronze Age societies of the Eurasian steppes. In other words, in a mobile pastoralist context, relatively low demographic parameters and high mobility of co-residential herder groups would preclude the formation of settlement patterns, commonly associated with early complex societies. On a regional scale, such settlement patterns traditionally involve some form of hierarchy in settlement size and function. Since the viewpoints on the degree of human mobility in the MBA and LBA in the Southern Urals vary, it is worthwhile to evaluate various lines of evidence that came out of the Zingeyka survey, as well as from the broader Southern Urals region.

The following discussion tests data obtained from the Zingeyka survey against the following expectations. In a mobile pastoralist setting, we should expect: 1) occurrence of specific species compositions in community herds, with preference given to small stock (sheep and goat) and horses; 2) seasonal campsite use; 3) little structural investment in habitation locales; 4) small and sparse occupation areas (Honeychurch and Amartuvshin 2006; Williams 2014:69). Another line of evidence that is used to explore population mobility in the following discussion is craft production. More specifically, the range of craft activities conducted in a mobile setting is expected to be rather limited. For example, evidence of metal production, which requires versatile and heavy equipment, such as furnaces, anvils, hammers, ore grinders etc., is taken (in tandem with other lines of evidence) to suggest sedentism.

5.1 MOBILITY IN THE MIDDLE BRONZE AGE

5.1.1 MBA fortified settlements

In terms of the MBA fortified settlements, Stobbe et al. (2016) call them "sedentary". Anthony (2007) is of the opinion that it is unlikely that the MBA fortified settlements' [Petrovka] economy depended on annual long-distance migrations. Koryakova and Epimakhov (2007:88-89) speak of "limited mobility" characteristic of the MBA archaeological cultures of the Southern Urals, although without specifying how limited. Frachetti (2009:32) discusses the MBA and LBA socio-political organization in the Southern Urals "from the perspective of mobile pastoralists". Kosintsev et al. (2010:67) are also of the opinion that populations who lived in the MBA fortified settlements were seasonally mobile. The following section attempts to contribute to the above discussion by summarizing the mobility/sedentism indicators obtained from three collection units associated with the fortified settlement of Sarym-Sakly (Figure 76).

The micro-topographic and geophysical prospection of the Sarym-Sakly settlement confirmed the presence of 27 structures, a defensive ditch, and a circular fortified wall (Figure 34 in chapter 2). Chechushkov (forthcoming), based on the volumetric analysis of the site's micro-topography, estimates that the collapsed wall was 2.8 m high and 3 m wide. These parameters are consistent with those observed at similar MBA [Sintashta-Petrovka] settlements in the Southern Urals. Such substantial labor investment into the construction of fortified settlements strongly suggests sedentism.

At this point, it is important to outline the results of limited excavations at Sarym-Sakly. A total of 3 test pits were excavated within and near the settlement over the course of the last 12 years (Figure 76). Test pit 2, which measured 1.5 m x 1.5 meters and was placed near the western edge of the settlement (Tairov et al. 1996), appears to be especially interesting in the context of the present discussion. Besides a ~40 cm-thick cultural layer that contained ceramics, slag, bones, and charcoal, archaeologists have identified a post hole and the outlines of what appeared to be a well (Figure 77). Test pits 1 (Tairov et al. 1996) and 3 (excavated as art of the Zingeyka project), measuring 1.5 x 1.5 m and 2 x 2 m, respectively, produced cultural layers that ranged 20 – 40 cm in thickness and contained burnt clay, animal bones, ceramics, lithics, and slag fragments. In summary, limited excavations at Sarym-Sakly produced archaeological features, layers, and materials that would traditionally be associated with sedentism.

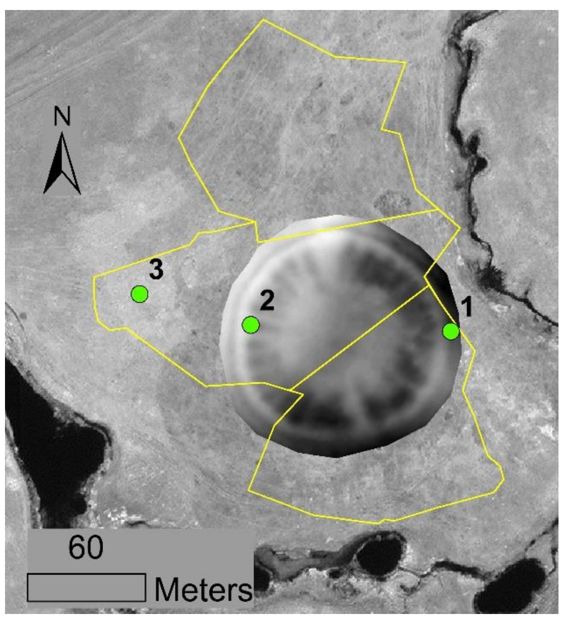


Figure 76: Locations of three test pits excavated in and around the fortified settlement of Sarym-Sakly. The figure depicts the settlement's microtopographic plan. Collection units #19, #20, #21, which together comprise local community #6 (SS), are outlined in yellow and are numbered in sequence from south to north. Satellite image courtesy of the DigitalGlobe Foundation.

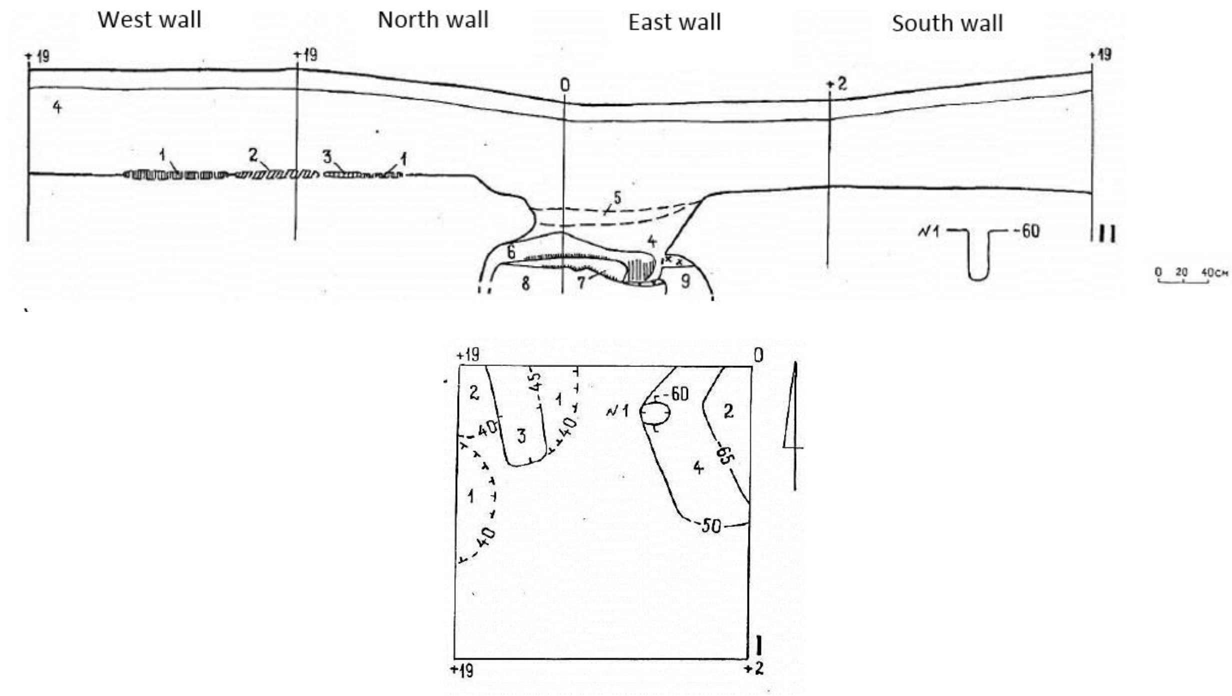


Figure 77: Test pit #2. *Above*: profile drawings of test pit # 2, showing the outlines of a well, the excavations of which were not finished due to the incoming water. *Below*: horizontal plan of the same excavation at the depth of -40 – 60. The post hole is marked as feature N1 (Tairov et al. 1996:83).

Using herd composition reconstructions as proxies for population mobility is common practice among archaeologists of northern and central Eurasia. This approach is based on the ethnographic observations of Eurasian pastoralist practices, as well as on biological and behavioral characteristics of domestic animals. In particular, in comparison to other domestic animal species, cattle have traditionally comprised the smallest percentage of mobile pastoralists' herds. For example, across 28 administrative districts of the 19th – early 20th century Kazakhstan, the average percent of cattle in herds was 12% (8% - 29% range), with the rest of the herds comprised of horses, sheep/goats, and occasionally camels. This percentage of cattle for Kazakhs, who represent a classic ethnographic example of Eurasian mobile pastoralists, was even lower prior to the 19th century sedentarization processes initiated by the Czarist Russian government (Khazanov 2000:125; Masanov 2011). In the herds of the early 20th century Kyrgyz mobile pastoralists cattle comprised 7-10% (Khazanov 2000:126). While the reasons for these low percentages of cattle are manifold, most of them boil down to the fact that this species is least adapted to a mobile lifestyle. Compared to horses, sheep, and goats, cattle are the slowest. Cattle are least adapted to obtain food for themselves during the winter months (Masanov 2011:280-281). In comparison to horses or sheep/goat, cattle need to access drinking water most frequently. As a consequence of their slow speed and daily water intake requirements, the distance that cattle can be taken from a permanent water source is the most limited compared to the other species (Chogdon 1980). Cattle are also most picky in terms of the number of species of grasses they eat and in terms of parts of plants they eat (Fiel'strup 1927; Ivanov 1973; Khazanov 2000:124; Koveshnikov 1967). Cattle also have the most weakly pronounced "herd reflex", i.e., animals stay in one herd less readily, making them more difficult to manage during long distance moves (Masanov 2011:287). All of these factors cause mobile pastoralists of the Eurasian steppes to generally keep fairly small quantities of cattle.

Researchers realize that rather than using strict categories such as 'mobile' or 'sedentary', it is more productive to think of human populations along a mobility-sedentism continuum (Wendrich and Barnard 2008). Nonetheless, ethnographic data pertaining to herd composition can provide clues as to the degree of population mobility. For example, Khazanov (2000:126) cites examples of different settled groups in the Eurasians steppes as having 34-47% of their herds being comprised of cattle (with the rest being horses, sheep/goat, and rarely camels). Another useful observation in this regard comes directly out of the Zingeyka valley. Historical data collected in 1914 points to the Katbakhskoye village's ~4,700-head livestock population consisting of 37% cattle, with the rest of the village herd consisting of horses, sheep/goats, and very few pigs (Epaneshnikov 2011:44). In 1914, the occupants of Katsbakhskoye could be described as pre-industrial sedentary agro-pastoralists. Another useful piece of information comes from historical records of Turkic-speaking Bashkir populations of the Southern Urals. These people have traditionally relied quite heavily on herding for subsistence. Bashkirs are usually referred to as 'semi-nomadic' in anthropological literature, meaning they migrated with their herds in the summer and lived in permanent settlements for the rest of the year (Yanguzin 2002:3-5). Mid-19th century ethnographic data from 13 districts of Russia populated by Bashkirs points to their herds being comprised of 21% cattle, on average (Cheremshanskij 1859; Yanguzin 2002:63). Bashkirs occupied the steppe and forest steppe zones, including the territories of present-day Chelyabinsk Oblast', in which the Zingeyka valley is located. In summary, historical and ethnographic data outlined above seems to converge on 30% of cattle being a rough "cut-off" mark that can help distinguish sedentary herders from mobile pastoralists.

From the three collection units associated with local community #6, collection units #19 and #20 (Figure 76) produced exclusively MBA material. Therefore, animal bones extracted out of shovel probes excavated in those units were assumed to date to the MBA period. The fact that these bones appeared prehistoric and many of them were extracted together with diagnostic MBA ceramics further justifies thier chronological attribution. Table 18 presents a combined summary of faunal data from the two collection units. Such data should be fairly representative of an entire local community's consumption patterns since shovel probes were spread evenly in space and targeted inter-house areas. This approach assumes that community members herded the animals that they consumed and that each local community managed its own herd. The NISP (number of identified specimens) was used to estimate the relative frequency of taxa for a couple of reasons. Firstly, this indicator is appropriate when comparing species that are fairly similar in size and have roughly the same number of skeletal elements (Reitz and Wing 2008). This criterion applies to our case, since we are comparing horses, cattle and sheep/goat. Secondly, the NISP quantification method was chosen to allow comparisons with previously published assemblages from the Eurasian steppes using a common basis (e.g., Frachetti and Benecke 2009; Outram et al. 2012).

Table 18 suggests a very low likelihood that the MBA populations that occupied the MBA fortified settlement of Sarym Sakly and its immediate vicinities were seasonally mobile. Such high proportion of cattle in the herd (64% ± 6% at 80% confidence level) is uncharacteristic of historically known mobile pastoralist groups of Eurasia. Relatively high proportion of cattle bones from Sarym-Sakly is broadly consistent with faunal assemblages from other MBA settlements in the Southern Urals and northern Kazakhstan. In particular, faunal assemblages from the settlements of Sintashta, Arkaim, Kamennyi Ambar, Bersuat, Kuysak, Petrovka-2, and Novonikolskoye-1 all contained 45% or more of cattle bones (Ivanova 1996; Koryakova and Epimakhov 2007:88; Malutina 1992). One prehistoric parallel in terms of faunal assemblages comes from the Chalcolithic (5100 BC – 3000 BC) Cucuteni-Tripol'ye development of the Eurasian forest-steppe zone. Faunal assemblages from settlement sites of this archaeological culture, considered to be sedentary, are broadly comparable to those mentioned above in terms of cattle percentages (Ellis 1984; Harper 2011).

Table 18: Faunal remains of domestic animals from collection units #19 and #20. The table includes only specimens that could be identified to a specie/sub-family. Species identification of all of the Zingeyka survey faunal material was performed by L. L. Gaiduchenko.

Taxa	**NISP**	**Proportion of herd**
Bos taurus (cattle)	67	64%
Ovis aries/Capra hircus (sheep/goat)	18	17%
Equus caballus (horse)	19	18%
Total	104	100%

Mobile pastoralist groups, which by definition do not occupy the same locale all year around, move with their herds seasonally. In this regard, it is worth discussing lines of evidence that were used to establish human presence in the study area during certain seasons of the year. One such line of evidence comes from the dental cementum increment analysis of animal teeth. This method, widely used by regional zooarchaeologists (Bachura 2009, 2014; Schmaus 2015), is based on the following considerations. Cementum is a tissue that covers the roots of teeth and attaches the outer layers of teeth (periodontium) to the alveolar sockets. It has been observed that among ungulates living in continental climates, the cementum is laid down rapidly in warmer months and more slowly in the winter (Klevezal’ 1988). When cross-sections of teeth are viewed through a transmitted light microscope, the opaque, thinner, dark bands represent winter deposition, and the translucent, thicker, light bands represent late spring, summer, and early fall depositions. The thicker bands are thick enough that it is possible to determine how far through the warm season the animal died (Schmaus 2015:84).

Olga Bachura of the Institute of Animal and Plant Ecology, Russian Academy of Sciences, performed the analysis of a series of animal teeth obtained in the course of the Zingeyka survey according to the methodology described above. Shovel probe #1049n3 (collection unit #20) produced an assemblage of 87 animal bones that were encountered at the depth of -30-40 cm from the modern surface. Two lower incisors (i2 and i3), which belonged to an old adult (25-28 years) horse, were analyzed. It has been established that the season of death was winter (Figure 78).

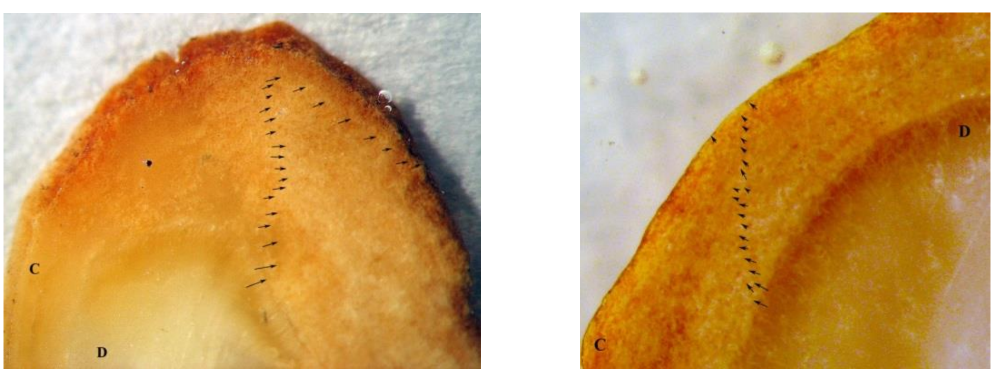


Figure 78: Images of cross-sections of horse i2 and i3 teeth from collection unit #20. C – cementum; D – dentin; black arrows – winter layers. Season of death – winter.

At this point, it is useful to return to the presence of a number of kurgan complexes that have been identified in the Zingeyka valley and have been preliminarily dated to the Bronze Age period by Russian archaeologists (Figure 72 in chapter 4). Koryakova and Epimakhov (2007:75) identify a spatial trend, according to which MBA settlements were usually accompanied by a contemporaneous kurgan cemetery (examples include the settlements of Stepnoye, Kamennyi Ambar, Chernorech'ye, Sintashta). It is important to note that the excavations of 2-4 m deep burial pits, associated with kurgans, required the removal of substantial amounts of earth (Vinogradov 2003). The climate of the Southern Urals is fairly severe and the top layers of soil freeze in the winter months up to the depth of 2 meters (Ministry of Construction of Russian Federation 1985). If we assume that: 1) at least some of the kurgans within the 12 kurgan burial complexes identified in Figure 72 of chapter 4 belonged to the MBA period; and 2) that the burials were excavated during the warmer part of the year (April – October), we can establish human presence in the Zingeyka valley in both the cold and the warm seasons of the year.

Inferences about the seasonality of MBA occupation of the Zingeyka valley outlined above seem to broadly coincide with wider regional data. Table 19 provides a summary of dental cementum seasonality indicators obtained from other MBA fortified settlement in the Southern Urals. Bachura (2014) observed that at the MBA settlements animals were either not slaughtered at all or slaughtered rarely in the summer. This trend was interpreted to indicate a mobility pattern, according to which if not all, then the vast majority of people, who occupied the fortified settlements migrated with their herds during the summers (Bachura 2014; Kosintsev et al. 2010). While determining the proportion of mobile people who otherwise lived permanently in the fortified settlements is a difficult task, what is worth highlighting for the purposes of this discussion are the precedents of animal slaughter during all four seasons at a number of settlements. This fact suggests year-round occupation at those settlements.

Table 19: Summary of existing MBA data pertaining to the seasonality of animal slaughter in the Southern Urals.

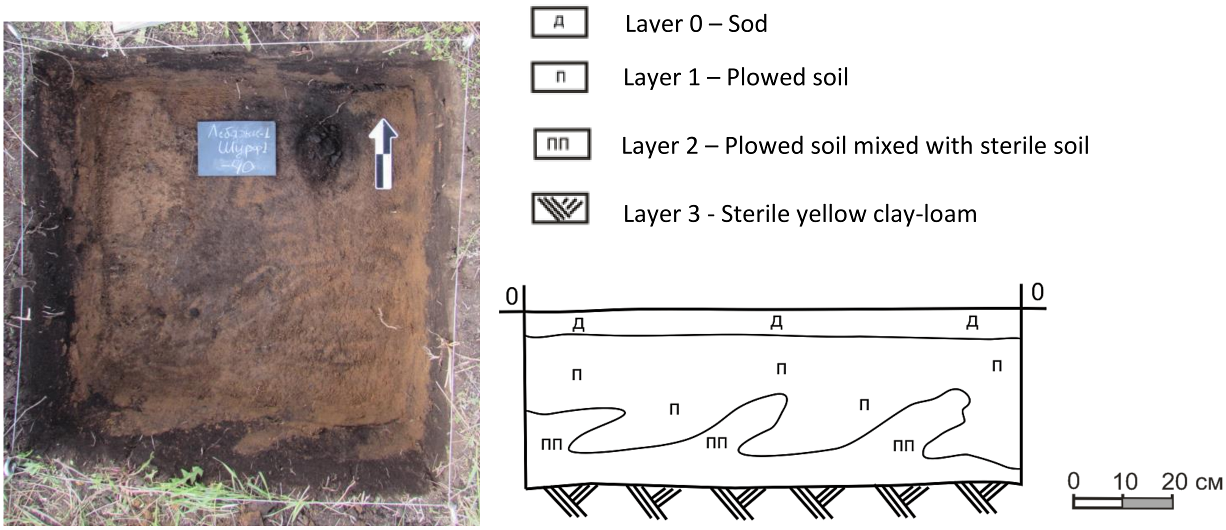
MBA settlement	**Season of death**	**Source**
Kamennyi Ambar	Spring and late fall/winter	Bachura 2013
Ust'ye	Winter, fall, spring, late spring/early summer	Bachura 2014; Gaiduchenko et al. 2011
Arkaim	All four seasons	Bachura et al. 2011
Alandskoye	All four seasons	Gaiduchenko et al. 2011
Stepnoye	Spring and winter/fall	Gaiduchenko et al. 2011

5.1.2 MBA unfortified settlements

As already mentioned in chapter 1, very little is known about the MBA populations that lived outside of the fortified settlements, including the degree of their mobility. Addressing this issue for the Zingeyka valley has important implications for the interpretation of the spatial pattern observed in Figure 64 (chapter 4). For example, one could suppose a scenario where a proportion of people who permanently lived at Sarym-Sakly came back to the same locations situated beyond the fortified walls over and over again to herd livestock. Such locations would over time produce materials dense enough to be interpreted as remnants of human residences. If this scenario was true, Figure 64 (chapter 4) would not show a spatial relationship between human residences but a relationship between residences and temporary herding camps in which people did not permanently reside. Although the area-density methodology described in chapter 2 would avoid counting these people twice, i.e., as living simultaneously in both the fortified and the unfortified settlements, the interpretation of what the settlement pattern depicted in Figure 64 means in terms of social organization would be undermined.

Thus far, our conclusions about how many people lived where during the MBA were largely based on ceramic densities. To investigate the nature of the smaller unfortified MBA sites further, it is useful to turn to the evidence collected during the survey that thus far has been discussed only briefly. This additional evidence primarily originates from 30-some test pits, most of which were 1 x 1 m in size (although a few reached the size of 2 x 2 m). They were excavated to get a better idea of the sequence and intensity of occupation episodes at each occupation area. While a number of structural depressions were identified previously, as well throughout the course of the survey, excavating house structures was beyond the scope of this study. However, an attempt was made to investigate spaces located beyond the visible housing structures by placing test pits near shovel probes that yielded high densities of ceramics. Shovel probes that produced materials dating to different time periods were preferred for this task, since such locations would inform us of site stratigraphy. We tried to distribute test pits evenly across space with the goal of excavating at least one test pit per collection unit. Before we turn to this evidence, it is important to note that: 1) hinterland MBA populations were small, and thereby left little evidence behind; 2) almost all of hinterland occupation areas appear to have been multi-phased, i.e., they were occupied during both the MBA and the subsequent LBA and/or FBA periods; and 3) the pace of soil accumulation in the steppe environments is extremely slow. Therefore, excavations ran into difficulties in identifying distinct MBA occupation layers, with diachronic materials often appearing within the same sediment layers. Nonetheless, some evidence pertaining to the nature of MBA hinterland occupations has been recovered. The following discussion summarizes relevant data obtained from each of the 6 MBA unfortified occupation areas identified in the course of the survey (refer to Figure 62 in chapter 4, as needed, to determine the relative location of each local community).

Local community 2 (L1). Local community #2, with an estimated MBA population of 31-46, was associated with a number of housing depressions that were identified through aerial photography (Zdanovich et al. 2003). This occupation area was multi-phased, i.e., it produced EBA, MBA, and LBA materials. Therefore, stratigraphic excavations were necessary to speak more confidently about the nature of the MBA period occupation. Out of four 1 x 1 m test pits excavated by the survey team, two produced MBA material. One of them was test pit #691. Due to the surface of the site being plowed repeatedly, no clear stratigraphy could be observed in the profiles of this test pit (Figure 79). However, the ~30 cm-thick cultural layer did contain MBA and LBA ceramics. What is significant in the context of present discussion is that upon reaching the sterile soil, we could identify the remnants of a post-hole, 15-20 cm in diameter. Data from test pit #691, therefore, speaks of a certain level of structural investment in this locale beyond the visible structural depressions and highlights the possibility of this investment dating to the MBA period. The other test pit that contained mixed material (#699) only contained one MBA ceramic and is described in detail in the subsequent section of this chapter that deals with population mobility in the LBA.



Layer	MBA ceramics	LBA ceramics	Undetermined ceramics	Bones	Other
1+2	7	176	7	65	Lithic (1)

Figure 79: Test pit #691. *Upper left*: photo of the excavation unit at the sterile level, showing the outlines of a 15-20 cm-wide post-hole. *Upper right*: drawing of the southern profile, partially seen in the photo. *Below:* summary of recovered material.

Local community 3 (L4). Another line of evidence, related to the issue of human mobility of MBA hinterland communities comes from local community #3. It was estimated that 9 to 14 people had lived at this locale, on average, throughout the MBA period. A shovel probe, excavated in collection unit #11 (Leb 4 2) produced a fragment of a stone casting mold that was used to produce bronze projectile points. Based on the recovered fragment, D. Zdanovich was able to reconstruct the parameters and morphology of the casted item (Figure 80). Projectile points of such parameters have parallels in a number of MBA sites in the Southern Urals and northern Kazakhstan and are not characteristic of other time periods (Avanesova 1991; Rutto 1995; Shevnina and Logvin 2015; Tkachev 2007b). This find suggests that people at this location engaged in metal craft activities. Such evidence would normally not be associated with temporary herding camps, but rather with a more permanent occupation. Although housing depressions were present in collection unit #11, we were not able to confidently assign any of them to the MBA period, since the occupation area was multi-phased.

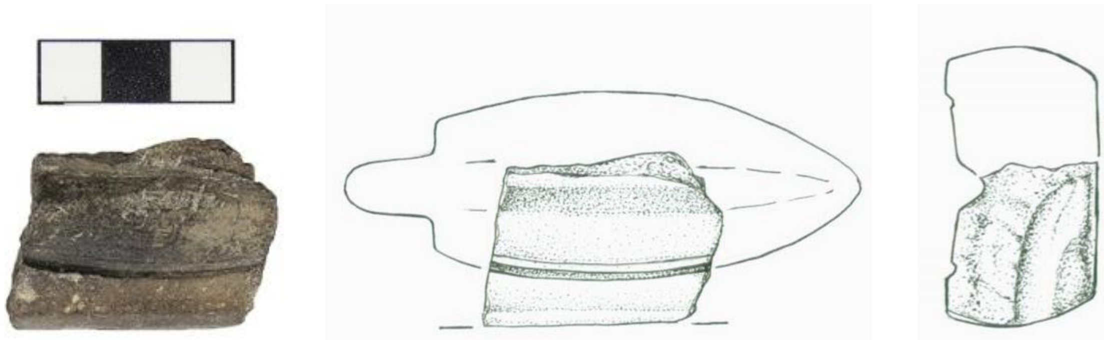
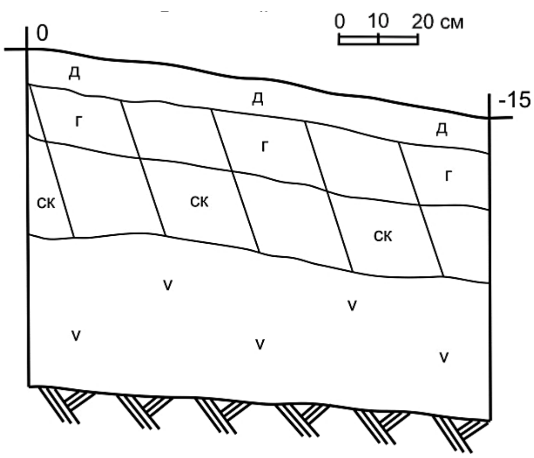


Figure 80: MBA casting mold fragment, recovered from a shovel probe excavated in collection unit #11 (Leb 4 2). *Left*: photo of the fragment. *Center*: projectile point type that the reconstructed casting mold would produce. *Right*: profile drawing of the reconstructed casting mold.

Four 1 x 1 m test pits that have been excavated within the single collection unit associated with this local community did not produce any MBA ceramics. The lack of MBA material may have been related to the fact that the test pits were spaced fairly closely apart (maximum distance of 25 m) and targeted only one portion of the occupation area (see Figure 101 later in this chapter).

Local community 4 (Z1+L6). Another occupation area that produced additional evidence of MBA occupation (beyond shovel probe data) was local community #4, located ~1.3 km away from the fortified settlement of Sarym-Sakly. A 2 x 1 m test pit was excavated at a location where one of the shovel probes produced a high density of material. This excavation unit (#712), in addition to animal bones, charcoal, and pieces of burned clay, contained 189 MBA ceramics. MBA ceramics, along with other eco-/artifacts were observed in different layers of a ~60 cm soil sequence (Figure 81). Ceramics or artifacts diagnostic of other time periods have not been identified in this excavation unit.

One remarkable find recovered from the bottom of layer #2 of test pit #712 is a multi-functional ground stone tool made of basalt (Figure 82). This tool had multiple work surfaces and throughout its use life combined the functions of a passive abrasive; active rubbing/grinding stone (*terochnik*, Rus.); and a hammer. The smaller (top) trapezoid-shaped surface was used as a passive abrasive, i.e., hard objects (presumably metal) were ground/polished by pressing up against it. The larger (bottom) surface was apparently used as an active tool for grinding down hard (presumably stone or metal) surfaces. Finally, multiple traces of chipping indicate that this tool was used as a hammer-stone. The primary function of this tool was attributed to metallurgy. The analysis of this tool was performed by D. Zdanovich, S. Zdanovich, and A. Shorin. It consisted of macro use-wear analysis using a magnifying glass and comparisons with the existing database of similar objects, which have been encountered in cultural layers of other Bronze Age settlements (Kungurova 2013; Levit 2013; Zaikov and Zdanovich 2000). The recovery of this object is significant in the context of current discussion because it points to a range of activities, other than herding (or simply visiting) that took place at this location during the MBA.



Layer 0 - Sod

Layer 1 - Black humified topsoil

Layer 2 - Grayish-brown humified soil

Layer 3 - Dark-brown loam interpreted as buried soil

Layer 4 - Sterile yellow clay-loam

Layer	MBA ceramics	LBA ceramics	Undetermined ceramics
1	8	0	0
2	173	0	2
3	6	0	0

Figure 81: Test pit #712. Drawing of the western profile and a summary of the recovered ceramic types.

Figure 82: Multifunctional ground stone tool from test pit #712. *Left*: drawing of the top surface. *Center*: photo of the top surface. *Right*: photo of the bottom surface.

It is also worthwhile to discuss the osteological material recovered from test pit #712. Forty seven animal bones, some of which were burnt, have been recovered. While not all bones were identified to a species or genus, it is clear that different species categories (large and small mammals) were consumed at the site (Table 20). It is also worth highlighting that those bones identified to a species belonged to adult cattle (*Bos taurus*). Moreover, the identified bone elements included the 1st phalanx and teeth. Since the forementioned elements are associated with low meat yields, they were less likely to have been transported away from the kill site, i.e., it is likely that the cattle was/were butchered at this location. In summary, osteological evidence points to the fact that at this location people butchered and consumed different animal species, some of which were fairly large, and, therefore, were unlikely to have been eaten expediently, i.e., in one sitting.

Table 20: Summary of faunal material recovered from test pit #712.

Taxa	**NISP**
Bos taurus	10
Large-sized mammal (size of cattle, horse, camel, etc.)	6
Medium-sized mammal (size of sheep, goat, pig, etc.)	5
Indet. mammal	26
Total	47

Collection units that comprised local community #4, in which an estimated 75-112 people had lived in the MBA, incorporated a number of housing depressions. A 1 x 1 m test pit (#247) was excavated next to one of these housing depressions, which measured roughly 22 x 12 m (Figure 83). While regional archaeologists normally associate such depressions with the remnants of semi-subterranean housing structures, the slightly elevated ‘brims’ surrounding the depressions are associated with collapsed walls and roofs (Zdanovich et al. 2003:32; see Figures 92 and 94 for other examples). MBA and LBA period ceramics were present throughout a ~60 cm thick soil sequence, along with charcoal, copper ore fragments, lithics, and animal bones (Figure 84). This evidence allowed us to associate part of this structure’s occupation sequence with the MBA period.

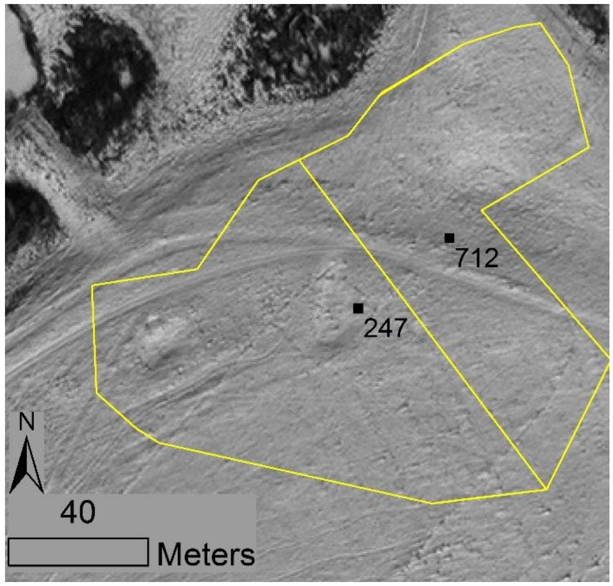
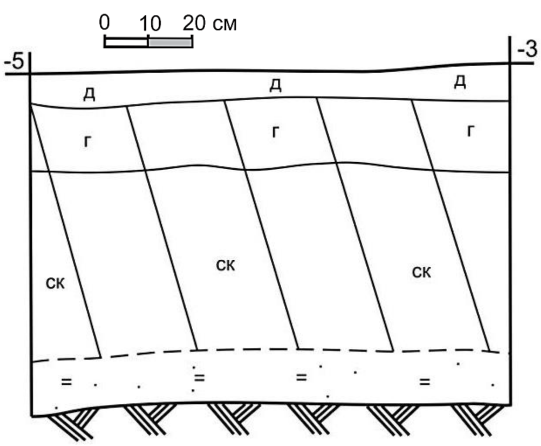
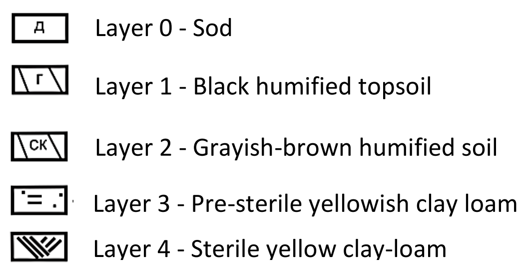


Figure 83: Location of test pits 712 and 247 in relation to the collection units associated with local community #4. Two structural depressions are visible in the left part of the satellite image that was taken in the winter. Image courtesy of the DigitalGlobe Foundation.





Layer	MBA ceramics	LBA ceramics	Undetermined ceramics
0+1	6	3	1
2	14	11	19
3	0	0	0

Figure 84: Test pit #247. Drawing of the eastern profile and a summary of the recovered ceramic types.

Local communities 1, 5, and 7. While shovel probes excavated in local communities 1, 5, and 7 produced MBA material, additional test pits associated with these occupation areas did not contain any MBA ceramics. Therefore, it is difficult to speak confidently to what degree the populations that inhabited these small hinterland MBA communities were mobile or sedentary. One obvious line of evidence related to the issue of mobility comes from the presence of structural depressions, but since they have not been excavated, we do not know what period they date to. Table 21 summarizes those lines of evidence coming from local communities 1, 5, and 7 that could be relevant to the discussion of human mobility/sedentism. It is worth noting that at least one local community (#7) satisfies a number of parameters of a mobile occupation: it is small, there is no evidence of structural investment, and there is no evidence of craft activities that would require a certain level of sedentism.

Table 21: Summary of data associated with local communities 1, 5, and 7, which relate to mobility / sedentism.

MBA local community # (name)	**Estimated MBA population**	**Structural depressions identified?**	**Is the occupation area multi-phased?**	**Did shovel probes produce MBA ceramics?**	**Did test pits produce MBA ceramics?**	**How many test pits were excavated**
1 (K2)	12-18	Yes	Yes	Yes	No	5 (1x1 m)
5 (Z11)	9-14	Yes	Yes	Yes	No	2 (2x2 m and 1x1 m)
7 (614)	11-17	No	Yes	Yes	No	1 (1x1 m)

5.1.3 Conclusion

Based on the data from the Zingeyka survey, as well as from the larger Southern Urals region, we can establish that at least a portion of the MBA population of the Zingeyka valley was sedentary and occupied this area year-round. We can also conclude that at least some of the occupation areas located some distance away from the fortified settlement of Sarym-Sakly in fact represent remnants of human residences (vs. being places that were frequented but not inhabited). In addition, there are a number of smaller hinterland occupation areas for which the degree of mobility/sedentism is not clear. At least one such local community (#7) satisfies a number of parameters of a mobile occupation. Therefore, it is likely that the context of human interaction in the MBA in the Zingeyka valley incorporated fully sedentary as well as more mobile population sectors.

In addition to the mobility indicators outlined above, two factors make us more inclined to interpret at least some of the smaller hinterland communities as living a more mobile lifestyle. The first consideration has to do with the fact that current evidence from the broader Southern Urals region, as well as from the Zingeyka valley, highlights domestic herd animals being if not the primary then one of the principal subsistence sources of the MBA populations. The second factor is a notion, which is widely supported by ethnographic and historical evidence, that sustaining large numbers of domestic animals in arid environments usually implies moving the herds in response to the temporal and spatial variability of rainfall and consequent forage (Leslie and McCabe 2013).

5.2 MOBILITY IN THE LATE BRONZE AGE

In the LBA, the Eurasian steppe was associated with three spatially extensive archaeological cultures: Srubnaya, Alakul, and Fedorovo (Figure 85). The latter two are usually assigned into the larger Andronovo "family" or "community" of archaeological cultures. These groupings reflect a certain level of uniformity in various aspects of material culture, including archaeological evidence associated with sedentism/mobility. Anthony (2007) considers both the Srubnaya and Andronovo settlements "permanent". Popova (2006:266), based on her excavations at two LBA Srubnaya settlements in the Middle Volga region concludes that they were occupied year-round. However, she also notes that due to the possibility of some members of the community taking the herds to distant pastures, "the question of sedentism remains inconclusive". Frachetti (2008:132,149), on the other hand, views LBA Andronovo-type settlements of eastern Kazakhstan, some of which featured semi-subterranean domestic structures, as locations that people would settle and return to seasonally.

While researchers seem to agree that in the Southern Urals, the Final Bronze Age (1400-800 BC) is associated with "predominance of mobile pastoralism" and "increase in mobility associated with animal husbandry" (Epimakhov 2009:81; Hanks et al. 2007:357), the level of population mobility in the preceding LBA is unclear. Koryakova and Epimakhov (2007:146) based in part on the permanent nature of settlements, characterize LBA [Alakul] stockbreeding as "pastoral" (*pastushestvo*, Rus.), which is a type of mobility pattern where herds and herders return to the village every night. Ventresca Miller (2013:12, 19) views the LBA period as associated with "greater levels of mobility", compared to the preceding MBA. The Zingeyka valley evidence provides a useful contribution to the discussion of human mobility in the context of the Southern Urals, as well as the broader Eurasian steppe, since the survey zone is located at the border of the Srubnaya and Andronovo cultural traditions (Figure 85; also see Table 12 in chapter 3). The following discussion summarizes relevant data obtained from each of the 11

LBA local communities identified in the course of the survey (refer to Figure 68 of chapter 4, as needed, to determine the relative location of each community).

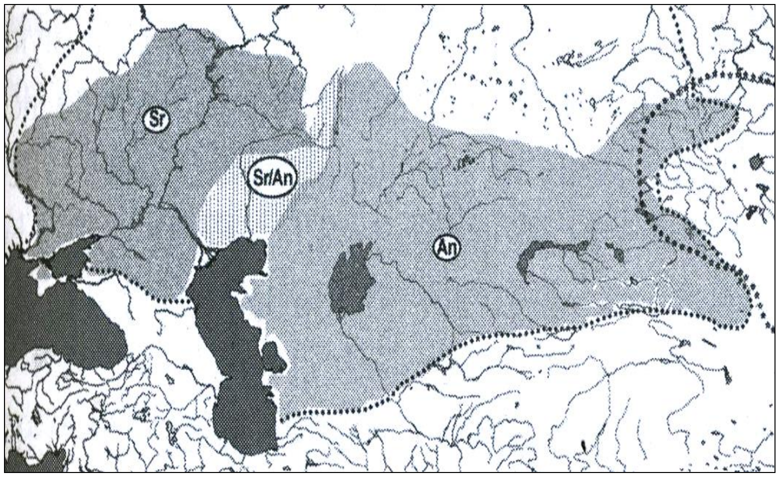


Figure 85: Late Bronze Age archaeological cultures of the steppes. *An*-Andronovo culture; *Sr*-Srubnaya culture; *Sr/An* – Mixture of Srubnaya and Andronovo cultural complexes (Chernykh 2009:137). The research area is located in the *Sr/An* zone.

5.2.1 LBA local communities

Local community 1 (K1). Local community #1 was associated with a number of housing depressions that were identified through aerial photography (Zdanovich et al. 2003:24). This occupation area was multi-phased, i.e., it produced EBA, MBA, LBA, FBA, and Iron Age materials. Therefore, stratigraphic excavations were necessary to speak more confidently about population mobility specifically during the LBA period. Out of three 1 x 1 m test pits excavated by the survey team, two produced exclusively LBA material (Figure 86). One of them was test pit #948, which produced a cultural layer that was ~30 cm thick and contained ceramics, animal bones, charcoal, lithics, and a droplet of copper (Figure 87). The light gray, fine-textured, loose sediment layers, similar to the one observed in test pit #948, are fairly common for the Bronze Age settlements of the Southern Urals. They are referred to as "ash pits" or "asheries" (*zolniki*, Rus.) (Koryakova and Epimakhov 2007; Krause and Koryakova 2013). These features are usually densely packed with animal bones and ceramic fragments and can range from light gray to grayish-orange in color. Such layers can be described as man-made soils or "anthrosols", defined as soils that had significant chemical input as well as obvious physical changes resulting from human activity (Holliday 2004:26, 314). The origins of these anthrosols, which usually show up in the excavations of inter-house space, are debated. Some view them as middens containing large amounts of ash that was generated as a result of heating the buildings, cooking, metal smelting, etc. (Salnikov 1954). Other researchers view them as remains of collapsed architecture, where ash and other garbage were used to insulate the roofs and walls of the structures (Alaeva 2016). What is important in light of the current discussion is that the presence of these layers in stratigraphic profiles suggests substantial human presence/activity at the site. Especially when such layers are horizontally extensive. Asheries sometimes show up on aerial photos as fairly large light-color spots with sparse vegetation. For example, the white spots around the southern cluster of depressions of local community #1 seen in the 1956 aerial photo may correspond an ashery area, which was subsequently destroyed by a more recent quarry (Figure 86; also see Figure 101).

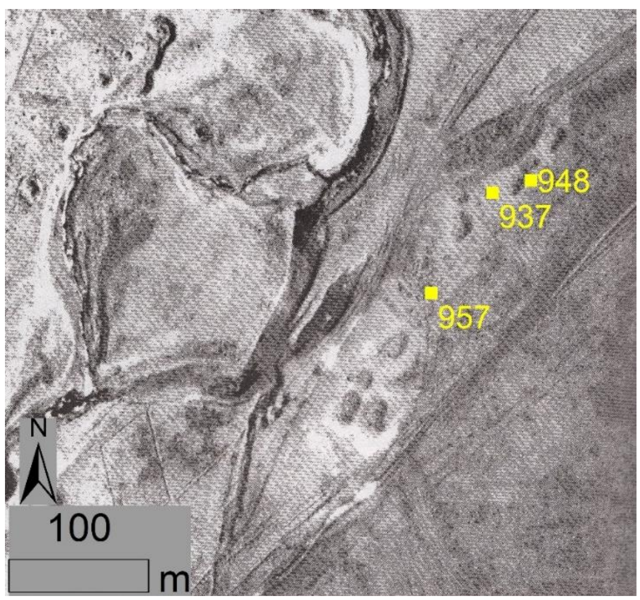
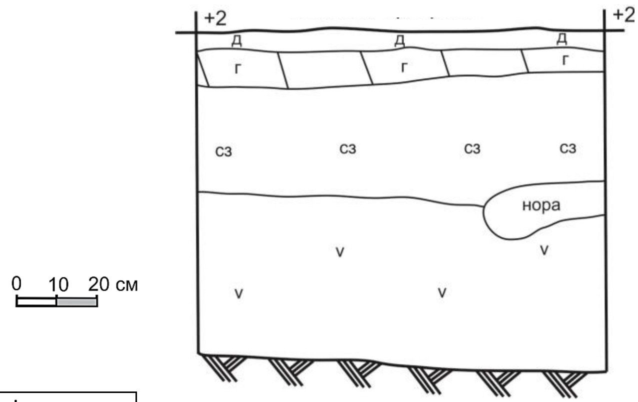


Figure 86: Test pits excavated in the area of local community #1. A 1956 aerial photo is used as the background. White spots around the southwestern cluster of structural depressions most likely represent an ashery area.



Layer	Ceramics (all are either LBA or undetermined)	Bones	Lithics	Other
0+1	1	2	0	0
2	20	177	4	Droplet of copper (1), slag (1), charcoal
3	0	11	1	0

д Layer 0 - Sod

г Layer 1 - Black humified topsoil

сз Layer 2 – Gray ashy sediment

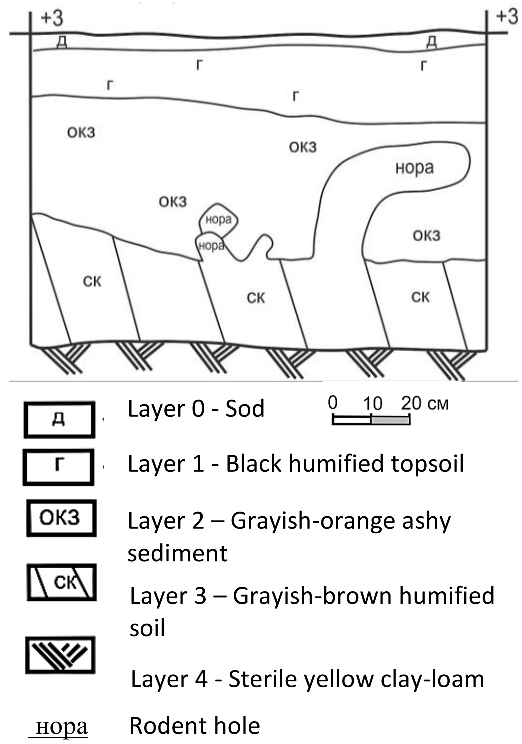
v v Layer 3 - Dark-brown loam, interpreted as buried soil

Layer 4 - Sterile yellow clay-loam

нора Rodent hole

Figure 87: Test pit #948. *Upper left*: photo of the southern profile at the sterile level. *Upper right*: drawing of the southern profile. *Lower left*: summary of recovered material. The ashy sediment layer shows up in the profile as a gray strip of soil.

The second test pit, #957, also contained exclusively LBA material, which was encountered at different depths of a ~70 cm sediment deposition sequence. The cultural layer that contained most of the material was a 30 cm-thick grayish-orange ashy sediment (Figure 88). The third test pit, #937, also contained an ashy sediment layer, which included LBA and FBA materials. The laboratory analysis of a soil sample from test pit #937, performed by A. Yakimov of the Russian Academy of Sciences, did point to higher concentration of ash, compared to the background soils. Test pits #957, #948, and #937, located over 100 m apart, point to a large horizontal extent of the ashy sediment depositions, which indicates substantial human activity. Additionally, artifacts associated with weaving, hide processing, and metal smelting, were recovered in the course of the surface collections. Although these items cannot be confidently assigned into a period more specific than the Bronze Age, they indicate a wide range of activities taking place in this occupation area. One artifact, associated with craft activities, which would require a certain level of sedentism, is a LBA-period casting mold for making bronze jewelry (Figure 89) (cf. Epimakhov 2010b). In summary, the thickness and nature of cultural layers, the density and nature of artifacts, as well as the presence of structural depressions allow us to speak of long-term sedentary occupation of local community #1 during the LBA.



Layer	Ceramics (all are either LBA or undetermined)	Bones	Lithics	Other
0+1	4	20	0	0
2	22	122	2	Charcoal, bronze item
3	5	46	2	Charcoal

Figure 88: Test pit #957. *Upper left*: photo of the southern profile at the sterile level. *Upper right*: drawing of the southern profile. *Lower left*: summary of recovered material. The ashy sediment layer shows up in the photo as a gray strip of soil.

If we assume that every local community managed their own herd, estimating the percentages of different animal species associated with the faunal remains left behind by a local community may provide clues to the degree of population mobility. Faunal remains coming from test pits #957 and #948 were combined to calculate the percentages of domestic animal species based on the NISP method. These calculations indicate that the percentage of cattle in the reconstructed local community #1 herd was 19% ± 6% (80% confidence level). This proportion of cattle is more consistent with mobile rather than sedentary herding.

Figure 89: LBA [Alakul]-period casting mold for making bronze jewelry recovered from the surface of one of the collection units, associated with local community #1. Photo access to this item was provided by Yu. Makurov who recovered it in 2013 as part of a monitoring survey.

Although the test pit data indicated that the LBA occupation at local community #1 was long-term and substantial, the question remains whether the occupation was seasonal or year-round. A clue as to the seasonality of the LBA occupation at local community #1 comes from the tooth of an adult *Bos taurus* extracted from layer 2 of test pit #957. Dental cementum increment analysis established that this animal was culled in the summer (Figure 90). Most ethnographic examples of seasonally mobile pastoralists of the Eurasian steppe involve groups that lived in dismountable dwellings year-round and did not build permanent homes. Henceforth, it is useful to return to the mobility patterns of the Southern Urals Bashkirs, briefly discussed in the beginning of this chapter, who occupied permanent homes but were nonetheless seasonally mobile. When Bashkirs did migrate with their herds in the summer they: 1) lived in light dismountable/makeshift dwellings, and 2) changed camp locations 2-3 times during the summer (Yanguzin 2002:77). If LBA occupation areas, such as local community #1, were indeed seasonal, the architectural (housing depressions) and sedimentation (accumulation of ash) evidence suggests they were occupied in the winter, rather than in the summer. Yet we observe a summer seasonality indicator. Therefore, we are likely looking at an area that was occupied both during the winter and during the summer.

In summary, the architectural, faunal, sedimentological, and artifactual evidence from this locale, with an estimated LBA population of 197-293, seems to converge on permanent year-round occupation. Since herd composition data, suggesting seasonal mobility, came from only two 1 x 1 m test pits spaced fairly close apart, this line of evidence does not seem to starkly contradict our overall conclusion.

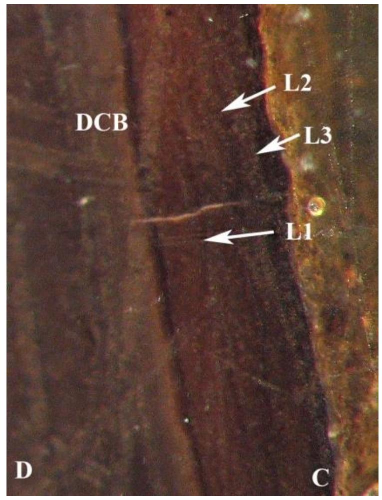


Figure 90: Cross-section of an adult Bos taurus tooth extracted from test pit #957. D – dentin; C – cementum; DCB – border between D and C; L1-L3 – winter layers. Season of death – summer.

Local community 2 (K6). A number of structural depressions were identified at this multi-period (LBA and FBA) occupation area through aerial photography and on-the-ground visual inspection. Three 1 x 1 m test pits, excavated within the collection unit that comprised this local community, produced 20-40 cm-thick cultural layers that yielded various artifact densities (Table 22). Although a piece of metal slag was recovered from one of the test pits (#889), it could not be dated, since the cultural layer from which it was recovered contained both LBA and FBA ceramics. This same test pit produced evidence of alterations to the ancient surface in the form of complete and partial removal of the 10-15 cm layer of the buried soil (i.e., ancient topsoil). These alterations, again, could not be assigned into either the LBA or the FBA periods.

Since the occupation area was multi-phased, the faunal data that could be confidently dated to the LBA period was too limited to speak of this local community's herd composition. The LBA faunal assemblage, although not numerous, allows us to speak of the consumption of a wide range of animal species at the site, which is indicative of a relatively long-term occupation.

Dental cementum analysis of a tooth (lower incisor) belonging to an adult sheep/goat indicated that this animal was culled in late summer – early fall (Figure 91). The tooth came from a grayish-brown humified soil layer of test pit #866, which contained only LBA material. As in the case with local community #1, evidence of structural investment (in the form of housing depressions) on the one hand, and an indicator of summer occupation on the other, are inconsistent with historically known Eurasian mobile pastoralist living patterns. When considered in tandem with other lines of evidence, such as large community size (288-430 people), the presence of structural depressions, possible metal craft activities, and the seasonality marker discussed above suggests permanent year-round occupation of this locale during the LBA.

Table 22: Faunal assemblage from LBA cultural layers of test pits associated with local community #2.

Taxa	**NISP**
Bos taurus (cattle)	2
Equus caballus (horse)	4
Ovis aries/Capra hircus (sheep/goat)	11
Sus scrofa (wild hog)	1
Large-sized mammal (size of cattle, horse, camel, etc.)	12
Medium-sized mammal (size of sheep, goat, pig, etc.)	29
Indet. mammal	32
Total	91

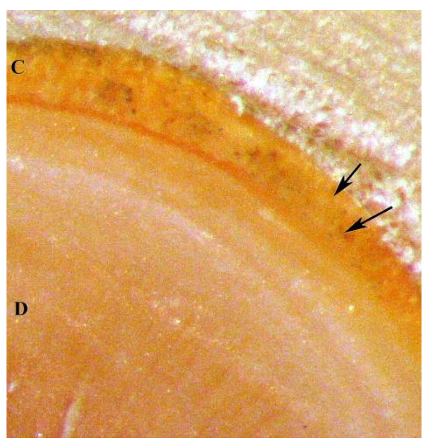


Figure 91: Cross-section of an i2 tooth of a sheep/goat from test pit #866. D – dentin; C – cementum; arrows – winter layers. Season of death – late summer/early fall.

Local community 3 (K2). Local community 3 was associated with a number of housing depressions that were identified through aerial photography (Figure 92) (Zdanovich et al. 2003:24). This occupation area was multi-phased, i.e., shovel probes produced MBA, LBA, and FBA materials. Five 1x1 m test pits, excavated in two collection units that comprised this local community, yielded exclusively LBA materials. The thickness of cultural layers, some of which incorporated ashy sediments, ranged from 30 to 45 cm (e.g., Figure 93). All test pits contained ceramics and animal bones, while some also contained lithics, slags, and copper ore. The fact that test pits #268, #655, #270, and #656 all contained cultural layers of the ashy sediment-type speaks of a relatively substantial occupation of this area, estimated to have housed 81-120 people in the LBA.

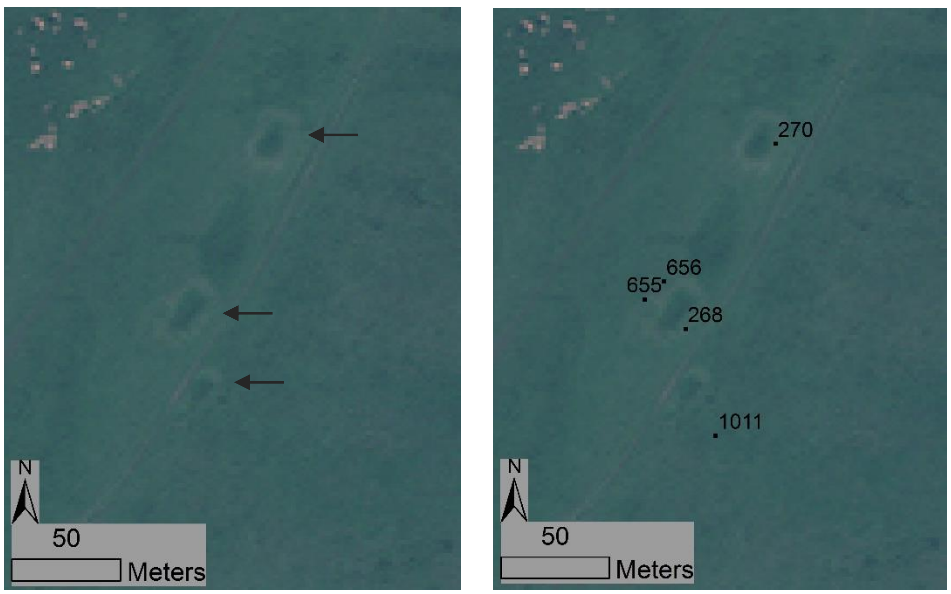
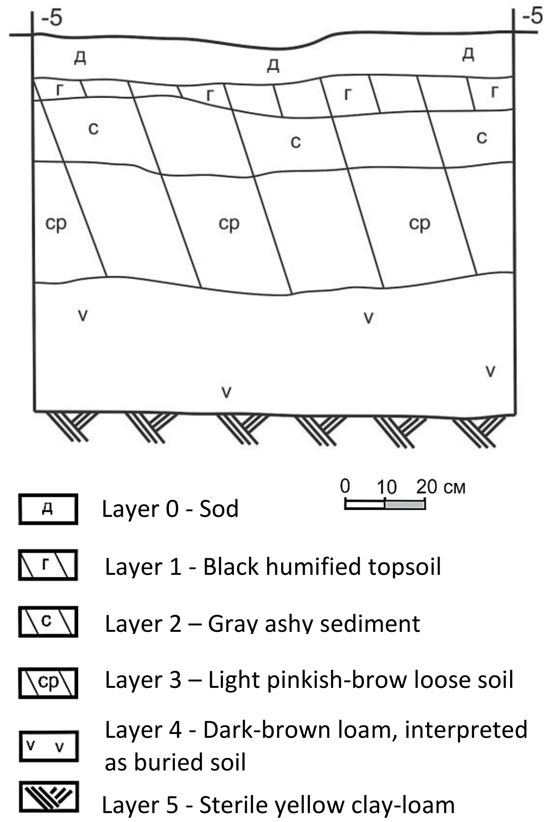


Figure 92: Structural depressions, associated with LBA local community #3. Left: as seen in a satellite image. Right: 1 x 1 m test pits excavated within local community #3. Test pits #268, #655, #270, and #656 contained ashy sediments. Image courtesy of the DigitalGlobe Foundation.

NISP-based estimates of herd composition, based on the totality of animal bones extracted from LBA layers, point to the local community #3 herd being comprised of 69% cattle ± 10% (80% confidence level). Such herd composition is strongly suggestive of sedentism. In summary, architectural, faunal, sedimentological, and artifactual data points to this locale being occupied permanently year-round during the LBA.



Layer	Ceramics (all LBA or undetermined)	Bones	Other
0+1	10	29	0
2	17	69	0
3	15	70	0
4	0	0	0

Figure 93: Test pit #655. *Upper left*: photo of the western profile at the sterile level. *Upper right*: drawing of the western profile. *Lower left*: summary of recovered artifact. The ashy sediment layer is seen as a gray strip of soil. Lab analysis of a sample from layer 2 did confirm ash content that was higher than in the background soil.

Local community 4 (K4). Two structural depressions were identified at this single-period (LBA) occupation area through aerial photography and on-the-ground visual inspection (Figure 94). Two 1 x 1 m test pits (#670 and #669), excavated within the occupation area, yielded low densities of arti/eco-facts. Test pit #670 indicated that ancient surface has been cut into/removed, which is probably connected to the construction of the semi-subterranean structure next to which the test pit was excavated (Figure 95). The 15-40 cm cultural layer in test pit #670 contained 10 ceramics and 91 bones, while a 15 cm-thick cultural layer of test pit #669 contained only one ceramic and 12 bones. No evidence of specialized craft activities and no chipped lithic artifacts have been recovered, which speaks of a relatively limited range of activities that took place in this local community with an estimated LBA population of 15-23 people

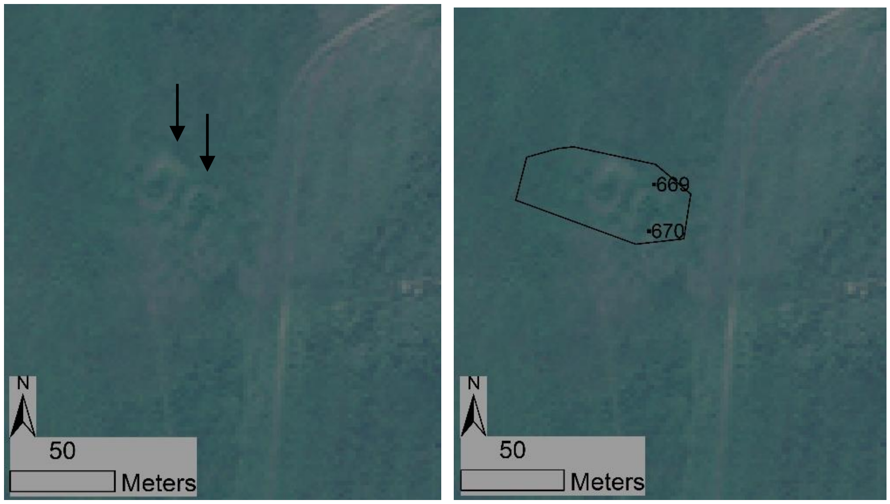
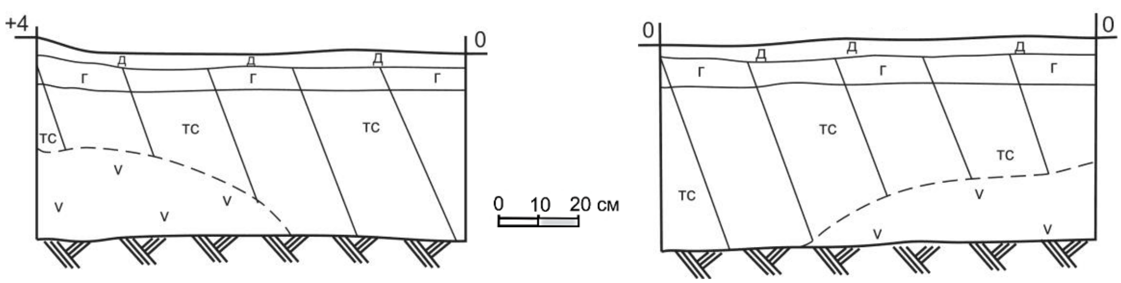


Figure 94: Structural depressions associated with local community #4. Left: as seen in the satellite image. *Right*: extent of the collection unit, associated with local community #4 and the location of two 1 x 1 m test pits. Image courtesy of the DigitalGlobe Foundation.



Layer	Ceramics (all either LBA or undetermined)	Bones	Other
0+1	3	10	0
2	7	81	Burnt clay pieces (4)
3	0	0	0

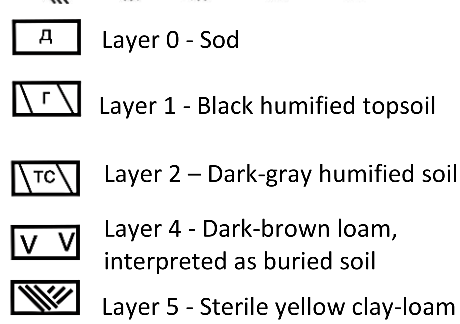


Figure 95: Test pit #670. *Above*: drawings of western (left) and northern (right) profiles. *Below*: summary of recovered material.

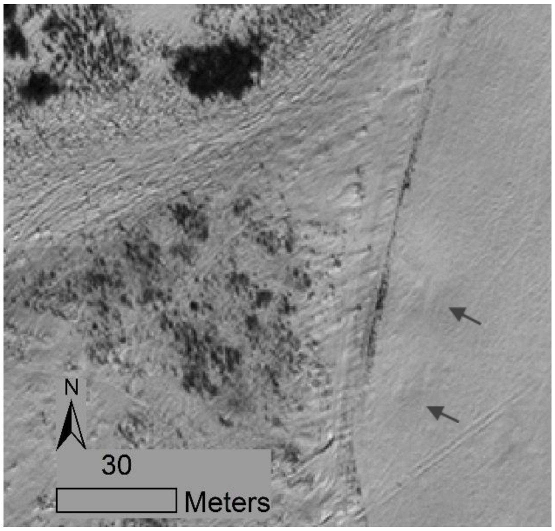
Identifiable faunal remains extracted from the shovel probes and two test pits were not numerous enough to speak confidently of this local community's herd composition. We can, however, speak of the consumption of a broad range of domestic species at the site: cow, horse, and (probably) sheep/goat (Table 23). Since no seasonality markers were obtained, we cannot tell whether this settlement was occupied seasonally or not. What is remarkable is the recovery of a fragmented mandible of an adult dog (the only occurrence of this species among all local LBA communities) from one of the test pits. Since in northern Eurasia, dogs are commonly associated with herding, the presence of this species could point to local community #4 being a herder hamlet.

Since indicators of both sedentism (housing depressions) and mobility (low artifact densities, small settlement size, limited activities) are present, the level of this local community's mobility is uncertain.

Table 23: Faunal assemblage from the test pits and shovel probes excavated in local community #4.

Taxa	**NISP**
Bos taurus (cattle)	10
Equus caballus (horse)	3
Canis lupus familiaris (dog)	6
Large-sized mammal (size of cattle, horse, camel, etc.)	20
Medium-sized mammal (size of sheep, goat, pig, etc.)	10
Indet. mammal	91
Total	140

Local community 5 (L1). A number of structural depressions have been identified at this occupation area through aerial photography (Zdanovich et al. 2003). Four test pits were excavated to further investigate the nature of this multi-phased (EBA, MBA, LBA) occupation area, with and estimated LBA population of 170-253 (Figure 96). Two test pits (#701w2 and #687) produced only LBA materials, while two other ones (#691, #699) produced mixed (MBA and LBA) cultural layers.



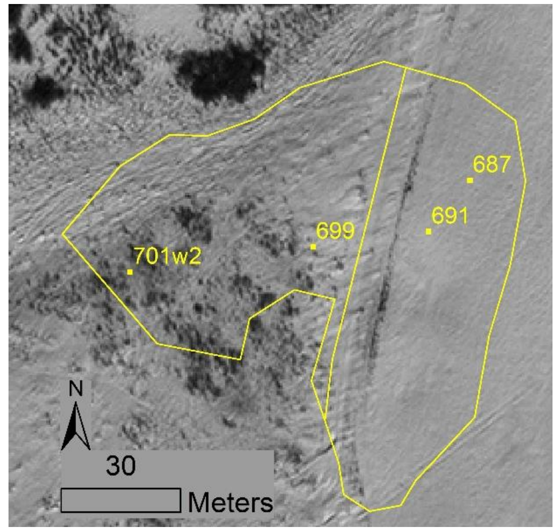
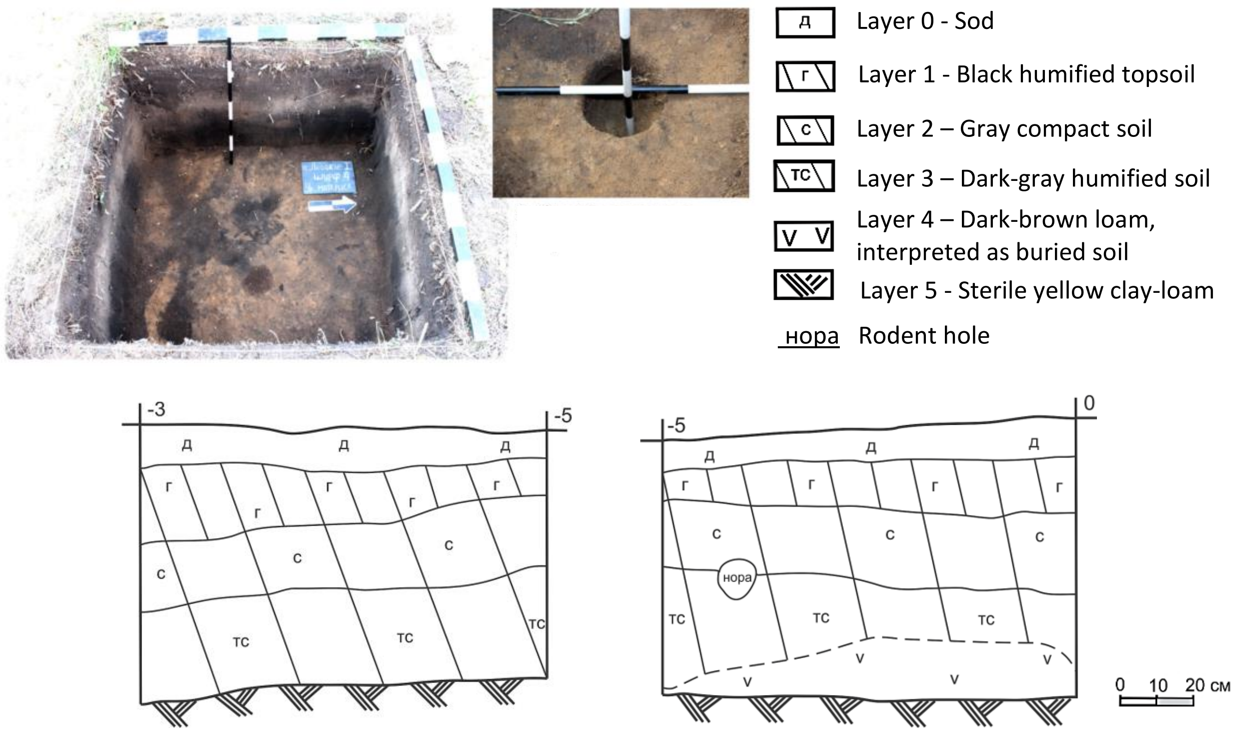


Figure 96: Two structural depressions associated with LBA local community #5. *Left*: as seen in a satellite image (marked with arrows). Due to the fact that one part of the site has been extensively plowed and the other part is covered with bushy vegetation, the housing depressions are not easily seen. *Right*: locations of four test pits, associated with local community #5. Collection units, comprising this local community are outlined in yellow. Image courtesy of the DigitalGlobe Foundation.

In terms of discussing local community #5's residential mobility, two test pits are worth elaborating upon. One of them is test pit #699 (Figure 97). In it, we have identified the remnants of a post-hole, which was 12 cm in diameter and was placed about 40 cm deep into the ancient surface. Test pit #699 also produced evidence of people removing substantial amounts of ancient soil, probably for construction purposes. Layer 5 of this test pit, due to its physical characteristics, the lack of finds, and large aerial extent (it was observed in test pits #699 and #701w2) was interpreted as ancient (buried) topsoil. The fact that this layer was present only partially in the northern profile of test pit #699 and absent from the southern, eastern, and western profiles of this test pit indicates digging activities, likely associated with construction. Since the principal cultural layer (layer #2) contained LBA and MBA ceramics, it is unclear during which period these construction activities took place. However, given the overwhelming predominance of LBA ceramics in the test pit, it is more likely that construction activities took place during this period. A single LBA ceramic in the lower layer (layer 3) likely got there due to bioturbational activity, evidenced from numerous rodent holes and modern-looking bones of *Spermophilus sp.* (ground squirrel), recovered from this lower layer.



Layer	LBA ceramics	MBA ceramics	Undetermined ceramics	Bones
0+1	2	0	0	11
2	10	1	16	184
3	1	0	0	29

Figure 97: Test pit #699. *Upper left*: photo of the western profile and a close-up photo of the post-hole, observed at the sterile level. Linear strips of dark soil are rodent holes. *Center left*: drawing of the western profile. *Center right*: drawing of the northern profile. *Below*: summary of the recovered material.

Artifacts, indicating various craft activities were collected from the plowed-over portion of this occupation area. They included: ground stone tools used for polishing/grinding down hard substances (presumably metal); a ceramic artifact used in weaving; a ceramic item that has been interpreted as a casting mold for making metal ingots. The functional attribution of the latter item was based on the interpretation of an identical item recovered from the settlement of Ust'ye (Vinogradov 2013). However, it was difficult to assign these artifacts to a period due to the fact that the occupation was multi-phased (EBA, MBA, LBA). Since the primary phase of the occupation of this area dates to the LBA, we can assume that at least some of these items date to this period.

Out of four test pits, only one (701w2) produced distinct cultural layers that contained exclusively LBA ceramics. Therefore, we refrained from reconstructing the species composition of this local community's herd based on the faunal data coming out of a single 1x1 m test pit.

Dental cementum analysis of a tooth (m3), which belonged to an adult *Bos taurus* indicated that this animal was culled in the summer (Figure 98). The tooth came from layer 2 of test pit #699, which contained LBA and MBA materials (Figure 97). Since this layer contained only one MBA sherd, there is a good chance of the tooth dating to the LBA occupation of this area. The evidence of substantial structural investment (in the form of housing depressions) on the one hand, and of summer occupation on the other, are inconsistent with historically known Eurasian pastoralists' mobility patterns. Therefore, such seasonality marker suggests year-round, rather than seasonal, occupation. In summary, the amalgamation of evidence from this occupation area suggests sedentary year-round occupation.

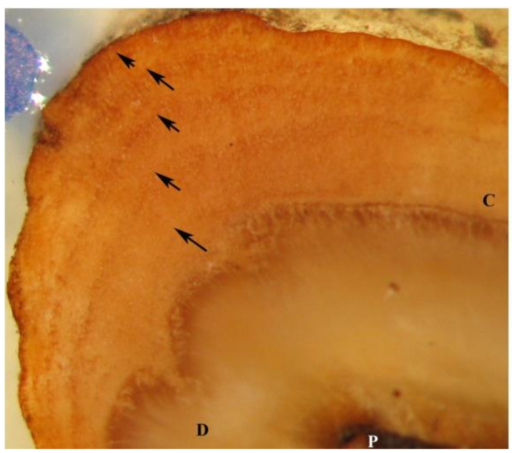


Figure 98: Cross-section of a tooth (m3) of an adult Bos taurus from layer 2 of test pit #699. D - dentin; C - cementum; P - pulp; arrows - winter layers. Season of death - summer.

Local community 6 (L4+Z1+L6). This large multi-phased local community, which produced MBA, LBA and FBA materials, was comprised of a few discrete but closely located occupation areas. The estimated LBA population was between 795 and 1186 people. This occupation area contained numerous structural depressions, identified through aerial photography, microtopographic survey, and visual inspection (see Figure 35 in chapter 2). Geophysical inspection confirmed the presence of additional structures that were not associated with depressions (see Figure 36 in chapter 2). Furthermore, a 387 m^2 excavation conducted by Petrova (2004) revealed the corners of two semi-subterranean housing structures and a smaller above-ground “economic” structure. Petrova (2004) reconstructs the areas of the larger structures to range from 150 to 170 m^2 and dates all three structures to the LBA period. According to the author, the larger dwellings are typical of the Srubnaya and Andronovo cultural groups in the presence of indoor wells, numerous post-holes, and other construction elements. The 3350-item collection of artifacts included ceramics, lithics, ground stone tools, bone tools, finished bronze items, one fragment of metal slag, and a copper droplet. What is noteworthy is the discovery of a “hoard” of five bronze sickles right outside of one of the larger structures (Figure 99). Whether used to cut down hay or to harvest plants for human consumption, the sickles are suggestive of settled living.

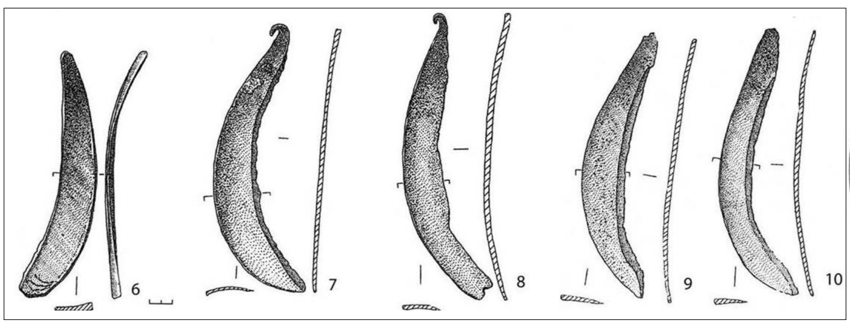


Figure 99: Five bronze sickles recovered from a cache located right outside of one the LBA dwellings in local community #6 (Petrova 2004).

At this point, it is worth noting that recent paleobotanical research efforts in the Volga-Ural interfluve found no direct evidence of any domesticated (i.e., morphologically altered) grains dating to the MBA or the LBA periods (Hanks and Doonan 2013; Popova 2006; Stobbe 2013; Ventresca Miller et al. 2014). However, researchers presume that besides a diet heavy in milk, meat, and fish (Judd et al. 2009; Lindstrom 2002; Privat 2004), populations of the Volga and Ural steppes actively incorporated plants such as *Hordeum brevisubulatum, Chenopodium, Polygonum, Brassica, Eragrosis, Galium, Vicia* and *Amaranthus* into their diet (Anthony 2007; Popova 2006; Stobbe 2013). Beyond the high likelihood of consumption, not much is known about the proportion of such plants in the populations’ diets or whether they were cultivated and/or gathered. It is also worth noting that stable isotope analysis of osteological material from kurgan burials in northwestern Kazakhstan indicated that subsistence economies changed little between the MBA and LBA periods (Ventresca Miller 2013).

A total of 10 1x1 m test pits were excavated within different collection units that comprised local community #6 by the Zingeyka survey crew (Figure 100). A number of test pits yielded LBA cultural layers of various thickness (20-50 cm) and composition, with some being of the ashy sediment type. The existence of extensive ash deposits within local community #6 was further confirmed by satellite imagery (Figure 101). The artifacts obtained from the LBA layers of the 10 test pits included ceramics, bones, lithics, metal slag, and copper ore.

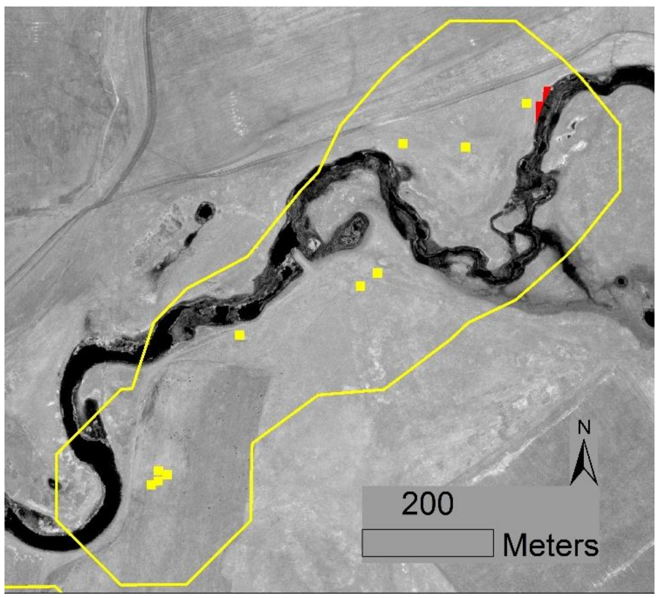


Figure 100: Locations of 10 1x1 m test pits (marked as yellow squares) excavated in local community #6. Area excavated by Petrova (2004) is depicted as a red polygon. Local community #6 is outlined in yellow. Image courtesy of the DigitalGlobe Foundation.

Items collected from the surfaces of collection units associated with this local community included artifacts used in hide processing and ceramic production. Additionally, surface collections produced a number of items related to metal production: hammers used for crushing hard substances (presumably minerals); a ground stone tool interpreted as a casting hammer; pestle for grinding hard substances (presumably minerals); abrasives used for shaping/polishing hard objects (presumably metals). Functions of these items were determined as part of the analysis mentioned in the context of the MBA local community #4 discussion. Although these artifacts cannot be confidently assigned into a period more specific than the Bronze Age, they indicate a wide range of activities taking place in local community #6, some of which suggest sedentism.

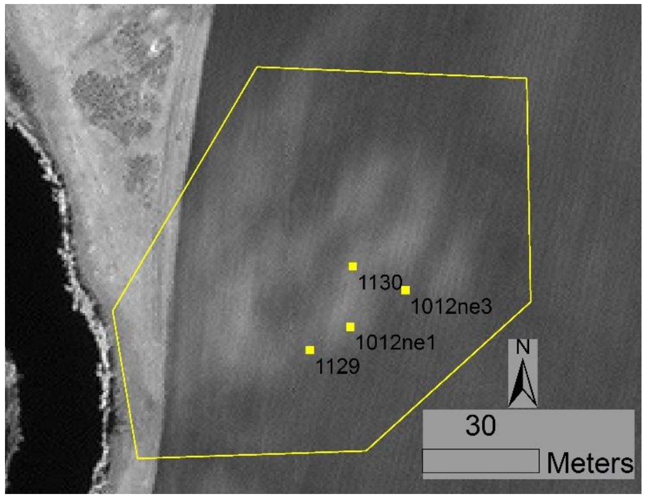


Figure 101: Extensive ashery, seen as a light ‘cloud’ surrounding 2-3 supposed housing depressions. This is a close-up of the southwestern cluster of four test pits, seen in Figure 100. The test pits are labeled. Image courtesy of the DigitalGlobe Foundation.

Bones out of all cultural layers that contained only LBA ceramics were combined and the herd structure was reconstructed based in the NISP method. The percent of cattle in the local community #6 herd was estimated to be 43% ± 8% (80 % confidence level), which is suggestive of settled life.

Dental cementum increment analyses were performed on two animal teeth extracted from the LBA layers of test pits #1129 and #1012ne1 (Figure 101). Cross-sections of the M3 tooth of an adult *Sus scrofa* (wild hog) and the I2 tooth of an adult *Bos taurus* indicated that both of these animals died in late fall (Figure 102). The analysis of the *Bos taurus* tooth was different from the ones discussed thus far in that seasonal layers were examined on the secondary dentin and not on the cementum. While secondary dentin surrounds the pulp and grows inward (unlike cementum, which growth outward), warm vs. cold season growth layers can still be distinguished in the same way.

In summary, the amalgamation of architectural, faunal, sedimentological, and artifactual data makes it very likely that local community #6 was occupied permanently year-round in the LBA.

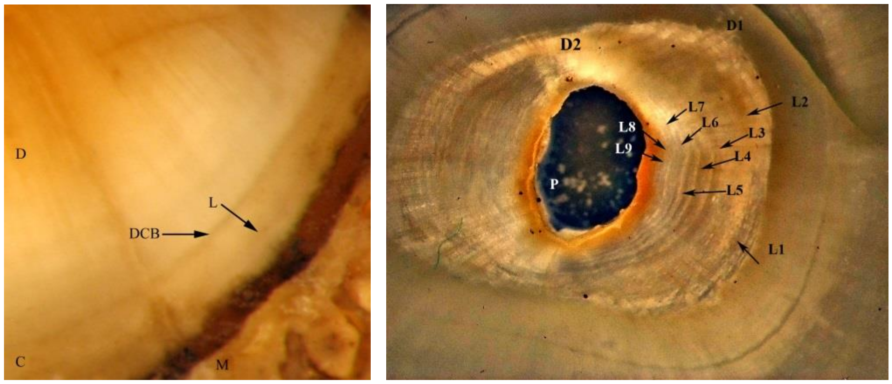


Figure 102: Cross sections of an M3 of an adult Sus scrofa from test pit #1129 (left) and an I2 of an adult Bos Taurus from test pit #1012ne1 (right). D – dentin; C – cementum; DCB – dentin-cementum border; M – bone; L – winter layers; D1 – primary dentin; D2 – secondary dentin; P – pulp. Season of death of both animals is late fall.

Local community 7 (Z11). Local community #7 was associated with a number of structural depressions that were identified through aerial photography and on-the ground visual inspection (Zdanovich et al. 2003; Petrov 2001). This multi-phased (MBA and LBA) occupation area was further investigated with 2 test pits, measuring 2 x 2 m and 1 x 1 m. Besides producing a 25 cm-thick LBA ashy sediment cultural layer (confirmed to have contained a high concentration of ash by laboratory analysis), the 2 x 2 m test pit (#1122) exposed a section of a ditch that was ~1 m wide and ~.5 m deep (measured from the level of the ancient surface) (Figure 103). Since the infill of the ditch did not produce any diagnostic artifacts (aside from chipped lithics and animal bones), it is difficult to say what period the ditch dates to. Nonetheless, the presence of such structural investment suggests sedentary living at this location, most likely sometime during the LBA. The second 1 x 1 m test pit (#1123) produced a ~40 cm sequence of 2 distinct cultural layers that contained animal bones and LBA ceramics.

The proportion of cattle in the reconstructed local community #7 herd, based on the faunal remains from the two test pits, was 32% ± 9% (80% confidence level). Such herd composition is inconclusive in terms of human mobility, i.e., it is too close to the 30% ‘cut-off’ value discussed earlier and could therefore represent either mobile or sedentary populations.

Layer	Ceramics (all are LBA or undiagnostic)	Bones	Lithics
0	5	13	0
1	35	393	2
2	0	19	2
3	0	0	0

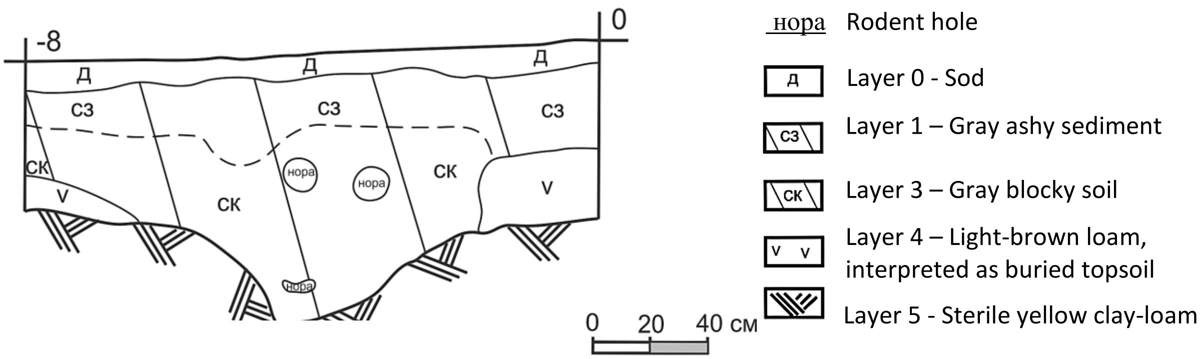


Figure 103: Test pit #1122. *Upper left*: photo of the western profile at the sterile level, showing a section of a ditch. *Upper right*: summary of the recovered material. *Below*: drawing of the western profile.

Two faunal seasonality indicators were obtained from layer 1 of test pit #1122. One of them was the first rib of a neonatal sheep or goat (Figure 104). The fact that in the Southern Urals sheep and goats are usually born at the end of March - beginning of April (Kuzeev and Bikbulatov 1979:68), suggests that people occupied this locale in the spring. Springtime calving and lambing seasons are common across Eurasia and are a result of herders managing animal reproduction so that the appearance of newborns coincides with the beginning of the vegetation season.

The second seasonality marker comes from the analysis of a lower incisor (i3 or i4) of an adult *Bos taurus*, also recovered from layer 1 of test pit #1122. Dental cementum analysis indicates that this animal was culled in the fall (Figure 105). Therefore, we are able to establish human presence at this locale in both spring and fall. In summary, the density of cultural material, the alterations to the ancient surface, and the faunal seasonality indicators make it likely that this locale, estimated to have housed 112-167 people, was occupied permanently year-round.

Figure 104: First rib of a neonatal sheep/goat recovered from layer 1 of test pit #1122.

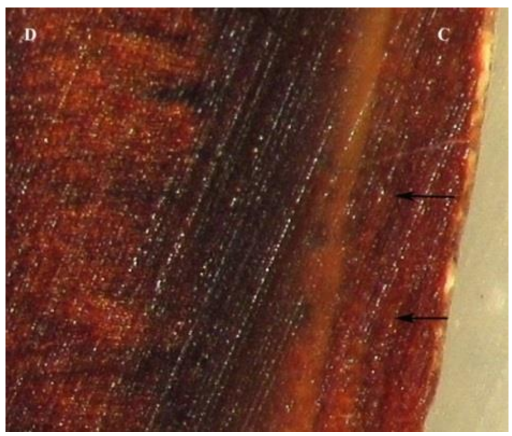


Figure 105: Cross section of an incisor of an adult Bos Taurus. D- dentin; C – cementum; arrows show winter layers. Season of death – fall.

Local community 8 (SS). This was a multi-period (MBA and LBA) occupation area located just to the north of the Sarym-Sakly fortified settlement. Except for the presence of LBA ceramics in the shovel probes, no additional evidence pertaining to the nature of this period's occupation was obtained. Due to the presence of 27 structural depressions associated with Sarym-Sakly, it is possible that a few of these structures were occupied/re-occupied by the estimated 51-76 LBA population. In summary, the level of this local community's mobility is unclear.

Local community 9 (614). No structural depressions have been identified in this occupation area through either aerial photography or on-the-ground visual inspection. This could be due to the meandering streambed of the Zingeyka River currently approaching and possibly cutting into this occupation area during the spring months (Figure 106). One 1 x 1 m test pit was excavated to further investigate this multi-period (MBA and LBA) occupation area with an estimated LBA population of 114-170 people. The test pit produced a single ~15 cm-thick LBA cultural layer that contained only 4 ceramics, 4 bones, and 3 lithics. No artifacts indicating specialized craft activity have been recovered from this occupation area. The quantity of bones that could be tied to a period was too small to speak of herd composition and no seasonality markers were obtained. In conclusion, since indicators of both sedentism (a relatively large, 'village-size' population) and mobility (no evidence of structural investment, low artifact densities, limited activities) are present, the level of this local community's mobility is uncertain.

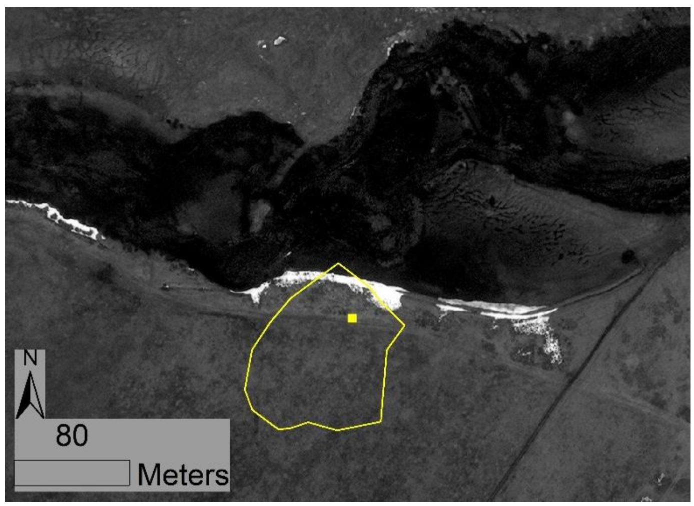


Figure 106: The outlines of the collection unit associated with local community #9. The satellite image shows the current springtime extent of the Zingeyka River. 1 x 1 m test pit is represented as a yellow square. Image courtesy of the DigitalGlobe Foundation.

Local community 10 (NS 5). Three structural depressions were identified in this occupation area visually during the course of the Zingeyka survey. Their presence was subsequently confirmed by the stereoscopic analysis of aerial photographs (by N. Batanina) (Figure 107). While this occupation area produced both MBA and LBA ceramics, the estimated LBA population was 22-33. One 1 x 1 m test pit indicated the presence of a single ~15 cm cultural layer that contained 7 ceramics, 12 bones, and 4 lithics. No artifacts indicating specialized craft activities have been recovered. The quantity of bones that could be tied to a period was too small to speak of herd composition and no seasonality markers were obtained. Since indicators of both sedentism (housing depressions) and mobility (low artifact densities, small size, limited activities) are present, the level of this local community's mobility is uncertain.

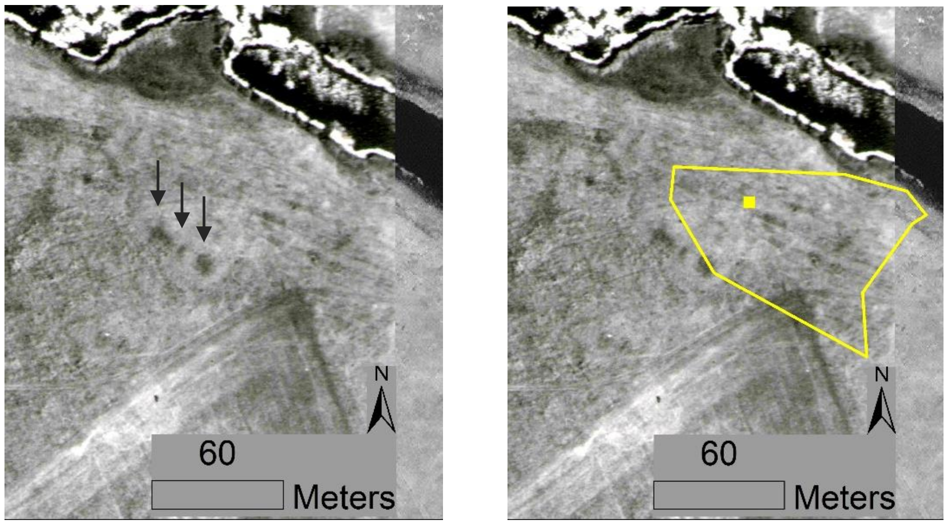


Figure 107: Aerial photo showing 3 structural depressions, associated with local community #10. The collection unit is outlined in yellow and the 1x1 m test pit location is marked by a yellow square.

Local community 11 (NS 4). Local community #11 is associated with a single-period (LBA) occupation by 21-31 people. Although one depression was identified by the Zingeyka survey team, it could not be confirmed by the aerial photograph analysis (by N. Batanina) (Figure 108). One 1 x 1 m test pit indicated the presence of a single ~20 cm-thick LBA cultural layer that contained 4 ceramics, 2 bones, and a piece of charcoal. The quantity of bones was too small to speak of herd composition and no seasonality markers were obtained. Since indicators of both sedentism (a possible housing depression) and mobility (low artifact densities, small settlement size, limited activities) are present, the level of this local community's mobility is uncertain.

Figure 108: A housing depression associated with local community #11.

5.2.2 Conclusion

Table 24 summarizes data pertaining to the degree of sedentism/mobility of the LBA local communities of the Zinegyka valley. Based on indicators listed in this table we can conclude the existence of two categories of occupation areas in the LBA. The first category includes local communities (#1, 2, 3, 5, 6, 7) that satisfy a number of parameters of sedentary occupation to the degree where these communities are considered to be fully sedentary and occupied year-round. The second group of local communities (#4, 8, 9, 10, 11) combines indicators of sedentary and mobile occupation. What these findings indicate is that the context of social interaction during the LBA in the Zingeyka valley was complex in terms of human mobility. It likely incorporated sedentary as well as mobile population sectors.

In addition to the mobility indicators outlined above, two factors make us more inclined to interpret communities belonging to the second group as living in a more mobile setting. The first consideration has to do with the fact that current evidence from the broader Southern Urals region, as well as from the Zingeyka valley, highlights domestic herd animals being if not the primary, then one of the principal subsistence sources for the LBA populations. The second factor is a notion, which is widely supported by ethnographic and historical evidence, that sustaining large numbers of domestic animals in arid environments usually implies moving the herds in response to the temporal and spatial variability of rainfall and consequent forage (Leslie and McCabe 2013).

Table 24: Indicators of sedentism/mobility of LBA local communities in the Zinegyka valley. Communities that are not highlighted are considered fully sedentary; communities highlighted in yellow are considered to be more mobile. "n/a" signifies insufficient data.

Local community # (name)	Estimated population	Structural investment into habitation locales		Season of occupation derived from faunal data	Herd composition suggestive of what mode of life?	Other indicators of sedentism/mobility		
		Housing depressions present?	**Other modifications to ancient surface?**			**Density of LBA cultural layer(s) (sherds/m²)***	**Presence of substantial human modifications to soil?**	**Markers of craft activities**
1 (K1)	197-293	Yes	Removal of ancient surface	Summer	Mobile	26	Presence of horizontally extensive ashy sediment	Copper droplet, a casting mold for making jewelry
2 (K6)	288-430	Yes	Maybe	Late summer / early fall	n/a	42	No	Maybe
3 (K2)	81-120	Yes	No	n/a	Settled	14	Presence of horizontally extensive ashy sediment	Slags
4 (K4)	15-23	Yes	Removal of ancient surface	n/a	n/a	5.5	No	No
5 (L1)	170-253	Yes	12 cm wide, 40 cm deep post hole. Removal of ancient soil.	Summer?	n/a	69	No	Maybe
6 (L4+Z1+L6)	795-1186	Yes	Removal of ancient soil	Late fall	Settled	17	Presence of horizontally extensive ashy sediments	Copper droplet; slags; copper ore
7 (Z11)	112-167	Yes	1 m wide x.45 m deep ditch	Spring and fall	Uncertain	10	Yes	No
8(SS)	51-76	Maybe	n/a	n/a	n/a	n/a	n/a	n/a
9 (614)	114-170	No	No	n/a	n/a	4	No	No
10 (NS5)	22-33	Yes	No	n/a	n/a	5	No	No
11 (NS4)	21-31	Maybe	No	n/a	n/a	4	No	No

* A more simplified [*sherds per m² of excavated surface area*] rather than [*sherds per cubic meter of excavated cultural layer volume*] measure was used in this analysis.

5.3 MOBIITY, COMMUNITY STRUCTURE, AND HERDING IN THE BRONZE AGE

The results outlined in the preceding sections of this chapter point to the MBA and LBA supra-local communities consisting of mobile and sedentary segments that were integrated into a larger socio-economic system. Ethnographic record of the Eurasian steppes suggests that the mobile population sectors likely specialized in herding. Mobile populations comprised 7% and 14% of the total study area population in the MBA and LBA periods, respectively. Given relatively low labor requirements of pastoral production (e.g., a single herder can manage up to 400 sheep (Barth 1961)), such population segments could successfully manage seasonal movements of larger herds. It is reasonable to suppose that mobile communities of the Zingeyka valley had close social ties with people who lived in larger permanent settlements. This presumption is based on the geographical proximity and similarities in material culture (e.g., ceramic styles) between the mobile and sedentary occupations.

The reconstructed demographic and mobility parameters of Bronze Age communities bring up a few important questions related to the management of large animal herds. If pastoralism was indeed the primary subsistence source, large agglomerates of people translated into even larger agglomerates of domestic animals. As previously mentioned, large herds are usually moved seasonally to ensure access to pasture. The question then becomes whether the MBA and LBA herds were large enough to require seasonal movement. Although the nature of the MBA and LBA subsistence systems requires further investigation (this especially pertains to the plant component of the Bronze Age diet), the analysis presented below assumes that the MBA and LBA populations relied quite heavily on herding for subsistence. After all, there is little debate about the fact that animal products played a significant role in the diet of Bronze Age populations (see section 5.2.1).

Table 25 outlines the calculations of how large a territory the MBA population of the Zingeyka valley would need to supply their livestock with enough forage throughout the year. These calculations are based on the following assumptions. 1) Bronze Age populations cut no hay, but rather relied on extensive pastoralism all year around. 2) Each MBA household owned the amount of livestock equivalent to the average 18th century Bashkir family, consisting of 10 people. As mentioned earlier, these pre-industrial mobile pastoralist groups of the Southern Urals relied quite heavily on herding for subsistence and, therefore, represent a useful ethnographic comparison in the context of present discussion. 3) Domestic animals consumed the same pastures twice during each vegetation season, which lasted spring through fall. This mode of grazing would provide pastures with sufficient recovery period and ensure long-term sustainability of steppe vegetation (Shvan-Guriyskiy 1978; Sobolev 1960). 4) Animals were not allowed to graze in winter pastures during other seasons to make sure enough forage was available during the months when no plant growth occurred (Russian State Agrarian University 2017).

Calculations outlined in Table 25 indicate that 46 households, which occupied the valley in the MBA would need 176 km^2 of pasture to provide their animals with enough fodder throughout the year. This estimate is rather conservative, i.e., it is likely that a lesser area could satisfy yearly fodder requirements. One reason why the above estimate seems rather conservative has to do with the presence of highly productive patches of vegetation within the survey zone, which were not accounted for, since no precise aerial measurement of such areas in the Zingeyka valley exists at this point. In particular, marshy areas near rivers like Zingeyka possess pasture productivity that is significantly higher than the productivity cited in Table 25 (Bykov 1955; Sobolev 1960). This is due to such patches of land containing plants like *Scirpus tabernaemontani* (great bulrush), *Typha anguistofilia* (lesser bulrush), *Phragmites australis* (common reed), and plants of the Cyperaceae family (sedges). It is also worth noting that such areas would provide crucial forage and shelter for animals in the winter season, when plant resources of the steppes are at their minimum. Another reason why the total required pasture estimate, calculated in Table 25 seems overly modest has to do with a massive scale depletion of soils and pastures of the Southern Urals that took place during the Soviet times (Levit and Mironycheva-Tokareva 2005:113). This process had a negative effect on the current pasture productivity parameters (third row down in Table 25). The third reason why a lesser area than the one calculated in Table 25 likely satisfied MBA population's yearly fodder requirements has to do with changes in the environment. Stobbe's (2013) palynological analysis concluded that environmental conditions in the Southern Urals were more favorable for plant growth during the MBA period than they are now.

Nonetheless, the resulting figure (176 km^2) can still be used as a rough estimate for the purposes of present analysis. Given that most of the MBA population was concentrated in a single settlement, it is feasible to picture the total required pasture area as a circle with a radius of 7.5 km. What is important in the context of this discussion is that such radius is not beyond the daily distance that human groups would travel on the regular basis to acquire resources (Kelly 1995; Morgan 2008). Considering that Bronze Age populations possessed horseback and draft animal transportation technology, such travel distances seem quite feasible. More interestingly, the median nearest neighbor distance between the Sintashta fortified settlements is 21 km. Such distances would allow for the herding catchment zones of neighboring supra-local communities (reconstructed based on the Zingeyka valley data) not to overlap with each other. These calculations support the notion that the MBA populations could have lived in one location all year around without the need to engage in seasonal migrations to support the herds. However, large quantities of sacrificed (unconsumed) livestock that are encountered in some of the MBA kurgans (e.g., up to 30 animals in a single burial) (Gening et al. 1992) point to the existence of domestic animal surplus. Although it is difficult to speculate how much additional livestock (beyond subsistence requirements, on which the calculations in Table 25 are largely based) was kept by the MBA populations, presence of livestock surplus brings up the possibility of its seasonal movement. Such seasonal movements could have been performed by the reconstructed MBA mobile population sector (7% of the total population).

Extrapolating the numbers presented in Table 25 onto the LBA period, which is characterized by a four-fold population increase, indicates that it is highly unlikely that LBA herds could have been managed in a fully sedentary context. Figure 75 illustrates that while the 40 km^2 study area was relatively highly packed with people, there was plenty of unoccupied space in the region where large quantities of livestock could be pastured. The necessary seasonal movements of livestock could have been performed by the reconstructed LBA mobile population sector (14% of the total) in areas that were not associated with permanent human occupation.

Another question related to the management of large animal herds has to do with where the animals were kept when they were not out grazing. In other words, there had to be a certain amount of space within or close to the settlements where animals would be confined on the regular basis. In the Eurasian extensive pastoralist tradition that relied on little to no hay, the vast majority of animals were kept outside all year around (Masanov 2011; Yanguzin 2002). Only young livestock, working horses, and milk cows were typically kept inside of structures, especially in the winter months (Andreev 1953; Shitova 1984; Yanguzin 2002). Besides such structures, a typical Eurasian pastoralist household could be accompanied by a corral, stacks of dried dung and/or wood, a meat storage, a storage for various tools and equipment (Margulan et al. 1959). Given the high rates of packing within the MBA fortified settlements, some of the economic structures described above could have been located just outside of the fortified walls.

Table 25: Pasture requirement calculations for the MBA population of the Zingeyka valley. Calculations are made based on the "Stipa-Festuca mesophytic steppe on chernozem soils" vegetation type, which is prevalent in the survey zone (Levit and Mironocheva-Tokareva 2005:80).

	Spring	**Summer**	**Fall**	**Winter**	**References**
Pasture productivity by season (kg of dry plant matter/ha)	750	600	450	263	Levit and Mironocheva-Tokareva 2005:81; Sobolev 1960:11-13
Percentage of plant matter consumed by animals	60%	60%	60%	60%	Sobolev 1960:177
Calculated plant matter consumed by animals (kg/ha)	450	360	270	158	
Hectares needed per:					
1 cow (needs 7 kg of nutrients per day, or 630 kg per 90 days)	1.4	1.8	2.3	4.0	Frachetti (2008:96) provides daily nutrient values for each species
1 horse (7.2 kg/day, or 648 per 90 days)	1.4	1.8	2.4	4.1	
1 sheep (1.2 kg/day, or 108 per 90 days)	0.2	0.3	0.4	0.7	
Hectares needed per 1 household, which owns:					
40 cows	56	70	93	160	Yanguzin (2002) cites this herd structure for an average 18th century Bashkir household of ~10 people.
20 horses	29	36	48	82	
40 sheep	10	12	16	27	
Total pasture needed for 1 household (ha)	94	118	157	270	
Total pasture needed for 46 households* that occupied the valley in the MBA in ha (km^2)	4342 (43)	5428 (54)	7237 (72)	9062 (91)	
Total pasture needed per year (km^2)	= (43+54+72)/2 + 91=176				Shvan-Guriyskiy 1978:110; Sobolev 1960:15; Russian State Agricultural University 2017 (see main text for further clarification)
Total required pasture (row above) as a circle with a radius of (km)	7.5				

* 566 (mean MBA population) / 12.5 (average household size) = 46 households.

In regards to providing enough space for domestic animals in the LBA period, it is useful to refer back to the somewhat peculiar spatial layout of some of the LBA local communities, which is best illustrated by the LBA local community #6 (see Figures 68 and 100). As mentioned in chapter 4, this local community's spatial layout is somewhat atypical for what is traditionally considered a village, i.e., it is comprised of a few discrete occupation clusters located some distance (80-150 m) apart. In light of our discussion, it useful to mention Houle's (2010:63) ethnographic observations of mobile pastoralists in central Mongolia. Houle's study concluded that an area of 1-2 ha provided enough space for an average herder camp, consisting of 2-5 houses (yurts). In addition to human dwellings, such areas contained structures to house animas (corals, pens), as well a certain buffer area between camps.

If we place 5-10 people in each yurt, we get 30 as the average population of a central Mongolian camp (5 people*2 yurts =10; 10 people*5 yurts =50; (10+50)/2=30). If we use the lower space limit for a camp area provided by Houle (1 ha), we see that 30 ha of camp space could have contained 900 people (30 ha x 30 people = 900 people). For comparison, total area of the LBA local community #6 is ~30 ha and the mean population estimate for this community is 991. What this comparison shows is that the unusual layout of LBA villages could be conditioned by the requirement to provide enough space for domestic animals.

As mentioned previously in this chapter, many questions about Bronze Age subsistence practices in the Southern Urals require further investigation. The analysis presented above is based on the assumption that subsistence strategies in both MBA and LBA period remained unchanged and that populations in both periods relied quite heavily on herding for subsistence. This analysis is an attempt to illustrate how a herding-based economy would operate in the context of the reconstructed settlement patterns.

5.4 CONCLUSION

Social changes associated with the MBA and LBA periods in the Zingeyka valley did not occur in the context of nomadic/mobile pastoralism. Rather, the human mobility context in both periods was complex, with some communities being more mobile than others. The amalgamation of archaeological, faunal, and ethnographic evidence points to the vast majority of regional populations in both periods being fully sedentary, i.e., occupying settlements year-round. In other words, although the MBA-LBA populations of the Zingeyka valley were relatively mobile, they were not mobile to the degree that would require a different (i.e., non-traditional or unique) approach to political centralization that is often suggested for the prehistoric societies of the Eurasian steppes. On the contrary, early complex societies of the Southern Urals produced the type of material record that is characteristic of numerous early complex societies around the world (Kowalewski et al. 1989; Wilson 1988). More specifically, settlement pattern evidence points to a certain degree of differentiation among local communities in terms of their size and function during both periods. Furthermore, such differentiation was not limited to a settled vs. mobile dichotomy, but rather existed between the settled communities, as well as between the settled and more mobile population sectors.

6.0 CONCLUSION

6.1 RESULTS OF THE CURRENT STUDY

This dissertation was set out to investigate the development of social complexity in the Southern Urals, Russia - a region that had not been incorporated into the Anglo-American archaeological scholarship to a great extent. What we knew about the archaeology of the region made it obvious that the MBA Sintashta development shared a number of socioeconomic characteristics with countless early complex societies around the world. These characteristics included: hereditary social inequality, highly developed craft technologies, substantial labor investment into public works, ceremonial feasting, and a focus on military organization. At the same time, the existing evidence pointed to the MBA societies of the Southern Ural steppes possessing some fairly unusual attributes, when compared to other chiefdom / middle range / early complex societies. Namely, it was claimed that the Sintashta societies: (1) largely lacked supra-local organization (i.e., integration of smaller local communities into spatial clusters), (2) were extremely small demographically, (3) lacked recognizable local antecedents in the EBA, and (4) disaggregated into smaller social formations during the LBA, after existing for a fairly short period of time.

These unusual characteristics were what sparked our interest. One of the goals of this dissertation was to find out whether this unusualness of the EBA-MBA-LBA social trajectory was due to: 1) incomplete archaeological evidence, or 2) a truly unique nature of the Sintashta development, which was unlike most early complex societies that we know to date. To achieve this goal, we designed and carried out a multi-scalar regional settlement pattern study of a carefully selected 40 km^2 area, located in the Zingeyka River valley. Our research asked the following questions:

1) How much more evidence of EBA/MBA/LBA occupation is there beyond the previously recorded sites?

2) How large were EBA/MBA hinterland/LBA populations?

3) To what extent were these populations mobile or sedentary?

4) Does the occupation evidence from the survey zone suggest the presence of a supra-local community comprised of one known MBA fortified settlement surrounded by a cluster of smaller unfortified local communities? Similarly, to what extent were there settlement clusters dating to the EBA or the LBA that suggest supra-local community(-ies)? If so, what was the demographic and spatial scale of these entities?

Beyond investigating the unusual characteristics of Sintashta, answering these questions would help develop a clearer picture of the overall EBA-MBA-LBA social trajectory. Question #3 stands out from the rest in that it was not explicitly listed as one of the unusual characteristics of Sintashta. However, answering it would address how some have previously explained Sintashta's unusualness (i.e., Sintashta settlements are unique because they were populated by mobile pastoralists). The discussion below summarizes our answers to the posed research questions. Although these answers characterize what happened in the study area, there are reasons to believe that the Zingeyka valley is representative of other valleys the Southern Urals in terms of Bronze Age archaeological evidence.

6.1.1 Implications at the regional scale

Prior to the Zingeyka survey, the EBA occupation in the 40 km^2 study area has not been established (the 3 pre-ceramic occupation areas in Figure 3 were dated to the 'Mesolithic-Neolithic' chronological window). While the Zingeyka survey recovered evidence of human occupation in the study area in the EBA, it was difficult to estimate the size of human communities. It is clear, however, that EBA populations were extremely small - perhaps on the order of a 30-60 people in the entire survey zone. Furthermore, archaeological evidence suggested that kurgans, commemorating the death of selected individuals, were being erected in the Zingeyka valley as early as the EBA period. These findings countered the previously held view that the MBA Sintashta development lacked any local antecedents.

In regards to the subsequent MBA period, the results of our study pointed to the existence of a single highly centralized supra-local community, which measured ~6 km across and included 460-685 people. As a result of employing a combination of surface collection, intensive shovel probe excavation, and stratigraphic test pitting, we were able to establish that 147-221 people (~30% of regional population) had lived outside of the fortified settlement of Sarym-Sakly (the only previously known MBA site in the survey zone). On the one hand, this finding was significant in that it countered the previously held view that the MBA Sintashta fortified settlements were completely centralized and isolated. On the other hand, the size of the reconstructed regional population further highlights the unusualness of the Sintashta development in regards to the absence of a demographically significant hinterland component. Nonetheless, the identification of an additional population segment living beyond the fortified walls (likely characteristic of other Sintashta settlements) requires revision of previously accepted estimates of how many people had lived in the Southern Urals during the MBA.

The survey methodology devised for this research, which primarily relied on systematic sub-surface testing, also proved successful in identifying additional occupation beyond the previously recorded LBA sites. Due to a problematic notion of “sites”, it is difficult to say how much additional occupation we have recovered, but at least 3 local communities with a combined population of 157-234 people were completely unaccounted for prior to the Zingeyka survey. The results of our study pointed to the existence of two supra-local communities in the valley during the LBA. They measured 1.3 km and 4 km across, contained 570-840 and 1310-1940 people, respectively, and were centered around large villages, with one such village reaching the size of 1,000 inhabitants. The approximated total LBA population for the Zingeyka valley of 2000-3000 counters previous estimates, which were generally much lower (Epimakhov 2009; Johnson 2014). These findings point to the fact that the supposed collapse-like dissolution of Sintashta organization was not associated with a population decline, but rather with a four-fold regional demographic increase.

Previously, LBA population estimates have been based on the numbers of structural depressions identified through aerial photography. The Zingeyka survey identified a number of problems with using structural depressions as paleodemographic proxies (see chapter 2). Our study was different from previous research efforts in that it used the area-density index as a population proxy and relied on multiple lines of analysis to arrive at paleodemographic estimates in a contiguous area. Namely, in order to investigate how people distributed themselves across the landscape we relied on the combination of geophysical prospection, stratigraphic excavations, soil property analysis, functional analysis of artifacts, micro-topographic survey, zooarchaeological analysis, surface collection, and systematic shovel probing.

Our findings challenge the previously held view that the MBA Sintashta communities disaggregated into smaller and more dispersed social formations. On the contrary, our data indicates that in the LBA local communities became spatially more extensive. In addition, during the LBA, both local and supra-local communities became demographically larger. In fact, the only way in which LBA communities did become smaller is in the spatial extent of supra-local communities. The supposed tendency toward population dispersion (i.e., the tendency of people to distribute themselves in a less clustered, less concentrated manner) needs to be evaluated at various scales. For example, populations did become more dispersed at the level of local communities, i.e., within local communities the density of people per m^2 has declined substantially in the LBA. Supra-local communities, on the other hand, became more densely packed with people. Also, judging from the Zingeyka survey, the landscape of the Southern Urals in general became more densely packed with people, which makes speaking of greater population dispersion in the LBA problematic.

On top of a four-fold population increase in the LBA, we found evidence of differentiation in the size and function of local communities and an increased level of interaction between occupation areas. The fact that decreasing local community nucleation occurred in increasing population circumstances further highlights a more peaceful nature of social relations in the LBA. In summary, the evidence outlined above does not support the view of the MBA-LBA transition as that of a general decline, social collapse, or devolution (Epimakhov 2002b; Kohl 2007; Koryakova and Epimakhov 2007). On the contrary, it seems that at least some institutions associated with social complexity (as evidenced by the supra-local organization) prevailed for nearly 700 years in the Southern Urals.

By relying on various faunal, sedimentological, artifactual, and ethnographic evidence, we concluded that the vast majority of populations in both periods were sedentary and occupied the valley year-round. At the same time, our evidence suggests that some segments of MBA and LBA populations were seasonally mobile. Since previous views about the degree of the MBA and LBA populations' mobility varied, our evidence seems to support the sedentary side of the argument. These findings were important in that they undermined the primary reason cited by those who think that traditional models for the development of early complex societies (e.g., demographic centralization, settlement hierarchy) cannot be applied to the prehistoric developments of the Eurasian steppes (Frachetti 2009; Honeychurch and Amartuvshin 2007). The Zingeyka survey illustrated the value of applying such traditional models to at least some of the prehistoric societies of the steppes. Also, what contributed the tendency to think of LBA populations as small is an assumption that they were more mobile than the preceding MBA populations. Various lines of evidence outlined in chapter 5 counter this point of view for the Zingeyka valley.

It is important to note that the view of the EBA-LBA transition described in this dissertation is different from the traditional culture-historical interpretations, which have dominated the archaeology of the Southern Urals. One major difference has to do with the scale of analysis. In culture-historical archaeology, the units of analysis of long-term socio-political change are archaeological cultures. In the Eurasian steppes, these entities stretch over vast swaths of land, reaching thousands of kilometers.

Available archaeological data points to the fact that the level of socio-political integration during the Bronze Age was much smaller than the size of any of the steppe archaeological cultures, like Srubnaya, Alakul, or Sintashta. Therefore, investigations of socio-political change need to be carried out at a more appropriate, smaller scale, at which early polities can be discerned. Our study aimed to do just that by producing a micro-regional dataset that investigated the nature of social and political relationships between a few Bronze Age communities located within a few tens of square kilometers. Such datasets have been largely missing from the archaeology of the Southern Urals.

Another aspect, related to the one outlined above, has to do with a strong tendency to use migration in explaining long-term socio-political change in the Southern Urals. This tendency especially pertains to the EBA-MBA transition, with Sintashta being viewed by some as an "alien" culture that "had no local roots" in the region (Koryakova and Epimakhov 2007:98, 320). We, on the other hand, in our discussion of the long term change in community structure, have implicitly emphasized local autochthonous processes of demographic growth. One factor that allowed us to do that is a certain degree of continuity between the EBA and MBA material culture traditions in terms of subsistence practices, burial rituals, and craft technologies (Koryakova and Epimakhov 2007; Mosin 2000; Vinogradov and Muhina 1985). We realize that the Zingeyka valley was not a completely closed system and that some degree of inter-regional population movement likely took place. At the same time, we do not think migration was the be-all and end-all factor, which would undermine the sequence of change in community structure, outlined in this dissertation.

Continuity in various aspects of material culture between MBA and LBA periods is pronounced to the degree where migration-based explanations do not dominate the regional archaeological literature. However, it is important to note that the long-term continuity in social inequality has been deemphasized, resulting in a more dramatic dichotomy between the two periods. As outlined in chapter 4, the tradition of kurgan burials, accompanied by jewelry, weapons, and symbols of power, has continued in the LBA. One aspect that has been used to argue for a substantial decline in social inequality in the LBA was an increase in the size and quantity of kurgan burial sites – something that has been interpreted to demonstrate more inclusive, "egalitarian tendencies" (Koryakova and Epimakhov 2007:324). Rather than indicating a stark contrast in social organization, we think this trend is indicative of a significant population increase, demonstrated by our data.

Finally, the findings of the MBA and LBA supra-local communities being comprised of both mobile and sedentary sectors go beyond monolithic culture-historical perspectives that tend to paint all communities assigned into a given archaeological culture with a single brush in terms of economic orientation and mobility patterns. At this point, it is clear that the Bronze Age settlement patterns of the Southern Urals do not align with the ethnographic record of Eurasia's nomadic pastoralists. It is our hope that studies like this will help the Eurasian scholarship move beyond the interpretations that automatically project the timeless notions of population dispersion and seasonal mobility onto all prehistoric societies of the steppes. In summary, this study's finer scale of analysis, greater emphasis on internal processes, and a focus on continuity of local traditions has created a picture of a long-term social change in the Southern Urals that is quite different from the previous view, outlined in chapter 1.

6.1.2 Implications at the macro-regional and global scales

Due to a relatively late spread of writing, the Eurasian steppe became part of the historical record fairly late. When it did, it emerged as a powerful player in the Central Eurasia's political arena. Early Chinese and Greek historical records characterize the Xiongnu (5th-3rd centuries BC) and the Scythian (9th-6th centuries BC) developments, which researchers often refer to as 'tribal confederacies' or 'states', as possessing fairly advanced political, economic, and social organization. While researchers agree that the roots of political authority, hereditary inequality, and economic differentiation in the Eurasian steppes extend back into the Bronze Age period, the evidence of the earliest forms of social complexity has thus far been largely limited to the mortuary and ceremonial sites. The archaeological record of the Southern Urals is particularly interesting in this regard because it provides an opportunity to investigate the emergence of early complex societies of the steppes from a settlement pattern perspective. The Zingeyka valley represents an example of one such study.

From a comparative perspective, it is interesting to see that the principles of supra-local organization, demographic centralization, and differentiation in settlement size and function apply to the early complex societies of the steppes. This finding agrees with the view that early complex societies across the globe were brought into being by similar social forces, operating consistently, in a limited number of ways. From a comparative perspective, one aspect that remains intriguing about Sintashta is its small demographic scale. Other societies that exhibited hereditary social inequality, highly developed craft technologies, substantial labor investment into public works, ceremonial feasting, focus on military organization, supra-local organization, and demographic centralization were generally demographically larger. Archaeological evidence associated with the MBA period in the Southern Urals suggests that large population numbers (i.e., measuring in the tens of thousands or even thousands) are not a necessary prerequisite for various processes, outlined above. Numerous researchers have previously discussed the notion that human collectives whose size exceeds 150-200 people will need to either fission or develop complex (e.g., hierarchical) mechanisms for conflict resolution and decision-making (Alberti 2014; Dunbar 1992; Johnson 1983). The Sintashta development presents a case study, which illustrates that such population threshold does not need to be exceeded by a whole lot before we start seeing material correlates of social complexity, such as substantial hierarchy (at least in symbolic and prestige terms). What is even more interesting is that by the time the demographic parameters of the Southern Urals societies caught up with their counterparts in other world regions (i.e., began to measure in the 1000's), the level of social inequality had declined (as suggested by some aspects of the mortuary evidence, outlined in chapter 4). In addition, the evidence of metal production became more ephemeral, while the fortifications diminished. These observations undercut demographically deterministic notions which automatically link greater population numbers with greater levels of socio-political complexity and vice versa.

One of the central questions in anthropological archaeology is how and why early complex societies emerged independently in multiple locations around the world. By recognizing cross-cultural similarities and focusing on the variability of developmental pathways, this study has helped us understand better how processes associated with the emergence of complex societies worked in a setting that is generally associated with low population densities and high levels of geographic mobility. By documenting the changes in the demographic and spatial size of communities, we were able to establish how early complex societies emerged in the Southern Urals and what shape they took. However, the 'why' part of the big question has not been addressed explicitly, i.e., besides documenting the centripetal forces of human interaction, our investigation did not focus on investigating other catalysts that could have caused such sharp shifts in the patterns of human interaction between EBA and MBA and again between MBA and LBA.

Nonetheless, in addition to what is already known from the archaeological work of others, the Zingeyka survey demonstrated that concentration of metal production within the MBA fortified settlement was significantly higher than in the hinterlands. Also, in the absence of any substantial changes to subsistence (as far as we know at this stage of research), the valley supported four times more people in the LBA, who did not engage in warfare (at least not to the degree that would require fortifications). This observation makes it unlikely that conflict over scarce subsistence resources was among the factors that drove the emergence of the MBA Sintashta supra-local communities. What other economic, social, or environmental mechanisms were behind the emergence, existence, and the eventual disappearance of the MBA Sintashta pattern? Asking such questions points the way to a promising direction for future research.

6.2 DIRECTIONS FOR FUTURE RESEARCH

In terms of the field methodology and the combination of analytical methods that were applied to the recovered material, the Zingeyka survey was the first of its kind in the Southern Urals. Moreover, our study has encompassed a rather limited territory that contained only one MBA fortified settlement. The unusualness and the small scale of this survey tend to limit the utility of its results. As previously mentioned, existing settlement pattern data coming from outside of the Zingeyka survey zone are subject to a number of biases and therefore represent poor material for comparison. For example, although Johnson (2014) systematically surveyed territories surrounding two other Sintashta fortified sites (Stepnoye and Chernorech'ye), we are unsure how the results of the two studies correspond with each other due to the surface collection method employed by Johnson being ineffective in establishing the parameters of prehistoric occupation areas in the Southern Ural steppe environments. Therefore, surveying other parts of the Sintashta-Petrovka territory using a methodology similar to the one presented in the current study would allow to place our 40 km^2 study area into a broader picture of social change in the region.

One way to get a more comprehensive understanding of the EBA-LBA social processes would be to expand the Zingeyka survey in the east and west directions. Doing this would make it possible to: 1) find the true eastern extent of the MBA district (which had to be guessed at); and 2) establish the spatial and demographic size of human communities associated with the neighboring MBA Kuysak settlement (located ~10 km to the west of the survey zone). After all, it is possible that the structure of MBA human communities associated with different fortified settlements varied substantially (see Figure 2). Expanding the survey to the west far enough to incorporate Kuysak would also make it posible to learn more about the chronological and functional relationships between different fortified settlements that are considered to be roughly contemporaneous.

Metal production has been discussed extensively in connection with the Sintashta development. Based on the results of our survey, we were able to make some initial inferences about the scale and distribution of metal production within the MBA and LBA occupation areas (see chapter 4). However, it is important to keep in mind that metal production involves a mining component, which remains an intensely debated topic among archaeologists (Grigoryev 2007; Hanks et al. 2015). We know of a confirmed Bronze Age open pit copper mine, Vorovskaya Yama, located ~5 km northwest from the study area. Systematically surveying the vicinities of the mine (which has not been done) would help answer questions pertaining to the intensity of its use and the degree of access to this resource during different phases of the Bronze Age.

How did fairly large concentrations of people organize themselves socially, economically, and politically in the context of the arid grassland environments of Eurasia? This study, which focused on settlement evidence at a regional scale, represents an important step toward answering this question. However, there are a number of other lines of evidence and scales of analysis that could enhance our understanding of how early complex societies first emerged in the steppes. For example, section 5.3 pointed out that in the LBA, at the level of local communities, large agglomerations of people organized themselves differently from what we typically envision when we think of 'villages'. To what degree were the particulars of such settlements conditioned by the requirements associated with a herding-based subsistence economy? Investigations of the spatial distribution of activities and structures associated with livestock management at a finer (intra - local community) scale would help unpack this issue. An important step in a related direction is being undertaken by I. Chechuskov of the University of Pittsburgh in his PhD dissertation (forthcoming), which deals with the distribution of human activities within MBA local communities associated with Sintashta fortified sites.

Our study has established the need to develop a better understating of various components of the MBA and LBA subsistence systems. In particular, there is a need to further investigate the role that chenopods and other native steppe plants played in the diets of Bronze Age populations. One way to achieve this objective would be to conduct a regional study that would incorporate systematic macro-botanical analyses of different period cultural deposits from various archaeological contexts. Parallel to that, it would be useful to conduct a paleoenvironmental study of the same geographic area to examine the spatial and chronological variability of local plant environments. As can be discerned from section 5.3, discussions of land carrying capacity, human mobility, and demographic growth potential in the Bronze Age are strongly tied to the productivity of local soil and vegetation resources.

Finally, the Sintashta case study suggests an intriguing possibility that small demographic scale may be a common feature shared by other early complex societies of northcentral Eurasia. The intensive methodology designed for the research reported here has produced surprising results in terms of community structure in both the MBA and LBA periods. This observation suggests that applying similar methodologies in other parts of northcentral Eurasia might expand, and possibly alter, our understanding this region’s prehistory.

APPENDIX A

VISUAL SUMMARY OF OCCUPATION AREAS

This appendix provides a visual summary of all (26) occupation areas that yielded significant traces of EBA-LBA occupation. In all of the figures presented below red circles denote positive shovel probes, black circles denote blank shovel probes, green triangles mark surface finds. For collection units #1-4, see Figure 20 in the main text. The collection units are not numbered in a strict sequence since some of them were left out of the analysis, as discussed in chapter 2. Refer back to Figure 13, as needed, for the map of all of the collection units within the study area. Satellite images in Figures 109-119 are courtesy of the DigitalGlobe Foundation.

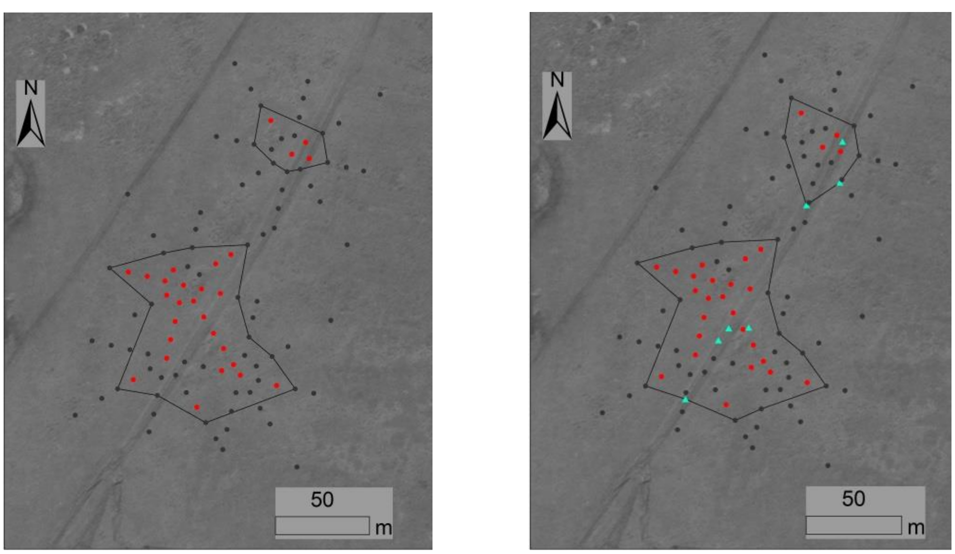


Figure 109: Collection units #5 (south) and #6 (north). Figure on the right shows the outlines of areas from which surface finds were pooled together with shovel probe finds to obtain the per-period sherd proportions.

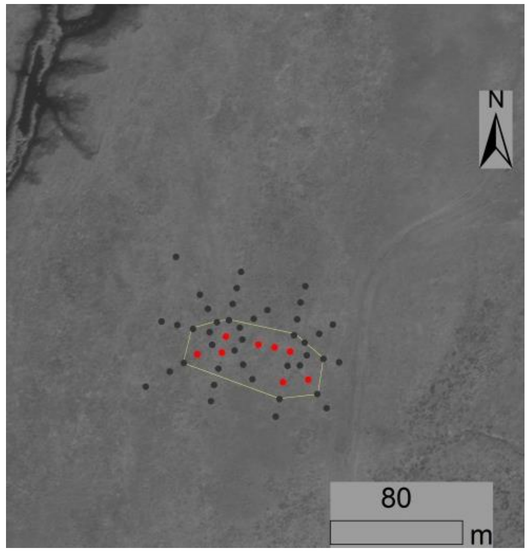


Figure 110: Collection unit #7. No surface finds were recovered.

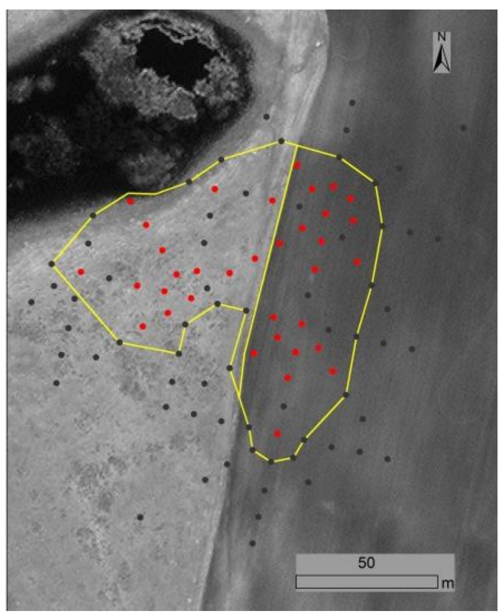


Figure 111: Collection unit #8 (east) and #9 (west). See Figure 15 for the outlines of areas from which surface finds were pooled together with shovel probe finds to obtain the per-period sherd proportions.

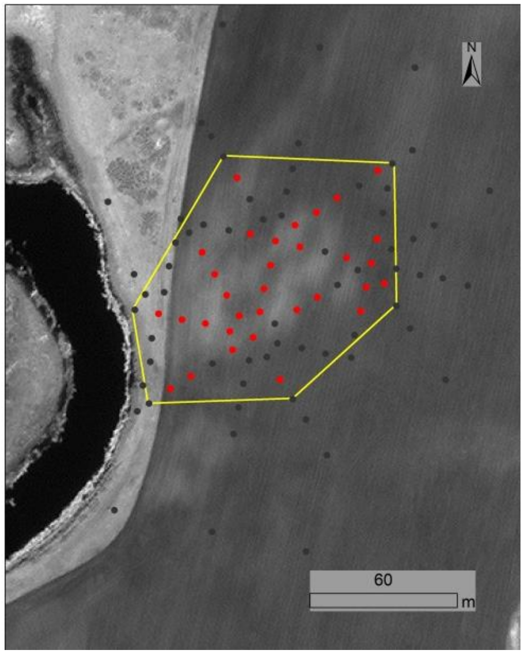


Figure 112: Collection unit #11. See Figure 21 for the outlines of areas from which surface finds were pooled together with shovel probe finds to obtain the per-period sherd proportions.

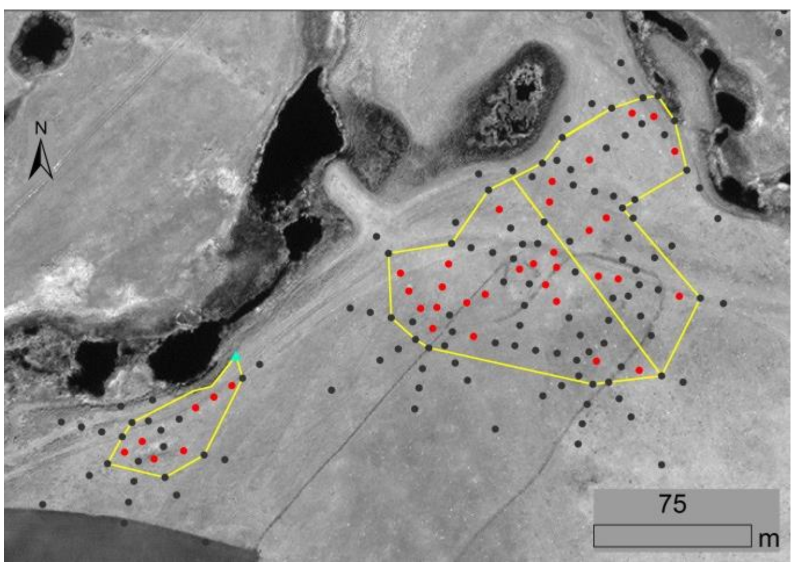


Figure 113: Collection units #13-15 (numbered from west to east). Since a single surface find (a ceramic sherd, denoted by the green triangle) was recovered, no alternative c.u. delineations were performed.

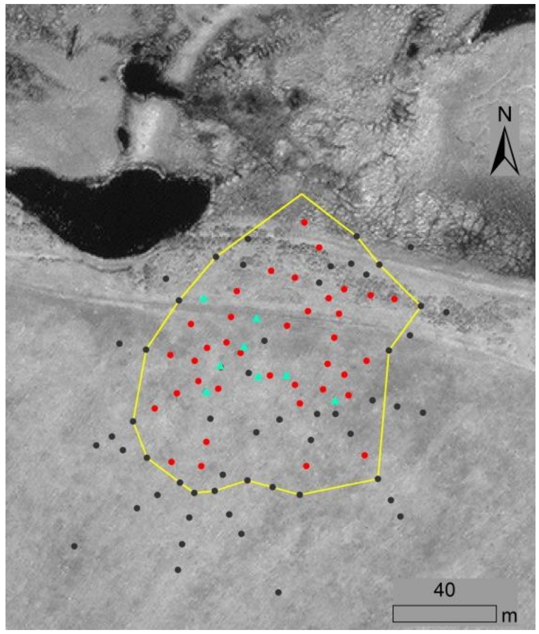


Figure 114: Collection unit #16.

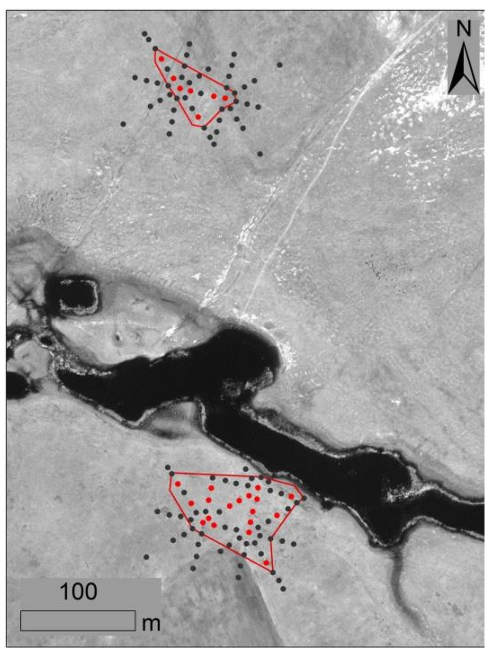


Figure 115: Collection units #17 (south) and 18 (north). No surface finds were recovered.

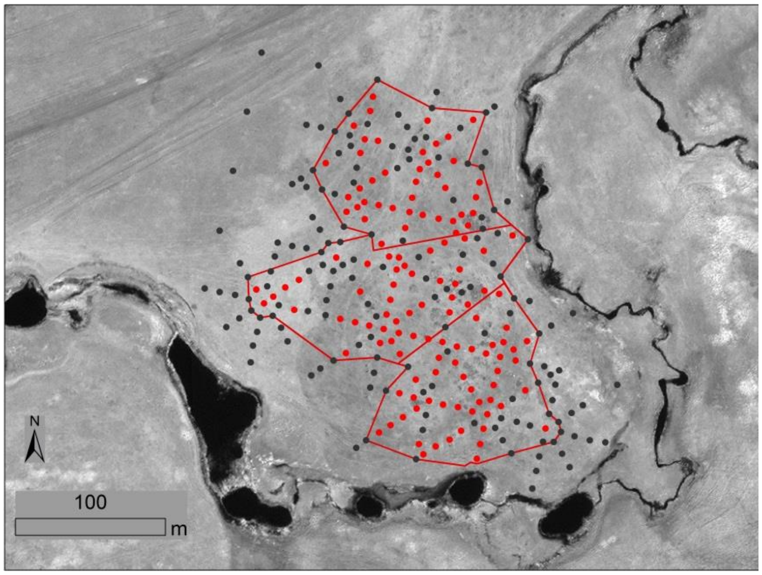


Figure 116: Collection units #19-21, numbered from south to north. No surface finds were recovered.

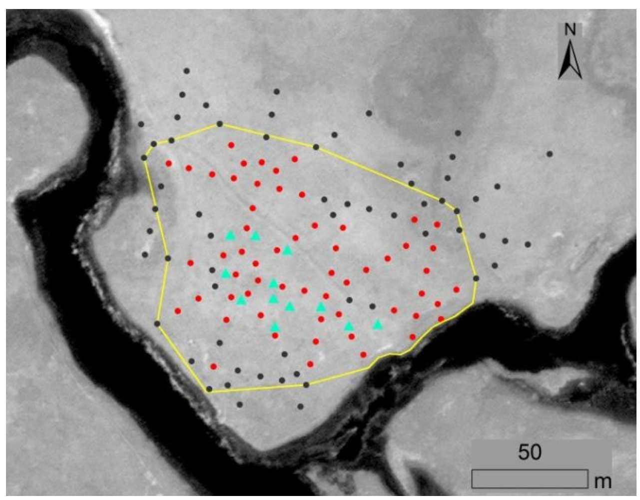


Figure 117: Collection unit #23.

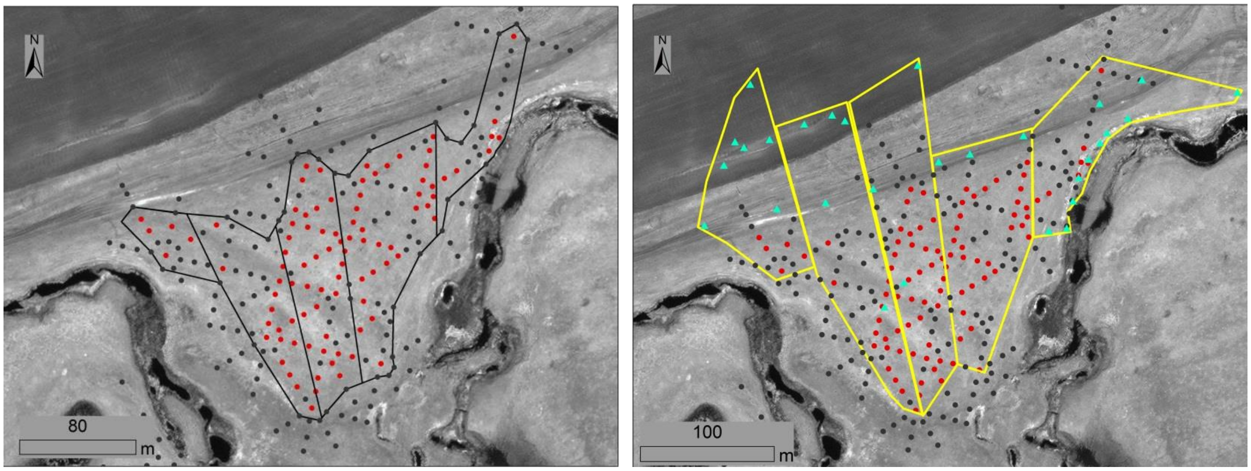


Figure 118: Collection units #24-28 (numbered from east to west). The Image on the right shows the outlines of areas from which surface finds were pooled together with shovel probe finds to obtain the per-period sherd proportions.

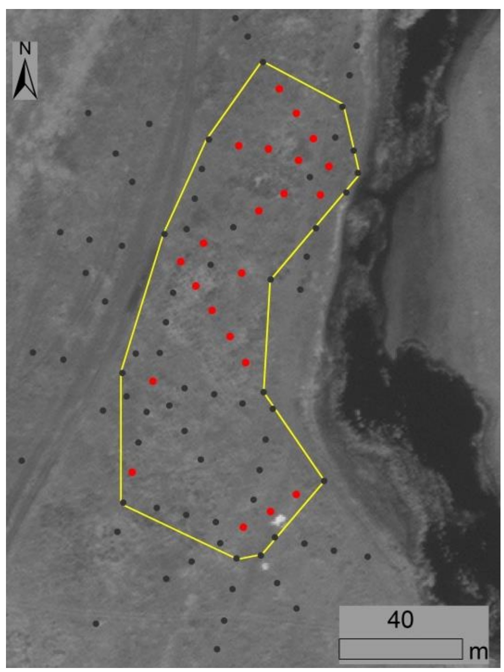


Figure 119: Collection unit #29. No surface finds were recovered.

APPENDIX B

ACCESS TO THE ONLINE DATASET

The regional dataset for the Zingeyka River valley is available electronically through the University of Pittsburgh's Comparative Archaeology Database. The downloadable dataset contains both spatial and quantitative information about the collection units that were documented during the regional survey. The locations and spatial limits of all collection units, as well as additional details about the recovery techniques, visibility conditions, and quantities of ceramics are provided. The data are available in a variety of formats and can be accessed at www.cadb.pitt.edu. General questions regarding the database and its contents should be sent to *cadb@pitt.edu*.

BIBLIOGRAPHY

Alaeva, Irina P.

2015 *Kulturnaya specifika pamyatnikov bronzovogo veka stepnoi zony Yuzhnogo Zauralya*. Ph.D. dissertation. Russian Academy of Sciences, Moscow.

2016 *Otchet ob arheologicheskoi razvedke v doline reki Zingeyka ot pos. Zarya do pos. Zingeyskiy na territorii Kizilskogo rayona letom 2015 goda*. Field report. Chelyabinsk State Pedagogical University, Chelyabinsk.

Alberti, Gianmarco

2014 Modeling Group Size and Scalar Stress by Logistic Regression from an Archaeological Perspective. *PLoS ONE* 9(3):e91510.

Alden, John R.

1979 A Reconstruction of Toltec Period Political Units in the Valley of Mexico. In *Transformations: Mathematical Approaches to Culture Change*, edited by Colin Renfrew and Kenneth L. Cooke, pp. 169-200. Academic Press, New York.

Allard, Francis and D. Erdenebaatar

2005 Khirigsuurs, Ritual and Mobility in the Bronze Age of Mongolia. *Antiquity* 79(305):547-563.

Andreev, M.S.

1953 *Tadjiki doliny Huf: verhovya Amu-Daryi*. Institut arheologii, i etnografii Tadjikskoy SSR, Stalinobad.

Ankushev, Maksim N., Irina P. Alaeva, Polina S. Medvedeva, Igor V. Chechushkov, Denis V. Sharapov

2016 Mineralnye mikrovklyucheniya v drevnih metallurgicheskih shlakah bronzovogo veka v doline r. Zingeyka. *Geoarchaeology and Archaeological Mineralogy* 2016(3):116-121. Institute of Mineralogy (Ural Branch of the Russian Academy of Sciences), Miass, Russia.

Anthony, David W.

2007 *The Horse, the Wheel, and Language: How Bronze-Age Riders from the Eurasian Steppes Shaped the Modern World*. Princeton University Press, Princeton, New Jersey.

Anthony, David W. and Dorcas Brown

2007 The Herding and Gathering Economy at Krasnosamarskoe, Russia, and the End of the Dependency Model of Steppe Pastoralism. In *Social Orders and Social Landscapes*, edited by Laura Popova, Charles W. Hartley, and Adam T. Smith, pp. 393-415. Cambridge Scholars, Newcastle, UK.

Arnold, Jeanne E.
1996 The Archaeology of Complex Hunter-Gatherers. *Journal of Archaeological Method and Theory* 3:77-126.

Atwood, C. P.
2007 Is There Such a Thing as Central/Inner (Eur)Asia and Is Mongolia a Part of It? In *Mapping Mongolia: Situating Mongolia in the World from Geologic Time to the Present*, edited by P.L. Sabloff, pp. 60-84. Penn Museum International Research, Philadelphia.

Avanesova, N. A.
1991 *Kultura pastusheskih plemen epohi bronzy asiatskoi chasti SSSR (po metallichskim izdeliyam).* Fan, Tashkent, Uzbekistan.

Auerbach, F.
1913 Das Gesetz der Bevolkerungskoncentration’. *Petermanns Geographische Mitteilungen* 59: 74-76.

Bachura, Olga P.
2009 Opredelenie sezona i vozrasta zaboya zhivotnyh po registriruyuschim strukturam iz poseleniya Ustye. In *Etnicheskie vzaimodeistviya na Yuzhnom Urale*, edited by A. D. Tairov and N. O. Ivanova, pp. 31-33. Izdatelskiy tsentr YuURGU, Chelyabinsk.

2013 Season and Age of the Slaughter of Cattle (Bos taurus) and Sheep (Ovis aries). In *Multidisciplinary Investigations of the Bronze Age Settlements in the Southern Trans-Urals (Russia)*, edited by Rüdiger Krause and Ludmila N. Koryakova, pp. 285-290. Habelt, Bonn.

2014 Sezonnyi hozyaistvennyi tsikl naseleniya sintashtinskoy kultury Yuzhnogo Zauralya. *Rossiyskaya arheologiya* 2014(2):21-26.

Bachura, Olga P., Gennady B. Zdanovich, and P. A. Kosintsev
2011 Sezon i vozrast zaboya domashnih kopytnyh po registriruyuschim strukturam iz ukreplennogo poseleniya Arkaim. In *Ekologiya drevhih traditsionnyh obschestv*, edited by N. P. Matveeva and A. N. Bogdashev, pp. 11-12. Izdatelstvo IPOS SO RAN, Tyumen.

Barth, F.
1961 *Nomads of South Persia*. Oslo University Press, Oslo.

Batanina, I. M. and I .O. Ivanova
1995 Arheologicheskaya karta zapovednika Arkaim: Istoriya issledovaniya arheologicheskih pamyatnikov. In *Arkaim. Issledovaniya, Poiski. Otkrytiya*, edited by Gennady B. Zdanovich, pp. 159-196. Kamennyi Poyas, Chelyabinsk.

Bayman, James M.
2001 The Hohokam of Southwest North America. *Journal of World Prehistory* 15:257-311.

Berezkin, Y. E.
1995 Arkaim kak ceremonialnyi centr: vzglyad amerikanista. *Arheologicheskiye Izyskaniya* 25:29-39.

Berrey, Adam C.
2014 *Organization and Growth among Early Complex Societies in Central Panama*. Ph.D. dissertation, Department of Anthropology, University of Pittsburgh, Pittsburgh.

Blanton, Richard E.
2004 Settlement Pattern and Population Change in Mesoamerican and Mediterranean Civilizations: A Comparative Perspective. In *Side-by-Side Survey: Comparative Regional Studies in the Mediterranean World*, edited by Susan Alcock and John Cherry, pp. 206-240. Oxbow, Oxford, UK.

Blanton, Richard E., Gary M. Feinman, Stephen A. Kowalewski, and Peter N. Peregrine
1996 A Dual-Processual Theory for the Evolution of Mesoamerican Civilization. *Current Anthropology* 37:1-14.

Brookfield, H. C.
1972 Intensification and Disintensification in Pacific Agriculture. *Pacific Viewpoint* 13:30-48.

Brown, B.
1987 Population Estimation from Floor Area: A Restudy of Naroll's Constant. *Behavior Science Research* 22:1–49.

Bushmakin, A. F.
2000 Mineralniy sostav korok na metallicheskih predmetah iz poseleniya Arkaim. In *Arheologicheskiy istochnik i modelirovanie drevnih technologiy*, edited by Gennady B. Zdanovich and S. Ya. Zdanovich, pp. 130-137. Museum-Reserve Arkaim, Chelyabinsk.

Byers, Martin A.
2013 *From Cahokia to Larson to Moundville: Death, World Renewal, and the Sacred in the Mississippian Social World of the Late Prehistoric Eastern Woodland*. Newfound Press, Knoxville, Tennessee.

Bykov, B. A.
1955 *Rastitelnost I kormovye resursy zapadnogo Kazakhstana*. Izdatelstvo akademii nauk Kazakhskoi SSR, Alma-Ata.

Carneiro, Robert L.
1981 The Chiefdom: Precursor to the State. In *The Transition to Statehood in the New World,* edited by Grant D. Jones and Robert Kautz, pp. 37-80. Cambridge University Press, Cambridge, UK.

Chechushkov, Igor V.
2015 *Otchet ob arheologicheskih rabotav v Kizilskom rayone Chelyabinskoy oblasti v 2014 godu*. Field report. Southern Urals Branch of the Russian Academy of Sciences, Chelyabinsk.

Chemyakin, Yu. P.
1974 Poselenie epohi bronzy Mirnyi IV. *Iz istorii Sibiri* 15:50-55. Izdatelstvo Tomskogo Universiteta, Tomsk.

Chernykh, E. N.
2009 Formation of the Eurasian Steppe Belt Cultures: Viewed Through the Lens of Archaeometallurgy and Radiocarbon Dating. In *Social Complexity in Prehistoric Eurasia: Monuments, Metals, and Mobility*, edited by Bryan K. Hanks and Kathryn M. Linduff, pp. 115-146. Cambridge University Press, New York.

Cheremshanskiy, V. M.
1859 *Opisanie Orenburgskoi gubernii v hozyaistvenno-statisticheskom, etnograficheskom i promyshlennyh otnosheniyah*. Ministerstvo Gosudarstvennogo Imuschestva, Ufa.

Chibilyov, A. A.
2002 Steppe and Forest-Steppe. In *The Physical Geography of Northern Eurasia*, edited by M. Shahdehanova, 248-266. Oxford University Press, New York.

Chizhikova, L. N.
1999 Selskiye zhilischa v XVIII – nachale XX veka. In *Russkie*, edited by V. A. Aleksandrov, I. V. Vlasova, and N. S. Polischuk, pp. 278-307. Nauka, Moscow.

Christian, David
1998 *A History of Russia, Central Asia, and Mongolia*, V.1. Blackwell, Oxford, UK.

Chogdon, Zh.
1980 *Obvodnenie pastbisch: na primere MNR*. Kolos, Moscow.

D'Altroy, Terence N., and Timothy K. Earle
1985 Staple Finance, Wealth Finance, and Storage in the lnka Political Economy. *Current Anthropology* 26:187-206.

Dohm, Karen
1990 Effect of Population Nucleation on House Size for Pueblos in the American Southwest. *Journal of Anthropological Archaeology* 9:201-209.

Doonan, Roger, Bryan Hanks, Dmitry Zdanovich, Elena Kupriyanova, Derek Pitman, Natal'ya Batanina and James Johnson
2014 Metals, Society, and Economy in the Late Prehistoric Eurasian Steppe. In *Archaeometallurgy in Global Perspective: Methods and Syntheses*, edited by Benjamin W. Roberts and Christopher P. Thornton, pp. 755-784. Springer, New York.

Drennan, Robert D.
1988 Household Location and Compact versus Dispersed in Prehispanic Mesoamerica. In *Household and Community in Mesoamerican Past*, edited by R. R. Wilk and W. Ashmore, pp. 273-293. University of New Mexico Press, Albuquerque.

1992 What Is the Archaeology of Chiefdoms About? In *Metaarchaeology: Reflections by Archaeologists and Philosophers*, edited by L. Embree, pp. 53-74. Kluwer Academic, Dordrecht.

1996a One for All and All for One: Accounting for Variability without Losing Sight of Regularities in the Development of Complex Society. In *Emergent Complexity: The Evolution of Intermediate Societies*, edited by J. Arnold, pp. 25–34. International Monographs in Prehistory, Ann Arbor, Mich.

1996b *Statistics for archaeologists: A commonsense approach*. Plenum Press, New York.

2008 Chiefdoms of Southwestern Colombia. In *Handbook of South American Archaeology*, edited by Helaine Silverman and William Harris Isbell, pp. 381-403. Springer, New York.

Drennan, Robert D., Adam C. Berrey, and Christian E. Peterson
2015 *Regional Settlement Demography in Archaeology*. Eliot Werner, New York.

Drennan, Robert D., Bryan K. Hanks, and Christian E. Peterson
2011 The Comparative Study of Chiefly Communities in the Eurasian Steppe Region. *Journal of Social Evolution and History* 10(1):12–48.

Drennan, Robert D., Teng Mingyu, Christian E. Peterson, , G. Shelach, G. G. Indrisano, Z. Yanping, Kathryn M. Linduff, G. Zhizhong and Manuel A. Roman-Lacayo
2003 Methods for Archaeological Settlement Study. In *Regional Archaeology in Eastern Inner Mongolia: A Methodological Exploration*, edited by The Chifeng International Collaborative Archaeological Research Project, pp. 122-162. Science Press, Beijing.

Drennan, Robert D. and Christian E. Peterson
2008 Centralized Communities, Population, and Social Complexity After Sedentarization. In *The Neolithic Demographic Transition and its Consequences*, edited by Jean-Pierre Bocquet-Appel and Ofer Bar-Yosef, pp. 359-386. Springer, New York.

2012 Challenges for Comparative Study of Early Complex Societies. In *The Comparative Archaeology of Complex Societies*, edited by Michael E. Smith, pp. 62–87. Cambridge University Press, Cambridge, UK.

Drennan, Robert D., Christian E. Peterson, and Jake R. Fox
2010 Degrees and Kinds of Inequality. In *Pathways to Power*, edited by T. Douglas Price and Gary M. Feinman, pp. 45–76. Springer, New York.

Dunbar, R. I.
1992 Neocortex Size as a Constraint on Group Size in Primates. *Journal of Human Evolution* 22:469-493.

Ellis, Linda
1984 *The Cucuteni-Tripolye Culture: A study in Technology and the Origins of Complex Society*. BAR International Series 217. BAR, Oxford, UK.

Epaneshnikov, M. G.
2011 *Poselok Katsbakhskiy: zemlya otcov, zemlya rodnyh lyudei*. Status, Magnitogorsk.

Epimakhov, Andrey V.
1985 *Razvedochnoe obsledovanie reki Zingeyka v Kartalinskom rayone i v Kizilskom Rayone Chelyabinskoi oblasti*. Field report. Chelyabinsk State University, Chelyabinsk.

1996 Demograficheskiye aspekty sociologicheskih rekonstrukciy (po materialam sontashtisnko-petrovskih pamyatnikov). In *XIII Uralskoye arheologicheskoya soveschanie*, edited by V.A. Ivanov, pp. 58-60. Vostochnyi Universitet, Ufa.

2002a Complex Societies and the Possibilities to Diagnose them on the Basis of Archaeological Data: Sintashta type Sites of the Middle Bronze Age. In *Complex Societies of Central Eurasia from the 3rd to the 1st Millennium BC: Regional Specifics in Light of Global Models*, edited by Karlene N. Jones-Bley and Dmitry G. Zdanovich, pp. 139-148. Institute for the Study of Man, Washington, D.C.

2002b *Yuzhnoe zauralye v epohu sredney bronzi*. Izdatelstvo YuUrGU, Chelyabinsk.

2007 Otnositelnaya i absolutnaya hronologiya sintashtinskih pamyatnikov v svete radiokarbonnyh datirovok. *Problemy Istorii, Filologii, i Kul'tury* 18:402-421.

2009 Ot arheologii pamyatnika k arheologii sociuma: epoha bronzy Yuzhnogo Zauralya. *Problemy Istorii, Filologii, i Kul'tury* 3:92-104.

2010a *Bronzovyi vek Yuzhnogo Urala: economicheskie i socialnye aspekty.* Ph.D. dissertation, Russian Academy of Sciences, Southern Ural State University. Izdatelstvo YuUrGU. Chelyabinsk.

2010b Novye materialy po istorii yuvelirnogo dela alakulskogo naseleniya epohi bronzy Yuzhnogo Zauralya. In *Integraciya etnograficheskih i arheologicheskih essledovaniy*, edited by N. A. Tomilov, pp. 113-115. Institut Istorii im. Sh. Mardzhani, Kazan, Russia.

Fedorova, N. V., V. V. Noskevich, V. S. Ivanchenko, A. S. Bebnev, and A. V. Malikov
2013 Geophysical Methods of Research of Archaeological Monuments Sarym-Sakly and Vorovskaya Yama (Southern Ural Mountains). *Uralskiy geofizicheskiy vestnik* 2(22):46-53.

Feinman, Gary M.
2013 The Emergence of Social Complexity: Why More than Population Size Matters. In *Cooperation and Collective Action: Archaeological Perspectives*, edited by David M. Carballo, pp. 35–56. University of Colorado, Boulder.

Fiel'strup, F.
1927 Skotovodstvo i kochevanie v chasti stepei Zapadnogo Kazakhstana. In *Kazaki: antropologicheskie ocherki*, Vol. II, edited by S. I. Rudenko, pp. 78-107. Izdatelstvo AN SSR, Leningrad.

Flannery, Kent V.
1972 The Cultural Evolution of Civilizations. *Annual Review of Ecology and Systematics* 3(1):399-426.

Frachetti, Michael D.
2008 *Pastoralist Landscapes and Social Interaction in Bronze Age Eurasia*. University of California Press, Los Angeles.

2009 Differentiated Landscapes and Non-uniform Complexity among Bronze Age Societies of the Eurasian Steppe. In *Social Complexity in Prehistoric Eurasia: Monuments, Metals, and Mobility*, edited by Bryan K. Hanks and Katheryn M. Linduff, pp. 19-46. Cambridge University Press, New York.

2012 Multiregional Emergence of Mobile Pastoralism and Nonuniform Institutional Complexity across Eurasia. *Current Anthropology* 53 (1):2-38.

Frachetti, Michael D. and Norbert Benecke
2009 From Sheep to (Some) Horses: 4500 Years of Herd Structure at the Pastoralist Settlement of Begash (South-Eastern Kazakhstan). *Antiquity* 83 (322):1023-1037.

Fried, Morton H.
1967 *The Evolution of Political Society*. Random House, New York.

Gaiduchenko, Leonid L., Dmitry G. Zdanovich, Elena V. Kupriyanova, and Bryan K. Hanks
2011 Vnutrigodovaya dinamika naselennosti ukreplennyh poselenyi epohi sredney bronzy v Yuzhnom Zauralye. In *Ekologiya drevnih i tradicionnyh obschestv*, edited by N. P. Matveeva and A. N. Bagashev, pp. 150-155. Izdatelstvo IPOS SO RAN, Tyumen.

Gening, V. F.
1973 Programa statisticheskoi obrabotki keramiki iz arheologicheskih raskopok. Sovetskaya Arheologiya 1973(1):114-136.

Gening, V. F., G. B. Zdanovich, and V. V. Gening.
1992 *Sintashta: arkheologicheskie pamyatniki ariyskih plemen Uralo-Kazakhstanskikh stepey.* Yuzhno-Ural'skoe knizhnoe izd-vo, Chelyabinsk.

Golyeva, A. A.
2000 Vzaimodeistvie cheloveka i prirody v severo-zapadnom Prikaspii v epohu bronzy. In *Sezonnyi ekonomicheskiy cikl naseleniya severo-zapadnogo Prikaspiya v bronzovom veke,* Vol. 120, edited by Natalya I. Shishlina, pp. 10-29. Gosurastvennyi Istoricheskiy Muzei, Moscow.

Gras, N. S.
1922 The Development of Metropolitan Economy in Europe and America. *The American Historical Review 27*(4):695-708.

Greenberg, Raphael
2011 Life in the City: Tel Bet Yerah in the Early Bronze Age. In *Daily Life, Materiality, and Complexity in Early Urban Communities of the Southern Levant*. *Papers in Honor of Walter E. Rast and R. Thomas Schaub*, edited by Meredith S. Chesson, Walter Emanuel Aufrecht, and Ian Kuijt, pp. 41-55. Eisenbrauns, Winona Lake, Indiana.

Grigoryev, S. A.

1999 *Drevnie indoevropeicy: opyt istoricheskoi rekonstrukcii*. Ural Branch of the Russian Academy of Sciences, Chelyabinsk.

2000 Bronzovyi vek. In *Drevnyaya istoriya Yuzhnogo Zauralya*, Vol. I, edited by I. V. Predeina, pp. 241-442. Izdatelstvo YuUrGU, Chelyabinsk.

2007 Problema rudnoi bazy, ispolzovaniya flusov I organizacii proizvodsva v drevnei metallurgii Yuzhnogo Urala. *Arheologiya Vostochno-Evropeiskoy stepi* 5:176-199. Nauchnaya kniga, Saratov.

Grigoryev, S. A., L. Yu. Petrova, and N. P. Salugina

2009 Tipologiya i technologiya izgotovleniya keramiki poseleniya epohi pozdney bronzy Mochische. *Izvestiya Chelyabinskogo nauchnogo centra* 2(44):40-43.

Gutkov A. I.

1995 Technika i technologiya izgotovleniya keramiki poseleniya Arkaim. In *Arkaim. Issledovaniya. Poiski. Otkrytiya.*, edited by Gennadiy B. Zdanovich, pp. 135-147. Kamennyi Poyas, Chelyabinsk.

1999 Byla li sel'skohozyaistvennaya okruga v bronzovom veke? In *XIV Uralskoe aarheologicheskoe soveshhanie (21-24 aprelya 1999 g.): Tezisy dokladov*, edited by S. A. Grigoryev, pp. 69-70. Rifei, Chelyabinsk.

1988 *Razvedochnye raboty v doline r. Zingeyka*. Field report. Chelyabinsk State University, Chelyabinsk.

2002 Techinka i technologiya izgotovleniya keramiki kurgana 25 Bolshekaraganskogo mogilnika (tablicy). In Arkaim: nekropol (po materialam kurgana 25 Bolshekaraganskogo mogilnika), edited by Dmitry G. Zdanovich, pp. 117-119. Yuzhno-Uralskoye knizhnoe izdatelstvo, Chelyabinsk.

2013 Techniko-technologicheskiy analiz keramiki poseleniya Ustye I. In *Drevnee Ustye: Ukreplennoe poselenie Bronzovogo veka v Yuzhnom Zauralye*, edited by Nikolay B. Vinogradov, pp. 179-185. Abris, Chelyabinsk.

Ivanov, A. I.

1973 *Kachestvennaya i ekonomicheskaya otsenka kormovyh ugodiy*. Kainar, Alma-Ata.

Ivanova, Nadezhda O.

1996 *Otchet: Ohrannye raskopki poseleniya Bersuat*. Field report. Chelyabinsk State University, Chelyabinsk.

Johnson, Gregory A.

1983 Decision-Making Organization and Pastoral Nomad Camp Size. *Human Ecology* 11(2):175-199.

Johnson, James

2014 *Community Matters? Investigating Social Complexity through Centralization and Differentiation in Bronze Age Pastoral Societies if the Southern Urals, Russian Federation, 2100-900 BC*. Ph.D. dissertation, Department of Anthropology, University of Pittsburgh, Pittsburgh.

Johnson, James and Bryan K. Hanks

2012 Society, Demography and Community: Reassessing Bronze Age Sintashta Populations in the Southern Urals, Russia (2100-1700 BC). In *Beyond Elites: Alternative to Hierarchical Systems in Modeling Social Formations,* edited by T.L. Kienlin and A. Zimmerman, pp. 355-368. Ruhr-Universitat Bochum, Germany.

Hanks, Bryan K.

2009 Late Prehistoric Mining, Metallurgy, and Social Organization in North Central Eurasia. In *Social Complexity in Prehistoric Eurasia: Monuments, Metals, and Mobility*, edited by Bryan K. Hanks, and Katheryn M. Linduff, pp. 146-168. Cambridge University Press, Cambridge.

2010 Archaeology of the Eurasian Steppes and Mongolia. *Annual Review of Anthropology* 39:469-486.

2013 Examining Social Complexity within Bronze Age Eurasian Steppe Societies. Presentation at the *19th European Association of Archaeologists (EAA) Annual Meeting* held September 4-9, 2013 in Pilsen, Czech Republic.

Hanks, Bryan K., Andrey Epimakhov, and Colin Renfrew

2007 Towards a Refined Chronology for the Bronze Age of the Southern Urals, Russia. *Antiquity* 81(312):353-367.

Hanks, Bryan K. and Roger Doonan

2013 Research Results from 2007-2012 by the Sintashta Collaborative Archaeology Research Project at the Fortified Settlements of Stepnoye and Ust'ye. In *The Environment and Cultural Development during the Bronze Age in the Southern Urals, c*onference held March 7-9, 2013 in Frankfurt, Germany.

Hanks, Bryan K., Roger Doonan, Derek Pitman, Igor Chechushkov

2012 Eventful Deaths - Eventful Lives? Bronze Age Mortuary Practices in the Southern Urals of Russia (2100-1500 BC). In *Death Shall Have No Dominion: the Archaeology of Mortality and Immortality*, conference held April 11, 2012 in Cambridge, UK.

Hanks, Bryan K., Roger Doonan, Derek Pitman, Elena V. Kupriyanova, and Dmitri Zdanovich

2015 Eventful Deaths - Eventful Lives? Bronze Age Mortuary Practices in the Late Prehistoric Eurasian Steppes of Central Russia (2100-1500 BC). In *Death Rituals, Social Order, and the Archaeology of Immortality in the Ancient World*, edited by C. Renfrew, M.J. Boyd, and I. Morley pp. 328-351. Cambridge University Press, Cambridge, UK.

Hanks, Bryan K., Derek Pitman, Igor V. Chechushkov, Roger Doonan, D. Pitman, B. Muzhich, I. Medarich, and M. Mori

2013 Noveyshie rezultaty i perspektivy issledovaniy mikrorayona drevnego rasseleniya Ust'ye i doliny reki Nizhniy Toguzak. In *Drevnee Ustye: Ukreplennoe poselenie Bronzovogo veka v Yuzhnom Zauralye*, edited by Nikolay B. Vinogradov, pp. 395-416. Abris, Chelyabinsk.

Hirth, Kenneth

2009 Craft Production, Household Diversification, and Domestic Economy in Prehispanic Mesoamerica. *Archeological Papers of the American Anthropological Association* 19(1):13-32.

Harper, T. K.

2011 Visualizing Agricultural Production during the Eneolithic: A Case Study from the Tripol'ye Giant-settlement of Tal'yanki. *Chronika* 1:27-32, 61-62.

Holliday, Vance T.

2004 *Soils in Archaeological Research*. Oxford University Press, New York.

Honeychurch, William

2013 The Nomad as State Builder: Historical Theory and Material Evidence from Mongolia. *Journal of World Prehistory* 26 (4):283-321.

Honeychurch, William and Chunag Amartuvshin

2006 States on Horseback: The Rise of Inner Asian Confederations and Empires. In *Archaeology of Asia*, edited by M.T. Stark. Blackwell Publishing, Cornwall, UK.

2007 Hinterlands, Urban Centers, and Mobile Settings: The "New" Old World Archaeology from the Eurasian Steppe. *Asian Perspectives 46*(1):36-64.

Houle, Jean-Luc

2009 Socially Integrative Facilities and the Emergence of Societal Complexity in the Mongolian Steppe. In *Social Complexity in Prehistoric Eurasia: Monuments, Metals, and Mobility*, edited by Bryan K. Hanks, and Katheryn M. Linduff, pp. 358-378. Cambridge University Press, New York.

2010 *Emergent Complexity on the Mongolian Steppe: Mobility, Territoriality, and the Development of Early Nomadic Polities*. Ph.D. dissertation, Department of Anthropology, University of Pittsburgh, Pittsburgh.

Judd, Margaret A., M. E. Kovacik, Bryan K. Hanks, D. Rajev, and Andrey V. Epimakhov

2009 Mining the Steppes: Community Health during the Sintashta Period. In *The 78th Annual Meeting of the American Association of Physical Anthropologists, c*onference held in 2009 in Chicago.

Kelly, R. L.

1995 *The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways*. Smithsonian Institution Press, Washington, D. C.

Kadyrbaev M. K.
1983 Shestiletnie raboty na Atasu. In *Bronzovyi vek stepnoi polosy Uralo-Irtyshskogo mezhdurechya*, edited by Svetlana Ya. Zdanovich, pp. 134-143. Bashkirskiy Universitet, Ufa.

Kalieva, S. S. and V. N. Logvin
1997 *Skotovody Turgaya v tretyem tysyachiletii do nashei ery*. Archaeological Institute of the Republic of Kazakhstan, Kustanai.

Kaloev, B.A.
2004 *Osetny: Istoriko-etnograficheskoye issledovanie*. Nauka, Moscow.

Khazanov, Anatoly M.
2000 *Kochevniki i vneshniy mir*. Daik-Press, Almaty.

Klevezal', G. A.
1988 *Registriruyuschie struktury mlekopitayuschih v zoologicheskih issledovaniyah*. Nauka, Moscow.

Koryakova, Ludmila N. and Andrey V. Epimakhov
2007 *The Urals and Western Siberia in the Bronze and Iron Ages*. Cambridge University Press, New York.

Koryakova, Ludmila N., Rudiger Krause, Jochen Fornasier, Andrey V. Epimakhov, Svetlana V. Sharapova, Natalia A. Berseneva and Sofya E. Panteleeva
2013 Archaeological Structures of the Kamennyi Ambar Settlement. In *Multidisciplinary Investigations of the Bronze Age Settlements in the Southern Trans-Urals (Russia)*, edited by Rüdiger Krause and Ludmila N. Koryakova, pp.85-129. Habelt, Bonn.

Koveshnikov, V. S.
1967 Voprosy ekonomiki tabunnogo konevodstva v sovhozah pustynnoi zony Kazakhskoi SSR: na primere sovhozov Guryevskoi i Kzyl-Ordinskoi oblastei Kazakhskoi SSR. In *Konevodstvo v opytah*, Vol. XXIV, Part 2, pp. 197-208. Moskovskiy Rabochiy, Moscow.

Kowalewski, S.A.
1990 The Evolution of Complexity in the Valley of Oaxaca. *Annual Review of Anthropology* 19(1):39-58.

Kungurova, N. Yu.
2013 Trasologicheskoye isuchenie kamennyh predmetov is raskopok ukreplennogo poseleniya Ust'ye I. In *Drevnee Ustye: Ukreplennoe poselenie Bronzovogo veka v Yuzhnom Zauralye*, edited by Nikolay B. Vinogradov, pp. 285-330. Abris, Chelyabinsk.

Krause, Rüdiger and Ludmila N. Koryakova (editors)
2013 *Multidisciplinary investigations of the Bronze Age settlements in the Southern Trans-Urals (Russia)*. Habelt, Bonn.

Kuzmina, E. E.
1994 *Otkuda prishli indoarii? Materialnaya kultura plemen andronovskoy obshnosti i proishozhdenie indoirancev*. Vostochnaya Literatura, Moscow.

Kennett, Douglas J., Bruce Winterhalder, Jacob Bartruff, and Jon M. Erlandson
2009 An Ecological Model for the Emergence of Institutionalized Social Hierarchies on California's Northern Channel Islands. In *Pattern and Process in Cultural Evolution*, Stephen Shennan, ed., pp. 297–314. Berkeley: University of California Press.

Kohl, Phillip
2007 *The Making of Bronze Age Eurasia*. Cambridge University Press, Cambridge, UK.

Koryakova, Ludmila N.
1996 Social Trends in Temperate Eurasia during the Second and Third Millennia BC. *Journal of European Archaeology* 4:243-280.

2002 The Social Landscapes of Central Eurasia in the Bronze and Iron Ages: Tendencies, Factors, and Limits of Transformation. In *Social Complexity in Prehistoric Eurasia: Monuments, Metals, and Mobility*, edited by Bryan K. Hanks, and Katheryn M. Linduff, pp. 99-117. Cambridge University Press, Cambridge.

Koryakova, Ludmila N. and Andrey V. Epimakhov
2007 *The Urals and Western Siberia in the Bronze and Iron Ages*. Cambridge University Press, Cambridge, UK.

Kowalewski, Stephen A., Gary M. Feinman, Laura Finsten, Richard E. Blanton, and Linda M. Nicholas.
1989 *Monte Albán's Hinterland, Part II: Prehispanic Settlement Patterns in Tlacolula, Etla, and Ocotlán, the Valley of Oaxaca, Mexico*. University of Michigan Museum of Anthropology, Ann Arbor.

Kupriyanova, Elena V.
2003 K voprosu o nekotoryh prichinah izmeneniya formy sosudov v arheologicheskih kulturah Yuzhnogo Zauralya epohi bronzy. In *Drevnyaya keramika: problemy i perspektivy kompleksnogo podhoda*, edited by Dmitry G. Zdanovich. Yuzhno-Uralskoe knizhnoe izdatelstvo, Chelyabinsk.

2012 *Spasatelnye raskopki poseleniya Streletskoe-1 (Troitskiy rayon Chelyabinskoy oblasti) i kopleksnye issledovaniya okruzhayushei territorii v 2012 godu*. Field report. Chelyabinsk State University, Chelyabinsk.

Kosintsev, P. A., A. Yu. Rassadnikov, Olga P. Bachura, O. G. Zanina, and O. M. Korona
2010 Istoriko-ekologicheskie issledovaniya poseleniya Kamennyi Ambar. In *Andronovskiy mir: sbornik statey*, edited by N. P. Matveeva, pp. 55-69. Tyumen State University, Tyumen.

Kuzeev, R.G. and N. V. Bikbulatov, N.V. (editors)
1979 *Khozyaistvo i kultura Bashkir v XIX-nachale XX v*. Nauka, Moscow.

Lekson, Stephen H. (editor)
2006 *The Archaeology of Chaco Canyon: An Eleventh-Century Pueblo Regional Center*. School of American Research Press, Santa Fe, New Mexico.

Leslie, P. and J. T. McCabe
2013 Response Diversity and Resilience in Social-Ecological Systems. *Current Anthropology* 54(2):114-144.

Levit, Aleksandr I.
2005 *Yuzhnyi Ural: geographiya, ekologiya, prirodopolzovanie*. Yuzhno-Uralskoe knizhnoe izdatelstvo, Chelyabisnk.

2013 Kollekciya kamennyh artefaktov is raskopok ukreplennogo poseleniya Ust'ye I. In *Drevnee Ustye: Ukreplennoe poselenie Bronzovogo veka v Yuzhnom Zauralye*, edited by Nikolay B. Vinogradov, pp. 265-285. Abris, Chelyabinsk.

Levit, Aleksandr I. and E. A. Belgorodskiy
2009 *Ocherki paleogeografii Yuzhnogo Urala*. Zapovednik Arkaim, Chelyabisnk.

Levit, Aleksandr I. and N. P. Mironycheva-Tokareva
2005 *Stepnye I lesostepnye landshafta yuga Chelyabinskoy oblasti I ih transformaciya*. Krokus, Chelyabinsk.

Lindstrom, R. W.
2002 Anthropological characteristics of the population of the Bolshekaragansky cemetery, kurgan 25. In *Arkaim: nekropol (po materialam kurgana 25 Bolshekaraganskogo mogilnika)*, edited by D. Zdanovich, pp. 159-164. Yuzhno-Ural'skoe knizhnoe izdatelstvo, Chelyabinsk.

Malutina, Tatyana S.
1992 *Otchet: Arheologicheskie raskopki ukreplennogo poseleniya Kuysak v 1992 godu*. Field report. Chelyabinsk State University, Chelyabinsk.

Malutina Tatyana S. and Usachuk, A.N.
2004 Zagotovka psaliya iz roga losya s ukreplennogo poseleniya Kuysak v Yuzhnom Zauralye. *Arheologicheskiy Almanah* 15:111-114.

Malutina Tatyana S. and Gennady B. Zdanovich
1995 Keramika ukreplennogo poseleniya Arkaim. In *Po stranitsam drevnei istoriiYuzhnogo Urala*: *Arkaim*, pp. 99-131. Yuzhno-Ural'skoe knizhnoe izdatelstvo, Chelyabinsk.

2012 Poselenie "Kamennyi Brod" – sputnik ukreplennogo centra Arkaim: stratigraficeskie gorizonty i ritmy povtorov zhznennyh ciklov v "Strane Gorodov". *Arheologicheskie Pamyatniki Orenburzhya* 10:50-62.

Malutina Tatyana S., Gennady B. Zdanovich, and L.Yu. Petrova
2006 Poselenie Bersuat XVIII. In *Archaeology of the South Ural: the steppe (problems of cultural genesis)*, edited by S.G. Batalov, pp. 153-173. Rifey, Chelyabinsk.

Marghulan, A. K., T. K. Basenov, and M. Mendikulov
1959 *Arkhitektura Kazakhstana*. Kazakhskoe gosudarstvennoe izdatelstvo, Alma-Ata.

Masanov, Nurbulat E.
2011 *Kochevaya civilizaciya kazahov: osnovy zhiznedeyatel'nosti nomadnogo obshchestva.* Print-S, Almaty. (Originally published as a PhD dissertation in 1995).

Masson, V. M.
1998 Epoha drevnih velikih stepnyh obshestv. *Arheologicheskie Vesti* 5:255-267.

2000 *Rannie kompleksnye obschestva Vostochnoi Evropy*. Evropeiskiy Dom, Saint Petersburg, Russia.

Matyushin, G. N.
1982 *Eneolit Yuzhnogo Urala*. Nauka, Moscow.

Matveeva, N. P.
2002 Interpretation Models of Sargat Culture Settlements in Western Siberia. In *Complex Societies of Central Eurasia from the 3rd to the 1st Millennium BC: Regional Specifics in Light of Global Models*, edited by Karlene N. Jones-Bley and Dmitry G. Zdanovich, pp. 380-386. Institute for the Study of Man, Washington, D.C.

McIntosh, Susan K. and Roderick J. McIntosh
1980 *Prehistoric Investigations in the Region of Jenne, Mali: A Study in the Development of Urbanism in the Sahel*. Bar International Series 89. B.A.R., Oxford.

McKenzie, Roderick Duncan
1967 *The Metropolitan Community*. Russell & Russell, New York.

Medvedeva, Polina S.
2015 Issledovanie otpechatkov tkani na keramicheskih sosudahsitashtinskoi i petrovskoi kultur (po materialam mogilnika Krivoe Ozero). In *Etnicheskie vzaimodeistviya na Yuzhnom Urale: VI Vserossiyskaya nauchnaya konferenciya*, edited by A. D. Tairov, pp. 75-82. Chelyabinsk State Regional Museum, Chelyabinsk.

Ministry of Construction of Russian Federation
1985 Construcion Norms and Rules for Building Foundations. Electronic document, http://docs.cntd.ru/document/1200084710, accessed March 26, 2017.

Morgan, C.
2008 Reconstructing Prehistoric Hunter–Gatherer Foraging Radii: A Case Study from California's Southern Sierra Nevada. *Journal of Archaeological Science* 35(2):247-258.

Mosin, V. S.
1996 Stoyanka Burli II i nekotorye voprosy eneolita Yuzhnogo Zauralya. In *Novoe v arheologii Yuzhnogo Urala*, edited by S.A. Grigoryev, pp. 48-61. Rifei, Chelyabinsk.

2000 Kamennyi vek. In *Drevnyaya istoriya Yuzhnogo Zauralya*, Vol. I, edited by I.V. Predeina, pp. 21-220. Izdatelstvo YuUrGU, Chelyabinsk.

2004 Eneolit Yuzhnogo Zauralya. *Arheologiya, Etnografiya i Antropologiya Evrazii* 2(18):79-93.

Mosin, V.S., Andrey V. Epimakhov, A. A. Vybornov, A. I. Korolev
2014 Hronologiya eneolita i epohi ranney bronzy v uralskom regione. *Arheologiya, Etnografiya i Antropologiya Evrazii* 4(60):30-42.

Muhametdinov, V. I. and A. K. Bashieva
2015 Techniko-technologicheskiy analiz keramiki iz mogilnika Staro-Yapparovo I. *Samarskiy nauchnyi vestnik* 4(13):80-85.

Murdock, George P.
1949 *Social Structure*. Macmillan, New York.

Naroll, R.
1962 Floor area and settlement population. *American Antiquity* 27(4):587–589.

Netting, R. M.
1968 *Hill Farmers of Nigeria: Cultural Ecology of the Koryar of the Jos Plateau*. University of Washington Press, Seattle.

Noskevich, V. V., N. V. Fedorova, A. S. Bebnev, A. G. Vdovin, and T. L. Mehonoshina
2014 Results of the Geophysical Research of Bronze Age Archaeological Monument Andreevskoye (Southern Ural Mountains). *Uralskiy geofizicheskiy vestnik* 1(23):72-80.

Outram, Alan K., Alexei Kasparov, Natalie A. Stear, Victor Varfolomeev, Emma Usmanova, and Richard P. Evershed
2012 Patterns of Pastoralism in Later Bronze Age Kazakhstan: New Evidence from Faunal and Lipid Residue Analyses. *Journal of Archaeological Science* 39(7):2424-2435.

Peterson, Christian E. and Robert D. Drennan
2005 Communities, Settlements, Sites, and Surveys: Regional-Scale Analysis of Prehistoric Human Interaction. *American Antiquity* 70(1):5-30.

2011 Methods for Regional Demographic Analysis. In *Settlement Patterns in the Chifeng Region,* edited by Chifeng International Collaborative Archaeological Research Project, pp. 57-79. University of Pittsburgh Center for Comparative Archaeology, Pittsburgh.

2012 Patterned Variation in Regional Trajectories of Community Growth. In *The Comparative Archaeology of Complex Societies*, edited by Michael E. Smith, pp. 88–137. Cambridge University Press, Cambridge, UK.

Petrov, Fedor N.
2001 *Otchet ob avariynyh raskopkah na poselenii Zarya XI v 2000 godu*. Field report. Chelyabinsk State University, Chelyabinsk.

Petrova, Larisa Yu.
2001 *Otchet: Ohrannye raskopki poseleniya epohi bronzy Lebyazh'ye VI in 2000*. Field report. Chelyabinsk State University, Chelyabinsk.

2004 Poselenie epohi bronzy Lebyazhye VI (publikaciya materialov ohrannyh raskopok). *Vestnik Chelyabinskogo Gosudarstvennogo Pedagogicheskogo Universiteta* 2004 (1): 181-207. Chelyabinsk State Pedagogical University, Chelyabinsk.

Patzelt, Arno E.
2013 Geomagnetic Investigation of Bronze Age Settlements at Varshavka, Chelyabinsk Region. In *Multidisciplinary Investigations of the Bronze Age Settlements in the Southern Trans-Urals (Russia)*, edited by Rüdiger Krause and Ludmila N. Koryakova, pp.53-67. Habelt, Bonn.

Pauketat, Timothy R.
2007 *Chiefdoms and Other Archaeological Delusions*. AltaMira Press, Lanham.

Plehanova, L. N.
2006 Pochvy zapovednika Arkaim v svete antropogennyh preobrazovaniy. In *Stepi i lesostepi Zauralya: materialy i issledovaniyam*, edited by F. N. Petrov, pp. 132-166. Korkus, Chelyabinsk.

Porcic, Marco
2012 Effects of residential Mobility on the Ratio of average House Floor Area to Average Household Size: Implications for Demographic Reconstructions in Archaeology. *Cross-Cultural Research* 46(1):72-86.

Popova, Laura M.
2006 *Political Pastures: Navigating the Steppe in the Middle Volga Region (Russia) During the Bronze Age.* Ph.D. dissertation, Department of Anthropology, University of Chicago.

Potemkina, T. M. and A. D. Degtyareva
2007 Metall yamnoi kultury Pritobolya. *Vestnik Arheologii, Antropologii i Etnografii* 8:18-39.

Price, Douglas T. and Gary M. Feinman
1995 Foundations of Prehistoric Social Inequality. In *Foundations of Social Inequality*, edited by T. D. Price and G. M. Feinman, pp. 3-11. Plenum Press, New York.

2013 *Images of the Past*. McGraw-Hill, New York.

Privat, K. L.
2004 *Paleoeconomy of the Eurasian Steppe: Biomolecular Studies*. Ph.D. dissertation, Univeristy of Oxford, Oxford, UK.

Reitz Elizabeth J. and Elizabeth S. Wing
2008 *Zooarchaeology*, 2nd ed. Cambridge University Press, Cambridge, UK.

Renfrew, Colin
1974 Beyond a Subsistence Economy: The Evolution of Social Organization in Prehistoric Europe. In *Reconstructing Complex Societies: An Archaeological Colloquium*. Bulletin of American School of Oriental Research, No. 20, edited by Charlotte B. Moore, pp. 69-96. The American Schools of Oriental Research, Cambridge, Massachusetts.

Reshin, M.
2010 *Letopis Zemli Kizil'skoy*, Vol.1. Tvoi Shans, Magnitogorsk, Russia.

Rogers, Daniel J.
2011 Inner Asian States and Empires: Theories and Synthesis. *Journal of Archaeological Research* 20(3):205-256.

Russian State Agrarian University
2017 Zimnie pastpisha dlya tabunnogo koneproizvodstva. Electronic document, http://www.activestudy.info/zimnie-pastbishha-dlya-tabunnogo-koneproizvodstva/, accessed May 5, 2017.

Rutto, N. G.
1995 Kurgany epohi bronzy na yugo-vostoke Bashkirii. In *Nasledie vekov. Ohrana i izuchenie pamyatnikov arheologii v Bashkotrostane*, edited by M. F. Obydennov, pp. 41-57. Nacionalnyi Muzei, Ufa, Russia.

2003 *Srubno-alakulskie svyazi na na Yuzhnom Urale*. Gilem, Ufa, Russia.

Salnikov, K. V.
1954 Andronovskie poseleniya Zauralya. *Sovetskaya Arheologiya* 20:213-252.

Salzman, Philip C.
2002 Pastoral Nomads: Some General Observations Based on Research in Iran. *Journal of Anthropological Research* 58(2):245–264.

Sanders, William T., Jeffrey R. Parsons, and Robert S. Santley
1979 *The Basin of Mexico: Ecological Processes in the Evolution of a Civilization*. Academic Press, New York.

Service, Elman R.
1962 *Primitive Social Organization: An Evolutionary Perspective*. Random House, New York.

Schmaus, Tekla M.
2015 *Seasonality and Social Change in Prehistoric Kazakhstan*. Ph.D. dissertation, Department of Anthropology, Indiana University, Bloomington, Indiana.

Sharapov, Denis V.
2011 *Middle to Late Bronze Age Transition in the Southern Urals (Russia): A Settlement Pattern Perspective*. Master's thesis, Department of Anthropology, Georgia State University, Atlanta. LAP LAMBERT Academic Publishing, Saarbrucken, Germany.

Shelach, Gideon

2006 Economic Adaptation, Community Structure, and Sharing Strategies of Households at Early Sedentary Communities in Northeast China. *Journal of Anthropological Archaeology* 25:318-345.

Shevnina, I. V. and A. V. Logvin

2015 O pogrebenii rebenka sintashtinskogo vremeni iz kazakhstanskogo Pritobolya (po materialam kurgana Halvai 3). In *Etnicheskie vzaimodeistviya na yuzhnom Urale: materialy 6-y Vserossiyskoi nauchnoi konferencii*, edited by A. D. Tairov, pp. 97-105. Ministry of Culture of Chelyabinsk Oblast, Chelyabinsk.

Shitova, S. N.

1984 *Traditsionnye poseleniya i zhilishcha bashkir: vtoraia polovina XIX—pervaia chetvert XX v.* Nauka, Moscow.

Shvan-Guriyskiy, I. P.

1978 Osobennosti ekspluatacii pastbish I senokosov za rubezhom. In *Estestvennye kormovye resursy SSSR i ih ispolzovanie*, edited by T. S. Hachaturov, pp. 98-116. Nauka, Moscow.

Slyadnev, A. M.

2014 *Otchet ob arheologicheskih issledovaniyah v Kizilskom, Bredinskom i Varnenskom rayonah Chelyabinskoi oblasti v 2013 godu*. Field report. Gosudartsvennyi nauchno-proizvodstvennyi centr po ohrane kulturnogo naslediya Chelyabinskoi oblasti, Chelyabinsk.

Smith, Michael E. (editor)

2012 *The Comparative Archaeology of Complex Societies*, Cambridge University Press, New York.

Sneath, David

2007 *The Headless State: Aristocratic Orders, Kinship Society, and Misrepresentations of Nomadic Inner Asia*. Columbia University Press, New York.

Sobolev, L. N.

1960 *Kormovye resursy Kazakhstana*. Izdatelstvo akademii nauk SSSR, Moscow.

Spengler, Robert, Michael D. Frachetti, Paula Doumani, Lynne Rouse, Barbara Cerasetti, Elissa Bullion, and Alexei Mar'yashev

2014 Early agriculture and crop transmission among Bronze Age mobile pastoralists of Central Eurasia. *Proceedings of the Royal Society B: Biological Sciences* 281(1783):2013338.

Steponaitis, Vincas P.

1991 Contrasting Patterns of Mississippian Development. In *Chiefdoms: Power, Economy, and Ideology*, edited by Timothy K. Earle, pp. 193-228. Cambridge University Press, Cambridge.

Stobbe, Astrid

2013 Long-term Perspective on Holocene Environmental Changes in the Steppe of the Trans-Urals (Russia): Implications for Understanding the Human Activities in the Bronze Age Indicated by Palaecological Studies. In *Multidisciplinary Investigations of the Bronze Age Settlements in the Southern Trans-Urals (Russia)*, edited by Rüdiger Krause and Ludmila N. Koryakova, pp.305-327. Habelt, Bonn.

Stobbe, Astrid, M. Gumnior, L. Rühl, and H. Schneider

2016 Bronze Age Human–Landscape Interactions in the Southern Transural Steppe, Russia: Evidence from High-Resolution Palaeobotanical Studies. *The Holocene* 26(10):1692-1710.

Stone, Glenn D.

1993 Agrarian Settlement and the Spatial Disposition of Labor. In *Spatial Boundaries and Social Dynamics: Case Studies from Food-Producing Societies*, edited by Augustin Holl and Thomas E. Levy, pp. 25-38. International Monographs in Prehistory, Ann Arbor, Michigan.

Tainter, Joseph A.

1988 *The Collapse of Complex Societies*. Cambridge University Press, Cambridge.

Tairov, A. D., I. M. Batanina, O. A. Kuznetsova, and S. S. Chernyanskiy

1996 *Otchet: Issledovaniya pamyatnikov strany gorodov v 1995 godu*. Field report. Museum-Reserve Arkaim, Chelyabinsk.

Tkachev, V. V.

2007a Processy kulturogeneza na zapadnoy pereferii alakulskogo varianta. In *Problemy istorii, filologii, kultury* 17:429-442.

2007b *Stepi Yuzhnogo Priuralya i zapadnogo Kazakhstana na rubezhe epoh srednei i pozdnei bronzy*. Aktubinskiy Oblastnoi Centr Istorii, Aktobe, Kazakhstan.

Tkachev, V. V., and A. I. Havanskiy

2006 *Keramika sintashtinskoi kultury*. Orskiy Gumanitarno-Technicheskiy Institut, Orsk, Russia.

Ventresca Miller, Alicia

2013 *Social Organization and Interaction in Bronze Age Eurasia: A Bioarchaeological and Statistical Approach to the Study of Communities*. Ph.D. dissertation, Department of Anthropology, University of Pittsburgh, Pittsburgh, PA.

Ventresca Miller, Alicia, Katherine Haas, Michael Rosenmeier, Emma Usmanova, Viktor Logvin, Saule Kalieva, Irina Shevnina, Andrei Logvin, Alina Kolbina, Aleksander Suslov, Karen Privat, Katherine Haas, and Michael Rosenmeier

2014 Subsistence and Social Change in Central Eurasia: Stable isotope analysis of Populations Spanning the Bronze Age Transition. *Journal of Archaeological Science* 42:525-538.

Vinogradov, Nikolai B.

1982 *Yuzhnoe Zauralye i severnyj Kazakhstan v rannealakulskiy period (po pamyatnikam petrovskogo tipa)*. Ph.D. dissertation. Akademiya nauk SSSR, Moscow.

2003 *Mogil'nik Bronzovogo Veka Krivoye Ozero v Yuzhnom Zaural'ye*. Yuzho-Ural'skoe Knizhnoe Izdatel'stvo, Chelyabinsk.

2011 *Stepi Yuzhnogo Urala i Kazakhstana v pervye veka II tys. let do n.e. (pamyatniki sintashtinskogo i petrovskogo tipa)*. Abris, Chelyabinsk.

Vinogradov, Nikolay B. (editor)
2013 *Drevnee Ustye: Ukreplennoe poselenie Bronzovogo veka v Yuzhnom Zauralye*. Abris, Chelyabinsk.

Vinogradov, Nikolay B. and Irina P. Alaeva
2013 Keramicheskaya kollekciya iz raskopok ukreplennogo poseleniya Ustye I. In *Drevnee Ustye: Ukreplennoe poselenie Bronzovogo veka v Yuzhnom Zauralye*, edited by Nikolay B. Vinogradov, pp. 142-177. Abris, Chelyabinsk.

Vinogradov, Nikolay B., A.D. Degtyareva and S. V. Kuzminykh
2008 Sluchainaya nahodka topora drevneyamnoi kultury v Chelyabinskoy oblasti. *Rossiyskaya Arheologiya* 4:111-114.

Vinogradov, Nikolay B. and M. A. Muhina
1985 Novye dannye o technologii goncharstva u naseleniya alakulskoi kultury Yuzhnogo Zauralya. In *Drevnosti Srednego Povolzhya*, edited by the Kubyshevskiy University staff, pp. 79-84. Kuybyshevskiy State University Press, Kuybyshev, Russia.

Vlasova, N. S.
1999 Brak i semya u russkih XII – nachalo XX veka. In *Russkie*, edited by V. A. Aleksandrov, I. V. Vlasova, N. S. Polischuk, pp. 422-442. Nauka, Moscow.

Wendrich, W. and H. Barnard
2008 The Archaeology of Mobility: Definitions and Research Approaches. In *The Archaeology of Mobility: Old World and New World Nomadism*, edited by H. Barnard and W. Wendrich, pp. 1-21. Cotsen Institute of Archaeology, University of California, Los Angeles.

Williams, James T.
2014 *Staple Economies and Social Integration in Northeast China: Regional Organization in Zhangwu, Liaoning, China*. Ph.D. dissertation, Department of Anthropology, University of Pittsburgh, Pittsburgh.

Wilson, David J.
1988 *Prehispanic Settlement Patterns in the Lower Santa Valley, Peru: A Regional Perspective on the Origins and Development of Complex North Coast Society*. Smithsonian Institution Press, Washington, D.C.

Wright, Henry T.
1984 Prestate Political Formations. In *On the Evolution of Complex Societies*: *Essays in Honor of Harry Hoijer 1982*, edited by Timothy K. Earle, pp. 41-77. Undena Press, Los Angeles.

Wright, Henry T. and G. Johnson
1975 Population, Exchange, and Early State Formation is SW Iran. *American Anthropologist* 77:267-289.

Yanguzin, R. Z.
2002 *Etnografiya Bashkir (istoriya izucheniya).* Kitap, Ufa, Russia.

Zaharov, S. V.
2010 K voprosu o proishozhdenii botaiskoi kultury. *Vestnik arheologii, antropologii i etnografii* 1(12):49-58.

Zaibert, V. F., A. Zh. Tulebaev, A. V. Zadorozhnyi, and Yu. V. Kulakov
2007 *Tainy drevnei stepi: issledovaniya poseleniya Botai v 2004-2006 gg*. Kokshetau University, Kokshetau.

Zaikov, V. V. and S. Ya. Zdanovich
2000 Kamennye isdeliya i mineralno-syryevaya baza kamennoi industrii Arkaima. In *Arheologicheskiy istochnik i modelirovanie drevnih technologiy*, edited by Gennady B. Zdanovich and S. Ya. Zdanovich, pp. 73-95. Museum-Reserve Arkaim, Chelyabinsk.

Zdanovich, Dmitry G.
1997 *Sintashtinskoe obshchestvo--sotsial'nye osnovy "kvazigorodskoi" kul'tury IUzhnogo Zaural'ia epokhi srednei bronzy*. Chelyabinsk State University Press, Chelyabisnk.

Zdanovich, Dmitriy G. and Genady B. Zdanovich
2014 Arkaim i "stana gorodov": modeli suschestvovaniya, ekonomika, ekologiya. In *Arkaim – ukreplennoe poselenie epohi bronzy stepnogo Zauralya: pochvenno-arheologicheskie issledovaniya*, edited by A.L. Aleksandrovskiy, pp. 89-142. Institute of Physicochemical and Biological Problems of Soil Science, Moscow.

Zdanovich, Gennadiy B.
1984 Otnositelnaya hronologiya pamyatnikov bronzovogo veka Uralo-Kazahstanskih stepei. In *Bronzovyi vek Uralo-Irtyshskogo mezhdurechya*, edited by Svetlana Ya. Zdanovich, pp. 3-23. Bashkirskiy Universitet, Chelyabinsk.

1995 Arkaim: Arii na Urale ili nesostoyavshayasya civilizaciya. In *Arkaim. Issledovaniya, Poiski. Otkrytiya*, edited by Gennadiy B. Zdanovich, pp. 21-42. Kamennyi Poyas, Chelyabinsk.

Zdanovich, Gennadiy B., and Iya M.Batanina
1995 "Strana gorodov" – ukreplennye poseleniya epohi bronzy XVIII-XVII vv. do n.e. na Yuzhnom Urale. In *Arkaim. Issledovaniya. Poiski. Otkrytiya*., edited by Gennadiy B. Zdanovich, pp. 54-63. Kamennyi Poyas, Chelyabinsk.

2007 *Arkaim – Strana Gorodov: Prostranstvo I Obrazi.* Yuzhno-Uralskoe Knizhnoe Izdatelstvo, Chelyabinsk.

Zdanovich, Gennadiy B., Iya M. Batanina, N. V. Levit, and Sergey A. Batanin
2003 *Arheologicheskiy Atlas Chelyabinskoi Oblasti: Step-lesostep. Kizilskiy rayon.* Yuzhno-Uralskoe Knizhnoe Izdatelstvo, Chelyabisnk.

Zdanovich, Gennadiy B. and Tatyana S. Malutina
2004 Ukreplennoe poselenie Alandskoe. Stroitelnye gorizonty i keramicheskie kompleksy. In *Etnicheskie vzaimodeistviya na Yuzhnom Urale*, pp. 56-61. Rifei, Chelyabisnk.