STAPLE ECONOMIES AND SOCIAL INTEGRATION IN NORTHEAST CHINA:
Regional Organization in Zhangwu, Liaoning, China

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The emergence of specialized mobile herding is long been thought to have taken place in Northeast China during the Late Bronze Age (1200 to 600 BCE). It is theorized that the interaction between specialized herders and sedentary farmers was the catalyst for increased social complexity in the region. However, in Northeast China there is little direct settlement and subsistence evidence which appears to indicate the emergence of mobile pastoralism. Therefore theories based on the interaction between herders and farmers remain tenuous. This research is designed to answer two questions.

Did reliance on grazing animals and residential mobility increase in some Late Bronze Age communities located in areas where such subsistence strategies would have been attractive alternatives to grain cultivation under warming and drying conditions?

Does such a subsistence shift, if documented, show the artifactual evidence and settlement patterning consistent with economic complementarity?

This dissertation outlines the changes in settlement patterns of 173 square kilometer region from 4500 BCE to 1200 CE. The Early and Late Bronze Age (2000 to 1200 BCE and 1200 to 600 BCE) is given special attention because this is when this substantial economic change is thought to have taken place. During the Bronze Age locational evidence and use-wear evidence is taken in concert to evaluate the notion of Late Bronze Age specialized mobile herders either dominating the landscape or part of a settlement system which includes sedentary farmers.

Results from this study call into question the emergence of specialized herders during the Late Bronze Age. Despite environmental conditions that would be conducive to herding economies and a warmer and dryer climate from the Early to Late Bronze Age, this dissertation finds evidence that local communities favored a mixed economy throughout the Bronze Age. The local environmental conditions tempered the degree to which communities carried out certain economic practices. However, economic specialization, which was previously thought to have characterized the region, does not appear to be at all consistent with the evidence.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

For Dad

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1.0 INTRODUCTION

The barbarians have their leaders,

and are not as good as our kings and State(s).

夷狄之有君，不如諸夏之亡也

Lunyu 3:5 [*]

In Chinese history from the Zhou period onward, the "nomads from the north" are sharply contrasted with dynastic China (Li 2006:280; Pines 2005). The example above is just one of many where Confucius and other early dynastic writers use the contrast with northern groups to identify what is "civilized" and good, and this dichotomy became a fundamental element in defining what it means to be Chinese (Di Cosmo 2002:2). And yet the beginnings of a nomadic way of life, which defines many of these groups and plays such a central role through thousands of years of historical writing on China, remain very poorly documented.

[*] All translations are by the author unless otherwise stated and cited. Hu, Di and Yi as well as their variants are translated as barbarian. Other translations (Brooks and Brooks 1998; Lau 2002; Legge 1861; Sligerland 2003) are even more explicit in the value-laden dichotomy but avoid using barbarian. The word "barbarian" is usually understood as pejorative, inferior and "uncivilized" especially when used contrastingly, like the passage above.

1.1 NOMADS FROM THE NORTH

The earliest historical accounts of northern nomads mention groups such as the Beidi (北狄), the Shanrong (山戎) Dongyi (东夷) and the Donghu (东胡) or just Yi (夷) and Hu (胡)— many of which are pejorative descriptions of people from the mountains, east or the north (DiCosmo 1994, 2002). Hu, for example, has been translated as "barbarian," "outsider," "outsider from the north," or "foreigner." Miller (2009:46) and Pines (2005) provide fuller analysis of these terms where they argue that these terms reference animals and the natural world. However translated, these terms represent a contrast to the "civilized" world, (to which the ancient authors belonged) (See footnote on other translations). The Donghu are said in historical sources to reside "north of the state of Yan," in modern-day Hebei Province. The historical Donghu have been seen as predecessors to a series of nomadic polities from the Xiongnu (209 BCE–93 CE) to modern-day Mongolians (Lin 2007). Much fuller accounts of mobile herding "barbarians" in northeastern China come from the Western Han period (206 BCE–8 CE) when Sima Tan and Sima Qian compiled the records we now know as the Shiji (Shiji 1959). The Shiji describes the Xiongnu as follows:

> …居於北蠻,隨畜牧而轉移。其畜之所多則馬,牛,羊…
>
> (…living in the region of the northern barbarians and following their animals from place to place. Their domestic animals are mostly horses, cows and sheep…)
>
> 逐水草遷徙，毋城郭常處耕田之業…
>
> (They migrate in pursuit of water and pasture and have no walled cities, they never cultivate fields…)

寬則隨畜,因射獵禽獸為生業,急則人習戰攻以侵伐。

(It is their normal custom to follow their animals and make their living by hunting birds and other creatures, but if necessary they can quickly prepare for war and assault.)

自君王以下，咸食畜肉…

(From the king on down to subjects, everyone eats the meat of domestic animals…)

The idea that interaction between herders and farmers set the stage for increased political complexity on both sides of the relationship has been a narrative for the past 2,000 years of Chinese written history (Di Cosmo 2002). Even though we have come to better understand "nomads" or specialized mobile herders, this narrative continues to frame much of historical scholarship today (Di Cosmo 2002:2). While avoiding the value judgments of histories written in dynastic China, modern scholars have proposed that the dynamic relationship between specialized mobile herders and sedentary farmers was of vital importance in the development of complex society. The idea was strongly expressed in Lattimore's widely read Inner Asian Frontiers of China (1940). More recently, Linduff (1995, 1997) has argued that interaction between specialized mobile herders and sedentary farmers was not only a force behind the development of increasingly complex polities in northern China, but also a stimulus to the development of the very large-scale states that emerged in the Central Plains. She has focused especially on the role this relationship played in the Shang (1550–1046 BCE) and Zhou (1046–771 BCE) polities. Following Linduff, Shelach (1999:221, 2009a:263) emphasizes core-periphery relationships between "Chinese" (华夏) and the north as the catalyst for social change.

Lin (2007) points out, however, that descriptions of the economic practices of the Donghu are quite limited. Later on, in Zhou times, many of the references to barbarians relate to areas quite close to the central plains of China. The people described in the Shiji, however, have been the inspiration for thinking about the earliest herders much farther away, north of the Great Wall. This thinking has been the basis for developing models to account for the emergence of mobile specialized herding.

1.2 THE EMERGENCE OF SPECIALIZED MOBILE HERDING

Communities of seasonally mobile households who's subsistence is mainly derived from domesticated animals are often referred to as nomads, pastoralists or mobile pastoralists. I prefer the term specialized mobile herders because it is an accurate description of both the pattern of residence and the main subsistence economy without conflating the two.

It is often suggested that specialized mobile herding in northeastern China emerged from already established agricultural or agro-pastoral economies (DiCosmo 2002; Shelach 1999). In particular, the emergence of a mobile herding adaptation has been seen as a response to increasingly marginal conditions for agriculture during a period of climatic drying out (Lattimore 1940; Xu et al. 2002). Shelach (1999) sees agricultural economies pressured by population growth and/or climatic change to exploit more effectively the agriculturally marginal dry zones of northern China. He argues that social circumscription (cf. Carneiro 1970) and intensification of agriculture in productive areas exaggerated the dichotomy between settled farmers and mobile herders, who were relegated to drier zones best exploited through large herds of grazing animals (Shelach 1999:197). The result was subsistence specialization and a symbiotic relationship between mobile herders in extensive grasslands and settled agriculturalists in better watered locations more favorable for agriculture.

Shelach's and DiCosmo's reconstructions of the emergence of mobile herding in northeastern China mirror other explanations of Neolithic and Bronze Age economic change found in the Old World. For example, the intensification of agriculture is the basis for Lees and Bates' classic (1974) model. As applied to the Near East, large-scale canal irrigation allowed agro-pastoralists to intensify cultivation in the Mesopotamian plain. Consequent population growth created the opportunity for a complementary specialized mobile herding adaptation in areas where water supplies were insufficient for intensive cultivation or even for year-round pasturing of animals in one place. The Jordanian desert (Kohler-Rollefson 1992) and other sectors of the far-reaching desert-steppe environmental zone (Zarins 1990) have been characterized in this way. According to Lees and Bates (1974) both farmers and herders became increasingly specialized over time and more economically dependent on one another.

Inspired by Lees and Bates, Heibert (1994) and Shishlina and Heibert (1998) have proposed a similar model to explain the emergence of pastoralism from agricultural antecedents. In the Pontic steppe, population pressure forced farmers to expand into previously unoccupied areas of the Caspian lowland desert, settling around spring-fed oases. As oasis populations continued to grow, communities would fission and new oases would be settled. By the Early Bronze Age (~3000 BCE) even desert oases were filling, and available ones were farther and farther away. At this point specialized herding communities emerged to exploit the potential for raising animals in a mobile residence pattern in the spaces between oases. Trade and exchange with the oasis agricultural communities were essential for these animal-dependent communities to thrive. Shishlina (2001) emphasized that the entire process was spurred along by the expansion of grassland environments throughout the Pontic Steppe resulting from climate change during the Bronze Age. Khazanov (1994) also stresses that increasing dryness in Central Asia would put pressure on both farmers and herders, causing them to intensify production, leading to increased specialization and furthering the complementarity of economic systems.

Other models suggest that specialized mobile herding is a result of political pressure and is a form of resistance by elites (Irons 1974; Hanks 2002; Frachetti 2004). While the catalyst in these models focus on social forces and elite agency rather than the environment, the outcome is ultimately the same: specialized herders occupying the grasslands of the steppe region while pursuing an economy which can best exploit its resources. These models, however, allow for the indigenous growth of social complexity among mobile herders irrespective of their relationship to sedentary societies. In many regions, specialized mobile herding regardless of its connection to social complexity is often seen as developing out of prior agricultural communities. This is not the case in all regions (Frachetti 2008; Wright 2006), but in northeastern China there is clear evidence of settled agricultural communities from 6200 BCE at the latest, and farming villages persist continuously into the Bronze Age and in some locations beyond.

Models for the emergence of specialized mobile herding in northern China have tended to focus on stress caused by the natural environment and population pressure from the south. Most fundamentally, they involve pressure to occupy new environments not easily exploited through agriculture. This pressure is generally thought to be induced by climate, population growth, or some combination of the two (Shelach 1999, see also An et al. 2004; Huang et al. 2003; Jin 2002; Liu and Feng 2012; Wu and Liu 2004; Xiao et al. 2004).

1.3 THE LATE BRONZE AGE EMERGENCE OF SPECIALIZED HERDING IN NORTHEAST CHINA

The archaeological cultures of the Late Bronze Age (1200–600 BCE) have often been suspected to represent the earliest specialized mobile herders in northeastern China. These include the Upper Xiajiadian and Upper Xinle archaeological cultures (Guo 1995:191). The site of Liulihe (Li 2006:335), 35 km southwest of Beijing, considered the center of the Yan polity during the Western Zhou period (1046–771 BCE) has played a central role in connecting the historical and archaeological records. Historians connected these archaeological cultures with the historical "barbarians" because of their chronological correspondence to the Western Zhou and because of the geographical distribution of archaeological cultures to the northeast of the State of Yan (燕国) is where the Shiji places the Donghu during the Zhou period.

The historical identification of archaeological cultures with the Donghu or other northern barbarians has been supported by art historical arguments based largely on bronze artifacts. Lin Yun's classic article (1986) painstakingly defines the characteristics of "Northern Complex" bronze artifacts and contrasts them to Shang bronze artifacts farther south. Consisting primarily of objects included as offerings in burials, Northern Complex bronzes include socketed axes, straight daggers, curved knives and buckles or plaques with animal motifs, including sheep, goats and horses (Figure 1.1). The "Northern Zone," where such objects are found, is bounded by the Greater Khingan mountain range in Manchuria and the Gobi desert to the east and north. It extends into Xinjiang in the west; in the south it extends as far as the central plains south of the Yellow River, excepting the Ordos loop (Shelach 2009a). Some expand this region to include southern Siberia and central Asia because of the similarities in style with artifacts associated with the Seima-Turbino and Karasuk archaeological cultures (DiCosmo 1999:888; Gao 2002; Li

2002). The notion of Northern Complex bronzes has been taken up by a number of scholars tracing regional influences, interactions, and styles (DiCosmo 1996, 1999; Guo 1995; Shelach 2009a, 2009b; So and Bunker 1995).

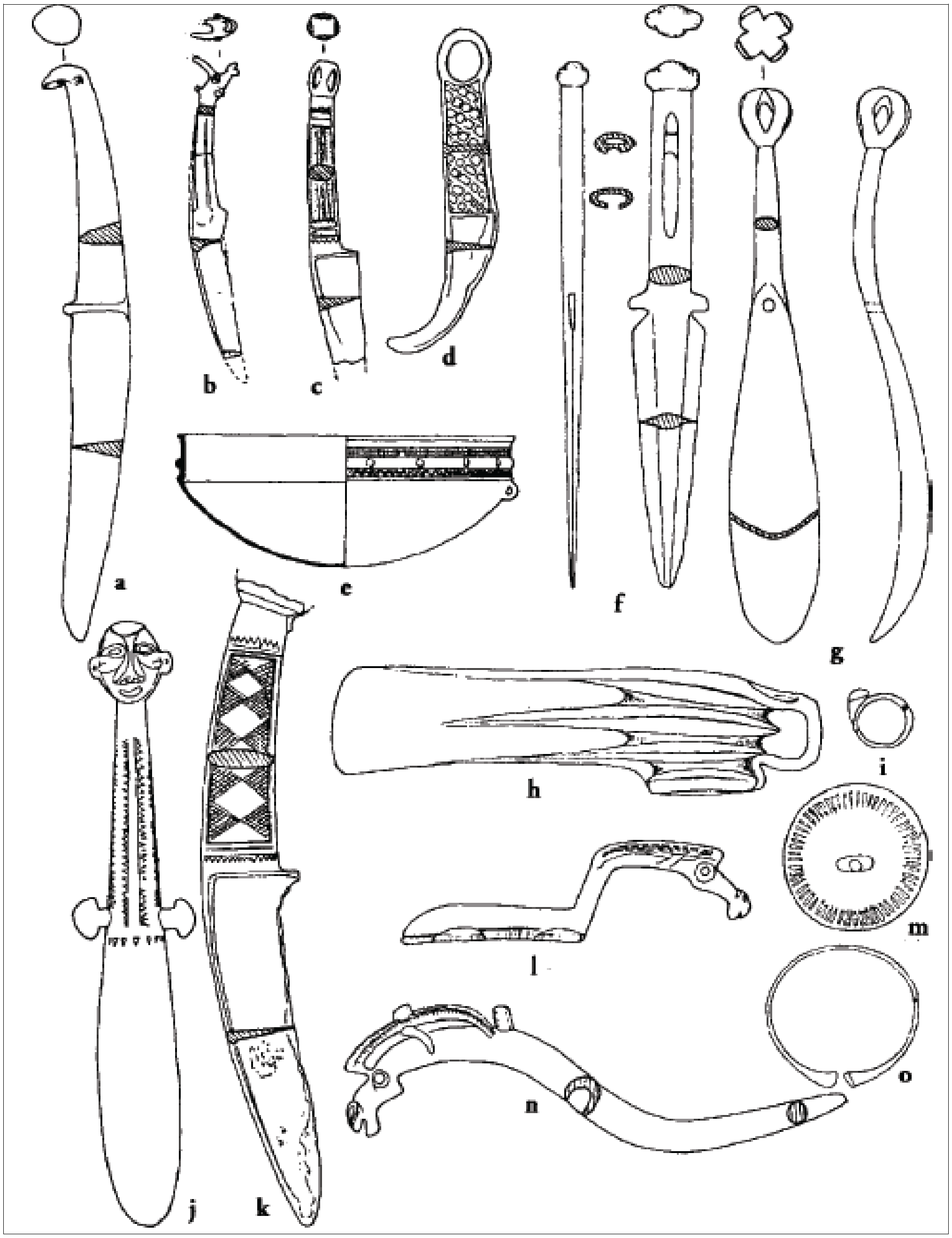

Figure 1.1 Example of Northern Style Bronze Artifacts (from Guo 1995; Shelach 2009a)

Northeast China has been a vital region for the discussion of Northern Complex Bronzes. The Upper Xiajiadian archaeological culture (1200–600 BCE) has often been suspected to represent the earliest specialized mobile herders in northeastern China (Di Cosmo 2002). Others include the Upper Xinle archaeological culture (1200–600 BCE) as the early herders (Zhao 2003). The site of Wanghua, for example, in northern Liaoning, has yielded examples of Northern Complex bronzes in association with the Upper Xinle ceramics (Fushun 1981). Northern Complex bronzes (Barnes 1999; Liu 2000), together with the presence of horse, sheep, goat, and cattle bones in both Upper Xiajiadian and Upper Xinle burials, have led to characterizations of a Late Bronze Age lifeway focused on mobile herding (Bagley 1999:221; DiCosmo 1999:891; Gao 2002; Yang 2008; Zhao 2003). The persistence of the Northern Complex of bronze artifacts from the twelfth century BCE into Xiongnu times has helped to link Upper Xiajiadian and Upper Xinle archaeological cultures to the descriptions of mobile herders in the Shiji. When Northern Complex bronze artifacts are found in central Chinese contexts, such as in the tomb of Fuhao at Anyang, they are seen as evidence of interaction with "foreign" mobile herding groups (Linduff 1997; Yang 2008). For a number of scholars, the transition from the Early to Late Bronze Age (1200 BCE) marks the start of the pivotal interaction between early Chinese complex societies and nomadic herding groups in the Northeast (Di Cosmo 2002:2).

Connecting archaeological materials with historical accounts, however, has not been universally accepted. Jin (1987) and Lin (1998), for example, have questioned the correspondence between the Upper Xiajiadian and Donghu, claiming a misunderstanding of the time and locations mentioned in the texts. Lin Yun (2002) has said that his characterization of the Northern Complex was not intended to be a means of reconstructing the economic systems of historical groups. Much has been written about the historiographic nature of Chinese archaeology (Chang 1981; Falkenhausen 1993) and the use of texts in interpretation of the archaeological record (Li 2006). This has led some (Allan 1991; Pines 2005; Shelach 1999, 2009a:16) to doubt, as a matter of principle, the wisdom of any attempt to identify particular peoples mentioned in Chinese texts with specific elements in the archaeological record. While I am sympathetic to the doubts of these scholars, it is apparent that the main lines of evidence by which nomadic herding groups and subsistence practices have been reconstructed are predominately bronze artifacts and historical associations, which is then grafted on archaeological cultures.

The names that are used to identify people by writers in antiquity, historians and archaeologists is certainly complicated. Chapter 2 deals with this subject in more detail for the research area since the regional survey recovered both Upper Xiajiadian and Xinle ceramics as well as ceramics refereed to as Xianbei, which is a mixture of archaeological and historical nomenclature.

1.4 ARCHAEOLOGICAL SETTLEMENT AND SUBSISTENCE EVIDENCE

Regional survey and excavation in the Chifeng region (Chifeng 2003, 2011a; Shelach 1999) about has provided direct evidence of Bronze Age subsistence and settlement. Population density during the Lower Xiajiadian period (2000–1200 BCE) was much higher than that of earlier periods in northeastern China (Chifeng 2003, 2011b:118). These populations were organized into small local polities only a few kilometers across, but numbering a few thousand inhabitants each. Settlements were often densely packed; many contained stone residential architecture representing substantial construction investment; and impressive fortifications testify to the presence of armed conflict (Shelach 2009b; Shelach et al. 2011). Agricultural tools and land clearing implements are regularly recovered from Lower Xiajiadian contexts (Shelach 1999:103, 2009a). In Chifeng, about 67% of Lower Xiajiadian domesticated faunal remains are those of pigs. Animals traditionally associated with mobile herding (cows, sheep and goats) account for the other 33%. Cultivated millet is by far the most abundant taxon among botanical remains recovered in stratigraphic testing in Chifeng (Zhao 2011). The antecedents to Upper Xiajiadian, then, were clearly sedentary agricultural societies with a fair degree of organizational complexity although without political integration on any large scale.

Shelach (1999:240, 2009a) characterizes the mud-brick semi-subterranean residential architecture of Upper Xiajiadian times as less substantial than that of Lower Xiajiadian, and he takes this to indicate less permanent residence patterns during the Late Bronze Age. He interprets a stronger preference for settlement in the uplands of the Chifeng region to indicate greater reliance on herding. These interpretations would be consistent with the identification of Upper Xiajiadian with early mobile herders, and could be used to suggest the development of a mobile pastoral way of life out of a well-established sedentary agricultural one. This led Shelach to characterize Lower Xiajiadian economy as primarily agricultural with a shift toward mobility and herding in Upper Xiajiadian. Systematic survey of 1,234 sq km in the Chifeng region, however, complemented by stratigraphic testing, documents extensive Upper Xiajiadian habitation areas with considerable stratigraphic accumulation of construction debris (Chifeng 2011b), as well as higher regional population densities than in Lower Xiajiadian times (Chifeng 2003, 2011b:126). Farming implements are recovered from Upper Xiajiadian sites as well. Most of the domesticated animal remains are still those of pigs (70%), and millet was still by far the most abundant taxon among identified seeds (Zhao 2011:30-34). This evidence is not consistent with the emergence of a Late Bronze Age lifeway built around specialized mobile herding.

All this leaves us with a picture of substantial sedentary agricultural settlement already well established in the Early Bronze Age and persisting through Late Bronze Age as well. Nonetheless, historical sources provide abundant and unequivocal documentation of mobile herding adaptations in the Northern Zone sustaining the complex Xiongnu polities of the third century BCE, only some 300 years after the end of the Late Bronze Age. It is difficult to believe that this entire way of life developed and flourished to such an extent entirely without longer-term antecedents, and this turns our attention forcefully back to Late Bronze Age subsistence and settlement systems. Recent settlement study and stratigraphic excavation do clearly demonstrate sedentary living and a subsistence system based on grain cultivation and animal husbandry in Chifeng. This does not, however, automatically mean that there were no specialized herders following a more mobile way of life during this period anywhere in Northeast China. Very broadly speaking, the Northern Zone is a steppe environment, but at the local scale to which subsistence systems are actually adaptations, it is a patchwork of subtly varied conditions that would have manifested differently the changes in temperature and precipitation during the Bronze Age. The Northern Zone contains a good bit of this environmental variability. A simple dichotomy between settled farmers and mobile herders surely fails to do justice to what must have been more subtly varied settlement and subsistence practices across the region. This subtle and varied landscape of economic practices has been discussed in many parts of Central Asia (Chang 2002; Frachetti 2009, 2012; Spengler 2013). Northeast China, however, remains theorized as a region sharply divided by economic practice and environment (Eng 2007:1; Zhang 2011; Guo 2012; Yang 2008). Evidence of specialized mobile herders during the Bronze

Age, should it exist, ought to be located in environments much more conducive to this economy than Chifeng.

1.5 ENVIRONMENTS CONDUCIVE TO HERDING AND FARMING

Environments where a complementary relationship between herders and farmers might develop would be defined as ecotones. These make ideal locations for investigating theories predicated on the theoretical notion that a relationship between specialized herders and farmers arose in the Bronze Age. There are a number of locations in northeastern China which would fit the definition of an ecotone. Chifeng is not, however, one of them. The trend of declining precipitation during the Bronze Age (Li et al. 2006; Su and Zhao 2003; Wagner et al. 2011; Zhang et al. 2005), to which Bronze Age subsistence and settlement change has often been attributed, would not necessarily pose problems for sedentary grain farmers and pig raisers in all locations across Northeast China, the Chifeng region being one of these locations. Even where these climatic changes would create pressure on subsistence resources, a shift in the direction of more mobile herding of grazing animals would not always be a viable response.

Zhangwu county, however, in northern Liaoning is located on one of these ecotones where, during the Bronze Age, a shift in economy might be a viable response. During the Bronze Age it would have straddled productive farmland in the south and open pasture in the north. Many of these characteristics are detectable today and detailed in Chapter 3. A much more detailed environmental reconstitution can be found in Chapter 3, therefore, what follows is a more basic account of the ecotone conditions that would be conducive to the emergence of specialized mobile herding in close proximity to settled agricultural communities. This, in turn, is the foundation for the rationale behind the choice of Zhangwu county as a region to study. Agricultural productivity is variable across Northeast China. Two particularly important variables in assessing a regions potential for agriculture and pasturing animals are soil typology and floodplain stability.

1.5.1 Environment and the Research Agenda

The Arenosols, Kastanozems and Mollisols that occur across northeastern China provide only for relatively low agricultural productivity (FAO 1998; Shi et al. 2004). Arenosols especially do not retain water well, often requiring irrigation for substantial agricultural production. Cultivation is thus especially at risk when precipitation declines. Although not especially good for millet cultivation, Arenosols often contain silts, which together with a moderately cohesive structure, encourage the dense growth of grasses that makes for good pasturage. Mollisols and Kastanozems, which are also fairly common in the zone, are very favorable for the growth of grasses in dry conditions, and with a reasonable water supply give considerably higher agricultural production than Arenosols since they have developed over longer periods of time and have incorporated more organic matter into the matrix (FAO 1998).

Unpredictable floodplains present particular challenges to farmers by limiting the locations where crops can be planted without risk of damage. Millet cannot thrive in flooded or waterlogged soils, so its cultivation in floodplains is especially at risk. Predictable floodplains and uplands with a reliable moisture supply thus provide highly favorable locations for millet cultivation. Where water supplies are more erratic, however, reducing reliance on millet and increasing reliance on grazing animals can enable subsistence producers to hedge their bets because herd animals are easily moved around in response to changing conditions. Herds can escape severe and constrained flooding by moving to higher elevations temporarily, where the increased precipitation that has caused the flooding will also have made moisture more abundant. Flooding in open, more even topography creates patchy marsh environments which are readily exploited by animal herders. Unpredictable floodplains and drier uplands can thus encourage an increased emphasis on the herding of grazing animals.

The Chifeng region is characterized by neither the soils nor the unpredictable floodplains most likely to encourage greater emphasis on animal herding. The Chifeng region is generally characterized by productive Cambisols in the uplands and silty deposits of well watered Fluvisols in the lowlands. In wetter conditions, crops in the floodplains are subject to severe risks of flooding, but water supply in the uplands is better. In drier conditions, the uplands become somewhat less productive, but the risk of flooding in the well-watered and fertile floodplains is reduced. Taken as a whole, the Chifeng region is thus a promising zone for cultivation under a range of conditions, and would never have had the large areas of grassland in which mobile specialized herding flourishes. The drying trend of the Bronze Age (Li et al. 2006; Su and Zhao 2003; Wagner et al. 2011; Wanner et al. 2008; Zhang et al. 2005) would have had only minimal impact on the prospects for sedentary grain cultivation and pig raising there (Chifeng 2011b: 129). In other regions, however, with less predictable floodplains and poorer soils for grain cultivation, even modest drying could have presented more severe challenges to these fairly widespread subsistence strategies during the Bronze Age. If, in addition, such a region had open topography and the typical steppe or prairie that promote the growth of grasses, drier conditions in the Late Bronze Age would have encouraged a reduction in millet cultivation and increased reliance on grazing animals.

Such a response might well have been exaggerated by proximity to zones where millet cultivation continued to be a reliable and productive subsistence strategy because this proximity of zones with contrasting productive potentials could sustain regular exchange of complementary products and make increasingly specialized subsistence strategies particularly advantageous. None of this implies that people who came gradually to rely more and more on herding animals and on moving them over larger distances with greater frequency would necessarily abandon cultivation entirely. By the same token, there is no reason to believe that people who came to rely increasingly on millet cultivation would necessarily abandon all animal husbandry.

If the Late Bronze Age did experience the emergence of specialized mobile herding, the shift to greater mobility and greater reliance on grazing animals would surely have occurred to varying degrees in different communities, even as other Late Bronze Age communities actually increased their reliance on grain cultivation. The evidence for communities heavily reliant on sedentary millet cultivation and pig raising in regions like Chifeng thus does not contradict the possibility of the emergence in the Late Bronze Age of a more diverse and varied subsistence economy with increased interdependence between communities. Nor does the evidence from regions like Chifeng demonstrate such a thing.

Evidence that would more directly evaluate this possibility requires documenting changing settlement and subsistence patterns through the Late Bronze Age into the Iron Age in a region where environmental conditions, like Zhangwu county, with contrasting productive potentials are found in close proximity. This region would have to contain sectors that would provide for stable, productive grain cultivation even under the warmer and drier conditions of the Late Bronze Age as well as sectors where grain cultivation would show diminishing returns but more mobile herding of grazing animals would provide an increasingly attractive alternative subsistence strategy. Prior to this study we simply do not have good documentation of settlement and subsistence systems in Northeast China that fit this description. The following dissertation aims to provide precisely this kind of evidence.

1.5.2 Zhangwu County

Based on initial reconnaissance in 2010, Zhangwu County, at the southern edge of the Gobi desert in Liaoning Province presents precisely the necessary combination of environmental conditions in close proximity. In addition, there is also evidence of the relevant archaeological material (see Chapter 2). The county is fairly sharply divided into two major environmental zones. Its southern part is characterized by rolling hills and swales, progressively giving way to large floodplains toward the south and west. The soils are predominantly Luvisols formed on stable surfaces, with Fluvisols becoming more common in the floodplains (Shi et al. 2004). The northern part of the county is part of the Horqin Sandy Lands. Despite the ominous label, the region is a combination of sandy and silty soils and supports many species of plant growth. Present land-use patterns observed in 2010 and again during 2012 emphasize maize and millet cultivation in the south and potatoes and arboriculture in the north. Areas in both zones that are not currently in use for farming are covered with natural grasses, and such vegetation is more abundant in the northern sector today. The south tends to have more hardwood (Oak and Birch) growth when left unmolested.

The environmental characteristics of Zhangwu County have no doubt changed since the Bronze Age but the contrast between its northern and southern portions would still existed. For example, studies of the Horqin Sandy Lands have been shown to be drier during the Late Bronze Age, grass pollen is quite pervasive. This, together with the presence of Chenopodiaceae and

Mongolian birch, has led researchers to classify the region as a steppe environment with limited forest during the second millennium BCE (Qiu et al. 1995). Paleoclimate data for the region shows that it participated in the drying trends documented elsewhere for the Bronze Age (Li et al. 2006; Su and Zhao 2003; Wagner et al. 2011; Wanner et al. 2008; Zhang et al. 2005). The northern part of Zhangwu County, then, presents environmental conditions that might have encouraged increasing reliance on herd animals and more mobile residence patterns in Upper Xiajiadian times, along the same lines that Wagner et al. (2011) have argued for western China.

The Mollisols and Luvisols of the southern part of Zhangwu County provide more stable environments for cultivation, and one might expect grain cultivation to persist and perhaps even intensify during Upper Xiajiadian, just as was apparently the case in Chifeng. Unlike the regions for which systematic settlement data are already available, then, the environmental setting in Zhangwu County is right for the emergence of greater subsistence specialization in Upper Xiajiadian times. A complementary relationship could develop between sedentary communities focusing on grain cultivation in the southern sector and communities with a subsistence strategy more strongly emphasizing animal herding and more mobile residence patterns in the drier steppe zone to the north. The degree of specialization in animal herding might well vary somewhat in the northern sector, since there are a few scattered locations where local water availability would better support grain cultivation.

Given these characteristics, Zhangwu county was chosen as an appropriate region to address the following questions:

Did reliance on grazing animals and residential mobility increase in some Late Bronze Age communities located in areas where such subsistence strategies would have been attractive alternatives to grain cultivation under warming and drying conditions?

Does such a subsistence shift, if documented, show the artifactual evidence and settlement patterning consistent with economic complementarity?

1.6 RESEARCH PLAN

To address these questions, a systematic archaeological survey of 173 sq km was conducted in Zhangwu County during the months of April, May and June 2012. This project investigates the changes in settlement from the Neolithic through the Liao dynasty (4500 BCE to 1200 CE), in environments that are more appropriate to document the changes in subsistence economy that have been suggested for the Bronze Age. This survey area cuts across the boundary between the productive farmland and the Horqin Sandy Lands. It will thus provide fuller documentation of the demographic and settlement patterns of what present evidence suggests is a sedentary agricultural occupation in its southern portion, during the early Bronze Age and compare and contrast this with contemporaneous demographic and settlement patterns farther north into the Horqin Sandy Lands. This type of ecotone is precisely what has been suggested by East Asian models (Barfield 1981, 1989; DiCosmo 1994, 1999, 2002; Linduff 1995, 1997; Shelach 1999; Xu et al. 2002) and other Old World models (Anthony 2007; Heibert 1994; Irons 1974; Khazanov 1994; Kohl 2002, 2007; Kradin 2002; Shishlina and Heibert 1998) to document the early exploitation by herders of environments not easily cultivated.

2.0 CHRONOLOGY AND CERAMIC TYPOLOGY

Defining periods in Northeast China (Figure 2.1) has been characterized as following a cultural-historical model that is found in much of the rest of the world. However, the origins of the cultural-historical model specific to China has a unique history which in turn affects the research of the region. Culture-history, as it relates to the archaeology of China, has its origins in the subject of history (Faulkenhausen 1993). History here means the written chronicling of leaders and dynasties rather than the establishment of a timeline for prehistory (Trigger 2006). This particular culture-historical approach has resulted in a narrative about the region we now know as China. The culmination of this narrative ends with the establishment of dynasties. Oftentimes this narrative takes on Marxist overtones as the framework for social change (Liu and Chen 2012:1). Critiques of this theoretical paradigm in China has been discussed at length by a number of well known scholars of early China, usually in the introduction of their respective books (Chang 1981; Faulkenhausen 1993, 2006; Linduff 2006; Liu 2004; Shelach 1999, 2009a). However, the narrative produced from a culture-historical approach creates and defines our testable hypotheses and models. Furthermore, the narrative establishes the chronology by which our understanding of social change is attached to. In Zhangwu, the survey area is on the edges of a number of archeological cultures and historically documented polities. The naming of periods and the lumping of archaeological cultures within this dissertation stem from the research agenda and is not designed to gloss over the variability of archaeological cultures found throughout the

Northeast. The research is designed, in fact, to illuminate any economic variability we might find regionally.

This chapter will discuss some of the historical and archaeological nomenclature within China and will attempt to synthesize the narrative and locate the research agenda with respect to it. In other words, this chapter makes explicit the chronological scheme of the project and how it navigates a nomenclature which is derived from history, received history, archaeology, and a generic Three Age System.

Figure 2.1 Northeast China and Eastern Mongolia. Survey area in red.

2.1 A NARRATIVE OF CENTRAL AND NORTHEAST CHINA

Approaching the conventional characterizations of archaeological cultures as testable hypotheses at smaller scales is a means to examine the diversity of human societies. This assumes that a geographic area as large as an archaeological culture can contain socio-economic variability. As outlined in the first chapter, while it has been proposed that there is an economic shift from sedentary agriculture to specialized mobile herding occurring by about 1200 BCE, we have little direct evidence to support this. Therefore, it is essential for the production of this dissertation that the normative views of the periods be outlined. Not because these regions are the units of analysis but because they provide the basis for this dissertation's research agenda.

Therefore, what follows are characterizations of archaeological cultures in space and time following the organization utilized by Liu Li (2012) and Gina Barnes (1999). This narrative is designed to explicitly (Chang 1981, Su 1997) or implicitly (Barnes 1999, Li 2012) demonstrate the foundations of Chinese civilization. For the purposes of this dissertation it is outlined here, to first orient the reader, but also as a means of exposing some of the testable notions inherent in the normative characterizations. The following section also provides the reader with a chronology of the study area in a larger narrative of "Chinese" archaeology. In some places the historical, technological (Neolithic, Bronze Age and Iron Age) and archaeological chronologies deviate from each other; however chronological schemes in the study area use all these categories.

2.1.1 Neolithic

About 5000 to 3000 years BCE, all across China, agrarian societies begin to nucleate into larger communities than ever before. Coinciding with this nucleation is an increase in ritual as well as social stratification (Liu 2012). Liu refers to this period as the “middle Neolithic” and characterizes it as when “social inequality emerges” (Liu 2012). The conspicuous remains of fancy elite burials in a number of regions throughout modern-day China speak to the inequality materialized through mortuary practice. The most well known archaeological cultures of the middle Neolithic include Liangzhu, Hemudu, Beixin, Dawenkou, and Yangshao and research is underway to better understand the dynamics of social inequality in these regions.

In Zhangwu county, the archaeological cultures included in this characterization are Hongshan and Xinle 5500-4800 BCE. When discussing the Xinle period it is necessary to make a distinction between Xinle, which is part of the middle Neolithic, and Upper Xinle, which is an upper layer of the Xinle type-site and part of the Late Bronze Age. The Hongshan culture is best known for intricately carved jade artifacts, monumental burials and ritual platforms (Lü and Da 2008). The county of Zhangwu is in a region that contains both Hongshan and Xinle ceramic styles. The survey region only recovered Hongshan ceramics.

The period from 3000 to 2000 BCE has been described by Liu (2012) in her chapter title as “The Rise and Fall of Complex Societies”. This period is described in this way because in central China increases in population associated with larger more nucleated settlements have been proposed. The Longshan culture is most often cited as proving the foundational elements on which greater social complexity could be built, ultimately resulting in Dynastic China (Liu 2004). At the same time, other highly “successful” cultures are thought to have collapsed at the end of this period (Li 2006; Wu and Liu 2004) . It has been proposed that the Northeast saw a decline in population which coincided with a collapse of the social hierarchies indicative of the middle Neolithic. Following the Hongshan period the depopulation during the Xiaoheyan 3000-2000 BCE and Pianpuzi 3000-2200 BCE periods is thought to indicate cultural collapse that occurred toward the end of the Chinese Neolithic. The major issue with this narrative is that collapse is poorly defined and there is a dearth archaeological material (including carbon 14 dates) (Shelach et al. 2011:19) that provide researchers with an accurate picture of this period. I would also speculate that much of this period may eventually be subsumed into later periods (Chifeng 2011b:117-118; Shenyang 2010). Therefore, following the Chifeng Project, until ceramics can be more accurately dated to this period, the Hongshan Period will end at 3000 BCE and Early Bronze Age will begin at 2000 BCE to preserve the conventional end and start dates of these better known and dated periods.

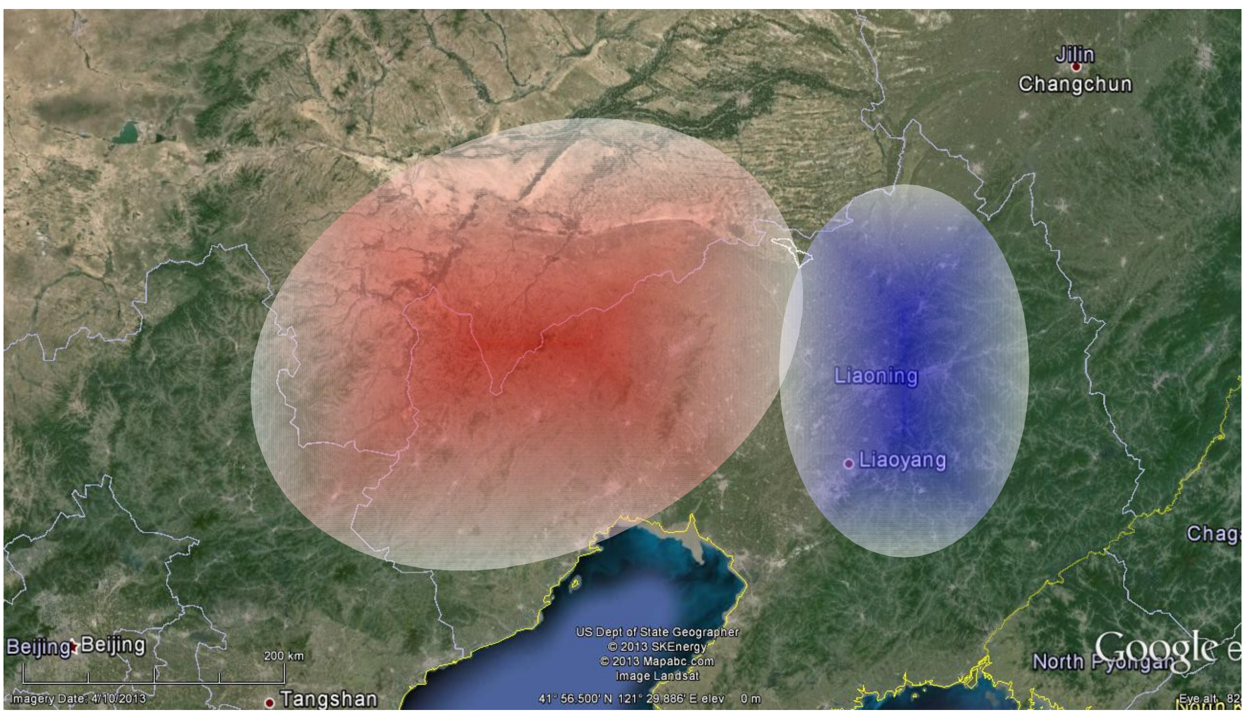

Figure 2.2 Middle Neolithic Archaeological Cultures: Hongshan in red, Xinle (lower) in blue

2.1.2 Bronze Age

The Bronze Age in China is when archaeologists begin to meld history together with material culture. As mentioned above, for much of China this means melding the Xia, Shang and Zhou historic periods with the Erlitou (ca. 2000-1600 BCE), Shang (ca. 1600-1000 BCE) and Zhou (ca. 1000-600 BCE) archaeological material remains. This period is characterized as a series of polities increasing in scale and influence. These polities grow and conquer more and more of so-called barbarous territory, including eventually major parts of the Northeast. In Liaoning, the transition from the Shang to Zhou coincides with the founding of the state of Yan. However, it is the historically named (Xia, Shang and Zhou) periods that are recorded by the National Archaeological Survey in the Northeast even though no historical and archaeological evidence of these polities exist within the survey area. The closest evidence of Erlitou or Xia evidence is more than 700 kilometers southwest of the survey area. The Shang never expanded beyond the Luan River about 450 kilometers southwest of the survey area (Figure 2.3). Keightly (1978) is even more conservative of Shang expansion and places them about 600 kilometers from the study area. However, according to Qin period sources (Li 2006:336), the state of Yan was founded in 1030 BCE. This means that for part of the Late Bronze Age, the prehistoric residents of Zhangwu would have found themselves on the periphery of a Zhou colony (Sun 2006). The state of Yan lasted through the end of the Late Bronze Age and into the next period. The territory never expanded as far north as Zhangwu although some suggest (Lewis 1999; Zhang et al. 1996) that it controlled an territory just south of the modern city of Zhangwu. Li (2006) is slightly more conservative and further suggests that any area very far from Liulihe (just outside of modern Beijing) was not held and controlled for very long (Figure 2.3).

In the study area, several archaeological cultures cover this period. Lower Xiajiadian and Gaotaishan cultures cover the first period from roughly 2000 BCE to 1200 BCE or the Early Bronze Age. This period is followed by the Upper Xiajiadian, Upper Xinle, Linghe and Shiertaiyingzi archaeological cultures dating from about 1200 BCE to 600 BCE, or the Late Bronze Age. There is debate as to whether or not these constitute separate archaeological cultures or variants (Yang 2000). Ultimately classifying them as separate archaeological cultures or not does not impact the normative claims made about these cultures which are nearly identical (Nelson 1995, Guo 1995). According to many authors, these cultures are described as less sociopolitically complex than the cultures of the central plains. It is also emphasized that they are more violent than the cultures of the central plains (Di Cosmo 2002). The archaeological characterization is a reflection of the barbarians (Yi), portrayed in the histories. Mentioned in Chapter 1, this, coupled with the inclusion of Northern Zone style bronze artifacts, suggest to some that there was a shift from a sedentary agrarian lifestyle to one which focused on specialized mobile herding. The most commonly cited date for this shift is around 1200 BCE. This date also serves to divide the archaeological cultures of the Bronze Age into the Early and Late Bronze Age.

The question of whether or not a shift from sedentary agrarian life to specialized mobile herding occurred during the Bronze Age is the primary concern of this dissertation. Since the dissertation is concerned with the potential timing of this shift and the environmental conditions. The actual names of the cultures, or ceramic styles, are less important to the question of tracing this potential economic shift. Throughout this dissertation, Gaotaishan ceramics are the evidence of an Early Bronze Age Period. The ceramics identified as Upper Xiajiadian, Upper Xinle and Shiertaiyingzi are grouped together in discussions of a Late Bronze Age Period. These groupings retain the amount of chronological precision required to address the goals of the research and understand long-term change overtime.

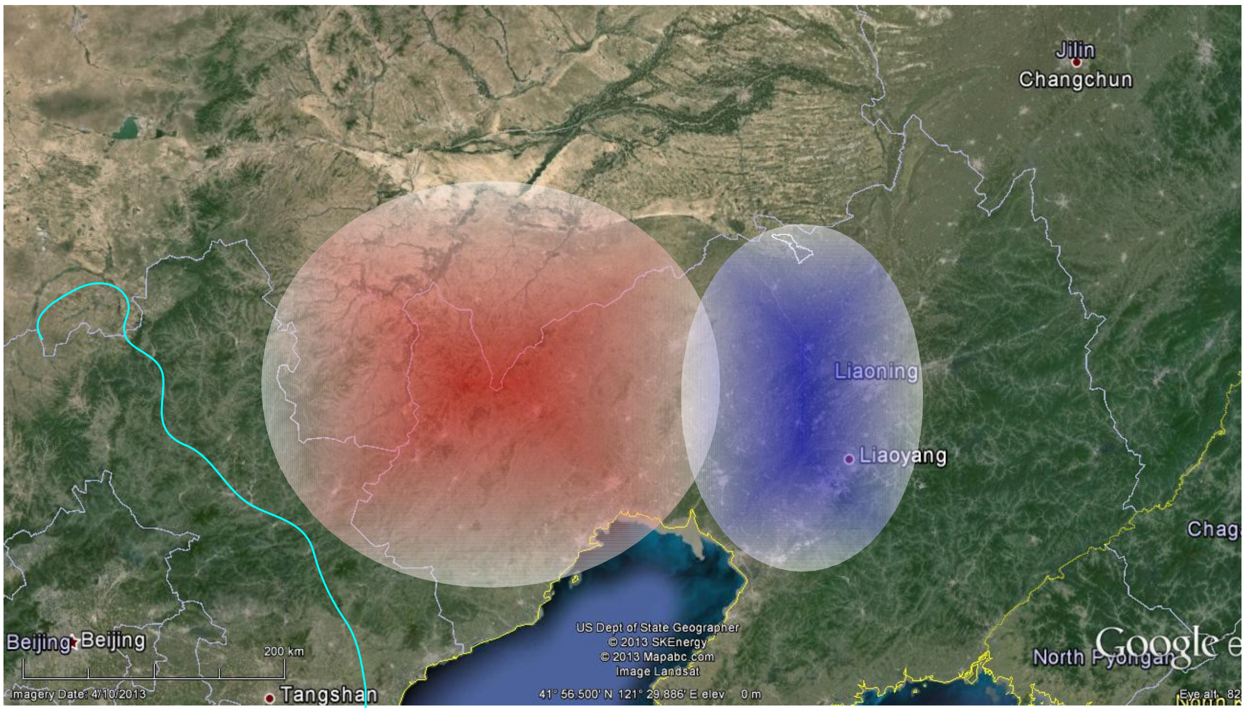

Figure 2.3 Early Bronze Age Archaeological Cultures: Lower Xiajiadian (red) and Gaotaishan (blue). Luan River in blue.

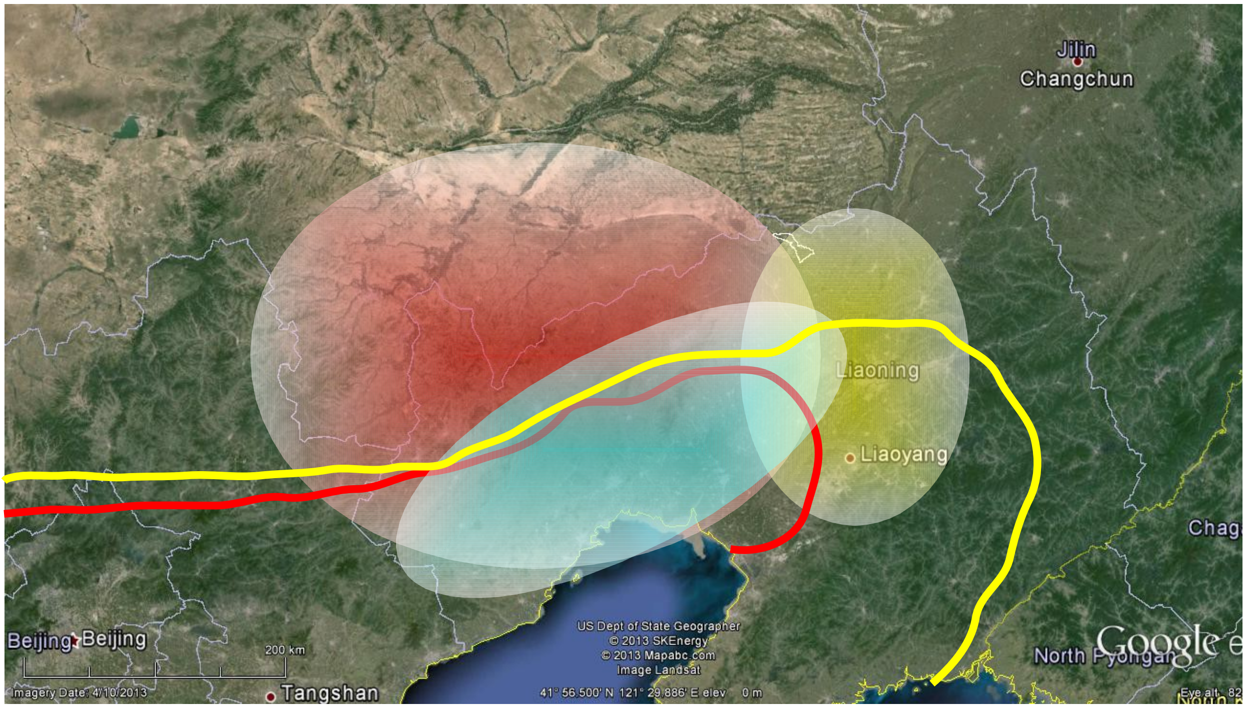

Figure 2.4 Late Bronze Age Archaeological Cultures: Upper Xiajiadian (red), Shier'taiyingzi (blue) and Upper Xinle (yellow) ceramics. The rough extent of the Yan (Zhou) polity according to Li (2006) in red and Lewis (1999) in yellow. Liulihe just southwest of Beijing.

2.1.3 Iron Age

Following the Late Bronze Age, the Warring States and Han Periods coincide roughly with the period when first hand documented histories become available. Prior to this, historical texts postdate the events which they discuss by hundreds or thousands of years. Earlier texts found on bronze, bone or shell are generally for divination or dedication not history, in the sense of a written chronicling of events through time although they have corroborated much of the Shang and Zhou histories. The Warring States and Han periods in the Northeast are periods which the documentation of xenonyms are explicit. This period marks the transition from generic terminology to what appears to be descriptions of political or ethnic groups. Some of these named groups are the Xiongnu, Xianbei, Wuhuan, Fuyu, Gaogouli (Korguryo) and some would argue the Donghu, although Hu a fairly generic term, is much like Yi. In opposition to these groups, the state of Yan occupied the area just south of the survey area until the Han replaced the Qin and Yan in 206 BCE.

The survey area is just outside the region thought to have been under control of the Yan and later the Han but there would have been frequent interaction between those within the Yan and Han polities and those on the outside (Sun 2006). This would have certainly included violent interactions (Barfield 1989, 2001) but new studies of the region focus on the non-violent and mutually beneficial relationship between the Yan and other groups (Sun 2006). Since the period is quite long (800 years) it may be inappropriate to characterize the period as either violent or peaceful. Although, just south of the city of Zhangwu (about 30 kilometers southwest of the survey area) there is evidence of sustained conflict. The northern extent of Yan controlled territory is marked by fortifications that have been well documented by the Zhangwu County Museum (Zhang et al. 1996). There are ceramic styles and archaeological cultures associated with these "outside" groups as well as a Warring States/Han style and culture. The types of ceramics found within the survey region are Warring States/Han ceramics and Xianbei ceramics. The distribution of both these ceramic styles is indicative of the habitation patterns found during the Iron Age or an early Historic period from about 600 BCE to about 200 CE.

2.1.4 Khitan and Liao

The final period represented in the survey is the Khitan or Liao. The latter refers to a particular well documented historic dynasty (907-1125 CE), Khitan or Qidan is sometimes used analogously to this. For others, Khitan refers to an ethnic group that would later be the ruling class during the Liao Dynasty. The Khitan ethnic group is thought to have occupied Northeast

China from about 400 CE to about 1200 CE. The end date I am using differs slightly from the Chifeng project. During the 1100s the Khitan (Liao) and Jin polities were engaged in numerous battles over control of northeast China. By the late 1100s the Khitans had either been defeated or subsumed into the Jin or Mongol polities. By the early to mid 1200s the Mongols had obviously taken over much of Asia and with it any regions controlled by the Khitans or Jin. The ceramics associated with this period represent the larger Khitan period (Makino 2007) and although the Liao label is used, it only because this is the nomenclature in Chinese. It is meant to be synonymous to the period between 200 CE and 1200 CE (or post-Han to pre-Mongol), not the dynastic period.

The archaeological and historical nomenclature for many regions, Northeast China included, is complicated. The following timeline (Figure 2.5) included some of the names and corresponding periods and lays out the chronological scheme of this dissertation. The historically defined names are not exhaustive, but include some of the nomenclature most pertinent to this dissertation.

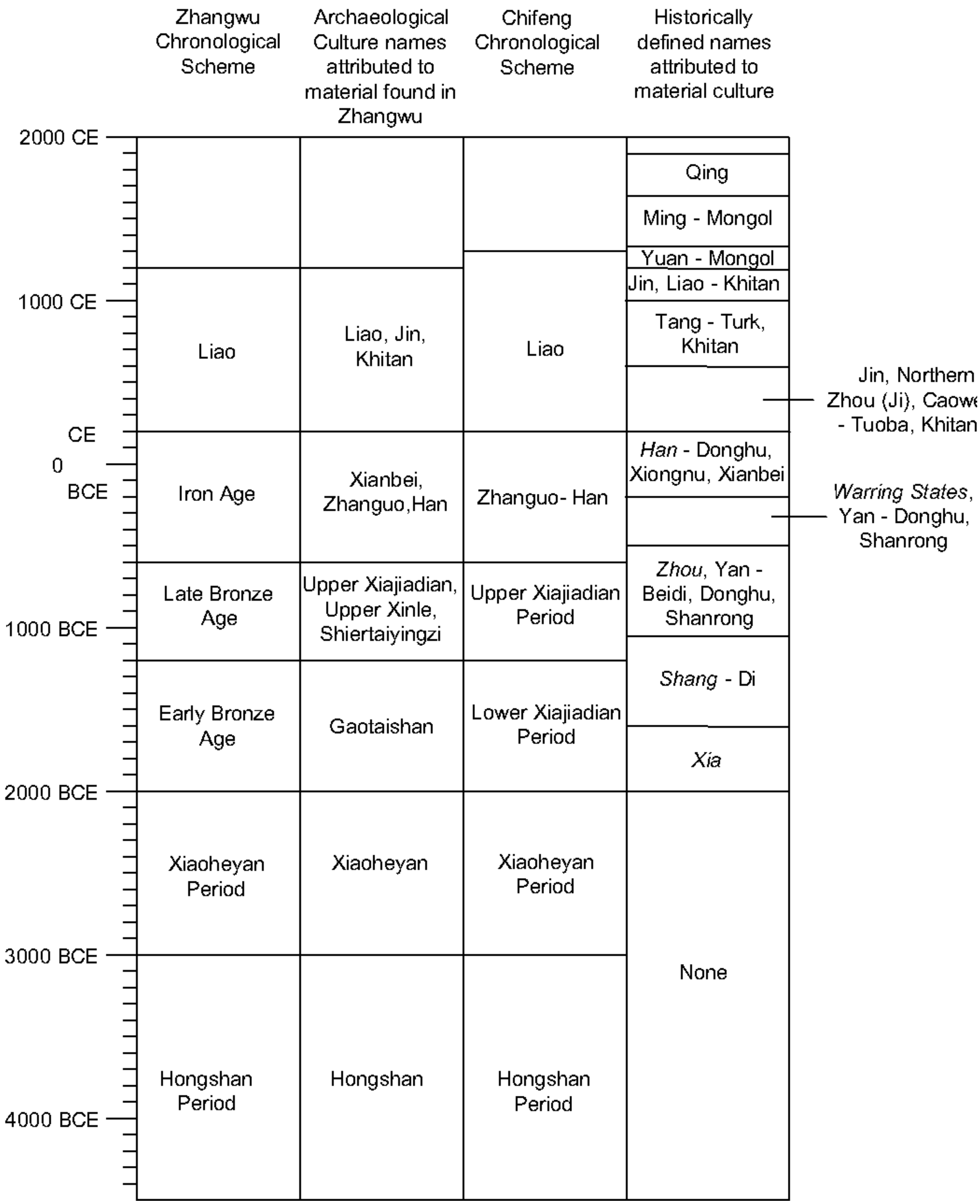

Figure 2.5 Timeline of the region
Italics indicates Chinese National Archaeological Survey Periods

2.2 CERAMIC CLASSIFICATION AND TYPOLOGY

With the nomenclature from the above narrative in mind, the project went on to group and divide ceramics with the help of a number of well know ceramicists. Professor Wang Lixin's work and most recent project (Wang 2013b) details the distribution and typology of ceramics from Northeast China (Wang 2005, 2013a; Wang and Qi 2002) and most of China (Wang 2013b). He along with Li Xinquan, the vice director of the Liaoning Institute of Archaeology and Xin Yan an institute researcher with over 30 years of archaeological experience in Northeast China established some of the diagnostic characteristics and the classification used for the project. The Early and Late Bronze Age, of critical importance to answering the research questions, are long periods (800 and 600 years, respectively). Future efforts to increase chronological resolution will, of course, be welcome, but the existing chronology made it possible to determine what settlements and settlement distribution were like in the southern and northern sectors of Zhangwu county during these two time spans, as well as the Neolithic and historic periods. The stratigraphic excavation that would be necessary to produce further chronological refinement is, in any event, beyond the range of possibilities for this dissertation project. For all the periods, most of the identifying features relate to paste, color and temper since whole vessels or larger are generally not found from surface survey.

2.2.1 Hongshan Period Ceramic Typology

Hongshan ceramics have a number of characteristic features that distinguish the sherds from other ceramics in the trajectory. Most of the sherds in the region are sandy tempered brown-wares. There are very few fine red/orange paste ceramics found in other regions. Some of the sherds have a characteristic incised zigzag pattern that has been observed and documented for other Hongshan ceramics. Certain painted pattens are unique to Hongshan ceramics. Although none of the sherds recovered were large enough to identify the types of painted patterns, black paint was identified on some of the sherds. Vessel form is also very difficult to ascertain from small sherds recovered by surface survey but rim sherds indicated both open and closed mouthed vessels. The characteristic ritual cylinders found in other regions were not recovered in the survey region. The ceramics recovered by the survey were mostly utilitarian vessels, as they have been described for other regions (Zhu and Guo 2011:11-12).

Figure 2.6 Sample of Hongshan Ceramics from survey area

2.2.2 Early Bronze Age Ceramic Typology

Gaotaishan ceramics are generally coarser and have thicker walls than Hongshan ceramics. They are higher fired than Hongshan ceramics resulting in a paste that is more gray and less brown than Hongshan sherds. These sherds also have a generally sandy temper. Some of the collections included diagnostic pieces that are unique to Gaotaishan vessel forms. Some of these features include flat rectangular handles and toggles as well as flared rims with a pointed termination. These types of toggles are characteristic of Gaotaishan ceramics and the flaired rim is thought to indicate a closeness to Lower Xiajiadian ceramics found further to the west (Ministry of Culture 2009). Clay is sometimes added under the rim either to strengthen the vessel rim or as decoration and is visible in a section of some rim sherds. Some Gaotaishan ceramics are decorated with red slip. Unlike Hongshan ceramics where the paint is a clear visible layer, the slip may have been applied prior to firing resulting in a less abrupt layering and less vibrant coloring. This is not at all similar to the brightly painted Lower Xiajiadian vessels occasionally found in elite burials.

Figure 2.7 Example of Gaotaishan ceramics

2.2.3 Late Bronze Age Ceramic Typology

Upper Xinle ceramics are even coarser and thicker than Gaotaishan ceramics. They are more crumbly and there are higher amounts of sand temper. The crumbly nature of the ceramics may be due to either the higher amounts of sandy temper or a lower firing temperature. The paste is generally darker but less uniform than any of the other periods. It includes more grays and in some places very dark gray to black. There are some examples of rubbed stone polish as a decoration or finish. Vessels may include rounded handles or toggles in contrast to the square or rectangular toggles found on Gaotaishan ceramics.

Upper Xiajiadian ceramics in this region are very similar to the Upper Xinle ceramics in paste and temper. These ceramics are thinner than Upper Xinle but still have a high proportion of sandy inclusions. In both of these Late Bronze Age types, the inclusions are much larger than the Hongshan or Gaotaishan ceramics.

Figure 2.8 Upper Xinle ceramics from the survey area
(7 sherds on the right side date to other periods)

2.2.4 Iron Age Ceramic Typology

Warring States/ Han ceramics are more evenly fired than the previous periods and more uniform in color. The paste is finer than to Neolithic and Bronze Age pottery. The color of the paste falls into the dark gray category. Cord marked decorations are the most commonly found in Warring

States/ Han sherds. Linear bands separating areas of decoration are common in both Warring States/ Han and Xianbei ceramics.

Although they are more crumbly than Warring States ceramics, Xianbei ceramics are also predominately grayware, but slightly lighter in color than Warring States/ Han ceramics. The more crumbly nature may mean a lower firing temperature but Xianbei ceramics are still better quality than the Late Bronze Age ceramics. Xianbei ceramics have more complex decorations than their Warring States counterparts (Sun 2007). In addition to cordedware, stamped designs and net designs are also common in Xianbei ceramics (Figure 2.9). Closed mouth vessels or jars are more common in ceramics identified as Xianbei.

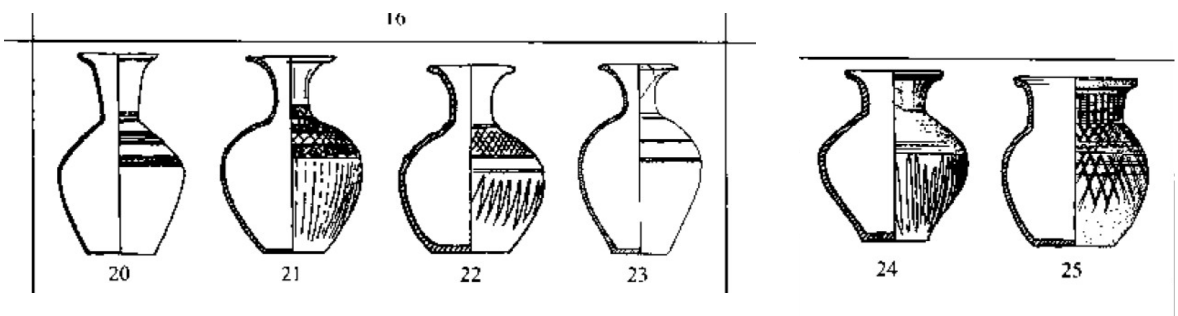

Figure 2.9 Example Xianbei ceramics (from Sun 2007)

2.2.5 Liao Period Ceramic Typology

Liao Period sherds are well documented in Northeast China as well as Mongolia and easily identifiable. They are the hardest highest fired ceramics in the trajectory. These ceramics were generally produced on a fast wheel and sherd thickness is very uniform. The sherds are thinner than Bronze and Iron Age sherds and composed of fine paste and generally lack the sandy temper of other periods. Decorated sherds are more common than other periods. The main form of decoration is linear punctuate (Figure 2.9) which is fairly pervasive during this period throughout northern Asia (Makino 2007).

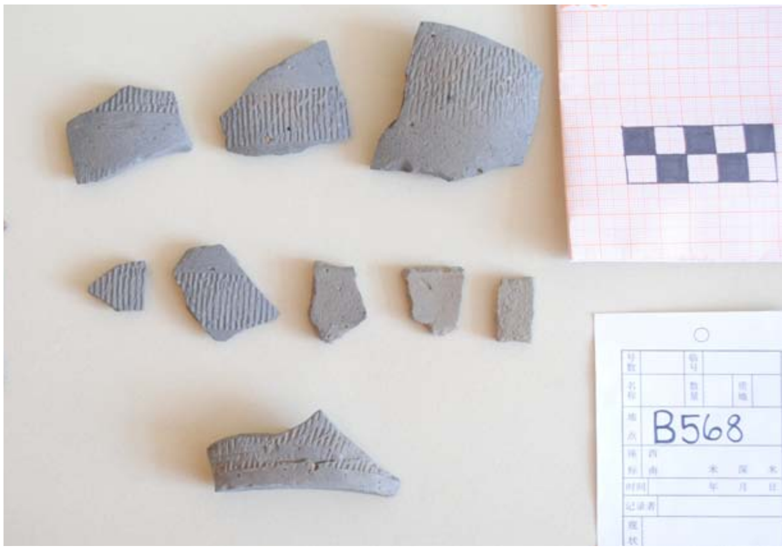

Figure 2.10 Example Liao Period Sherds

2.3 SUMMARY

In Northeast China, especially Zhangwu county, it is necessary to address the conflation of historical, cultural and archaeologically defined chronological labels. These labels are used to indicate periods in time and spaces in geography but they derive from different foundations. Through understanding the origins and functions of different forms of periodzation, we can more productively group, split and choose the most affective chronological scheme given particular research questions. In order to best understand long-term economic and societal change, the chronological scheme above uses generic terms from a Three Age System. This is appropriate because the sociopolitical and economic claims about Late Bronze Age archaeological cultures are nearly identical for a number of cultures in the Northeast. This is especially true of the Late Bronze Age cultures where they have already been grouped together using the shared style of Northern Style Bronze artifacts as a rationale to do so (Shelach 2009a, Yang 2008).

It could be debated that dynastic political change may involve rapid change over large swaths of territory and therefore the culture-historical model I have described is appropriate for describing interactions between polities and large scale socio-political change. When applied to smaller scale polities, however we are ill equipped to understand the processes of change which may not be as uniform across a single archaeological culture, let alone multiple ones.

3.0 RESEARCH AREA AND ENVIRONMENT

As discussed in Chapter 1, the ecotone environment found in Zhangwu is the ideal context to examine many of the models about the emergence of pastoralism (Anthony 2007; Kazanov 1994; Kradin 2002; Khol 2002, 2007) In East Asia, Owen Lattimore is one of the earliest scholars to propose that an environmental divide in in Northeast China has implications for subsistence economy and social complexity (Lattimore 1940). Environmental foundations for a number of theories developed in China (DiCosmo 1994, 1999, 2002; Linduff 1995, 1997; Shelach 1999) explain the rise of social complexity, the rise of sedentary and nomadic polities and the relationships between them. Therefore, a detailed accounting of the environmental conditions is necessary to interface with these theories.

The following chapter examines the environment of the study area in more detail as well as establish a more concrete contrast to the Chifeng region (Figure 3.1). The chapter discusses multiple sources of data to better create the prehistoric environmental reconstructions that serve as the foundation for further analyses in Chapters 4 and 5.

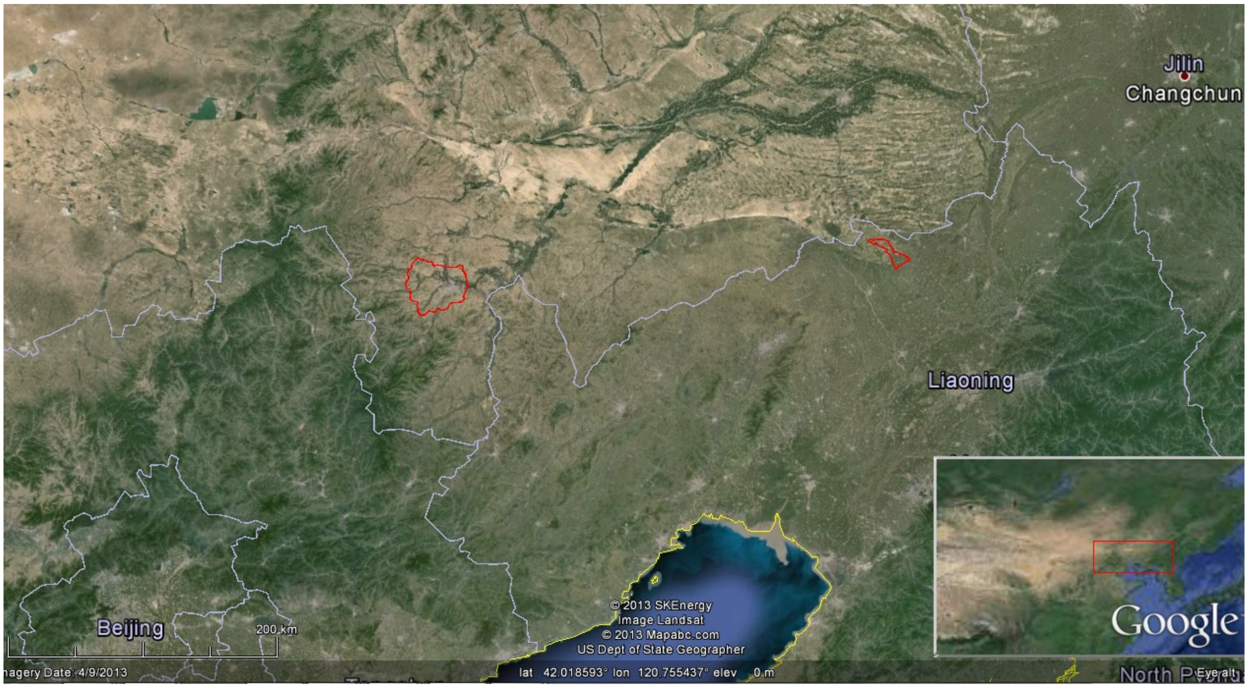

Figure 3.1 Southern Northeast China and locations of Chifeng and Zhangwu survey areas

3.1 MACRO REGIONAL ENVIRONMENT

The provinces of Liaoning, Jilin, Heilongjiang and the eastern half of Inner Mongolia are known collectively as Northeast China or Dongbei (东北). This region has a variety of environments which would be conducive to a whole host of economic endeavors. Latitudes of this region fall between about 53 and 40 degrees. Annual rainfall highs range from 300mm to about 1200mm, most of which falls in the mountains during the months of June, July and August. Winters are very dry, with some regions only receiving a few millimeters of precipitation per month during the months of December, January and February. In addition to precipitation, temperature is also highly variable. Monthly average temperatures can rise as high as over 30 degrees Celsius in the south with winter temperatures as low as -30 degrees in the north. Despite these low temperatures and high latitudes the region was never glaciated during the Pleistocene due to a lack of precipitation.

The picture macro-regional soil distribution reveals some interesting and less variable patterns. The highly productive Cambilsol soils of Central China stretch as far as the southwestern section of Northeast China, roughly 200 kilometers east the Chifeng region, where they gradually give way to sandy Arenosols (Aridisols USDA classification) soils in the north, and more loamy Luvisols and Phaeozems in the southern and eastern sections of Northeast China. On the boundary between the sandy and loamy soils, soil types such as Chernozems and Kastanozems generally form. The most common soils under rivers and floodplains in this region are Fluvisols (Figure 4.2). Based on the information from dominant soil composition in Northeast China, three large biomes can be interpreted. When one paints Northeast China with the broadest of brushes there are three major environmental zones: steppe in the north and west, forest to the east and far north and the broad floodplains of the Liao and Hun rivers in the southwest portion of Northeast China. These three zones, while correct, do not do the diversity of the region justice. The data exists to develop more detailed characterizations of the region and answer the question: what type of steppes and forests can we distinguish within this region?

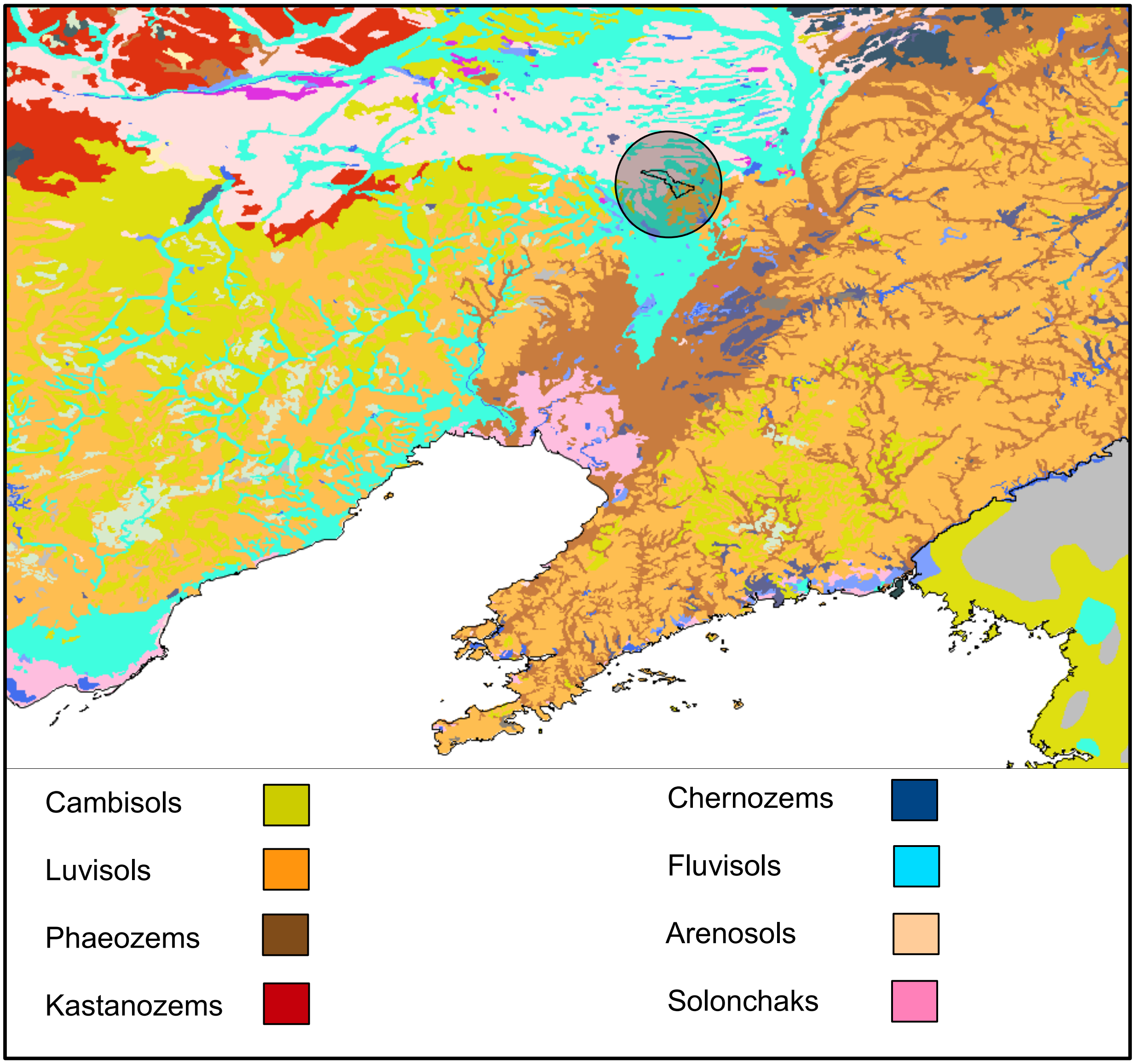

Figure 3.2 Dominant soils of southern Northeast China from the Harmonized World Soil Database (HWSD 2012)

Farming is by far the most common land use pattern in Northeast Asia today. The clearing of land and natural growth for farming poses challenges to historic and prehistoric reconstruction and so authors are often forced to paint Northeast China with broad strokes. Liu Huamin and colleagues identified no fewer than 16 unique environments (Liu et al. 2009) in

Northeast China. One of the goals of the project was to predict the natural vegetation patterns and environments had they not been influenced by modern farming.

The resolution of this study is still not high enough to make any correlations to regional settlement pattering but it underscores two critical points. First the study reconstructs a higher resolution for the region. But perhaps more importantly, the environmental reconstruction above (Liu et al. 2009) provides one with qualitative resolution in terms of the taxa of flora. This is a key element to calculating herd composition and productive capacity found in Chapter 4. Both of these points allow us to move beyond a simple steppe and forest characterizations that authors too often rely on (Anthony 2009; Chernykh 2009; Eng 2007:1; Kohl 2007; Koryakova 2002; Zhang 2011; Guo 2012; Yang 2008) (but see Frachetti 2008:83-105).

3.2 CURRENT ENVIRONMENTS OF THE SURVEY REGION

Zhangwu County falls between at 42.8 and 42.3 north latitude and 122.2 and 123.2 east longitude. It is situated on one of the ecotones described by theorists which also contains the relevant archaeological evidence (see Chapter 2) to examine the relationship between economic change and environment during the Bronze Age.

The different combinations of latitude, rainfall, altitude and soil composition produce the variety of environments and biomes found in Northeast China. There are dozens of steppe and forest environments within Northeast China. Based on the soil composition, the Zhangwu survey area falls on the one of these boundaries between sandy Arenosols and loamy Luvisols. Based on Liu's (2009) reconstruction, the survey area falls on the boundary of Lyme Grass steppe and

Laiotung Oak forest. This is intermixed with small areas of desert scrub and grass. With this in mind, the survey area was delimited and divided into two regions.

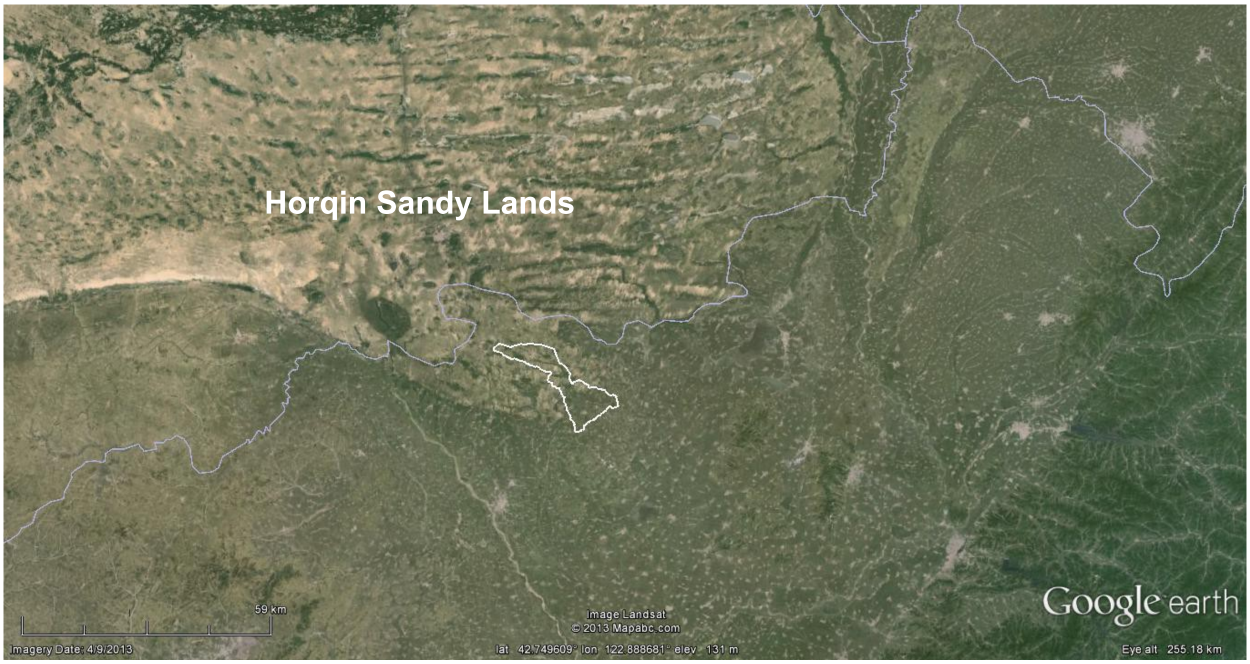

Figure 3.3 Survey area and nearby surrounding region. Grey line indicates boundary between Liaoning and Inner Mongolia.

3.2.1 The Northern and Southern Areas

Two regions were roughly mapped out based on satellite imagery prior to fieldwork. The divide between these two environments is visible due to the lower levels of vegetation in the north. During fieldwork on-the-ground observations of soil composition and land use confirmed the initial assessment. The two regions become delimited as the northern and southern area (Figure 3.4). The northern area covers 91 square kilometers and the southern area covers 77 square kilometers.

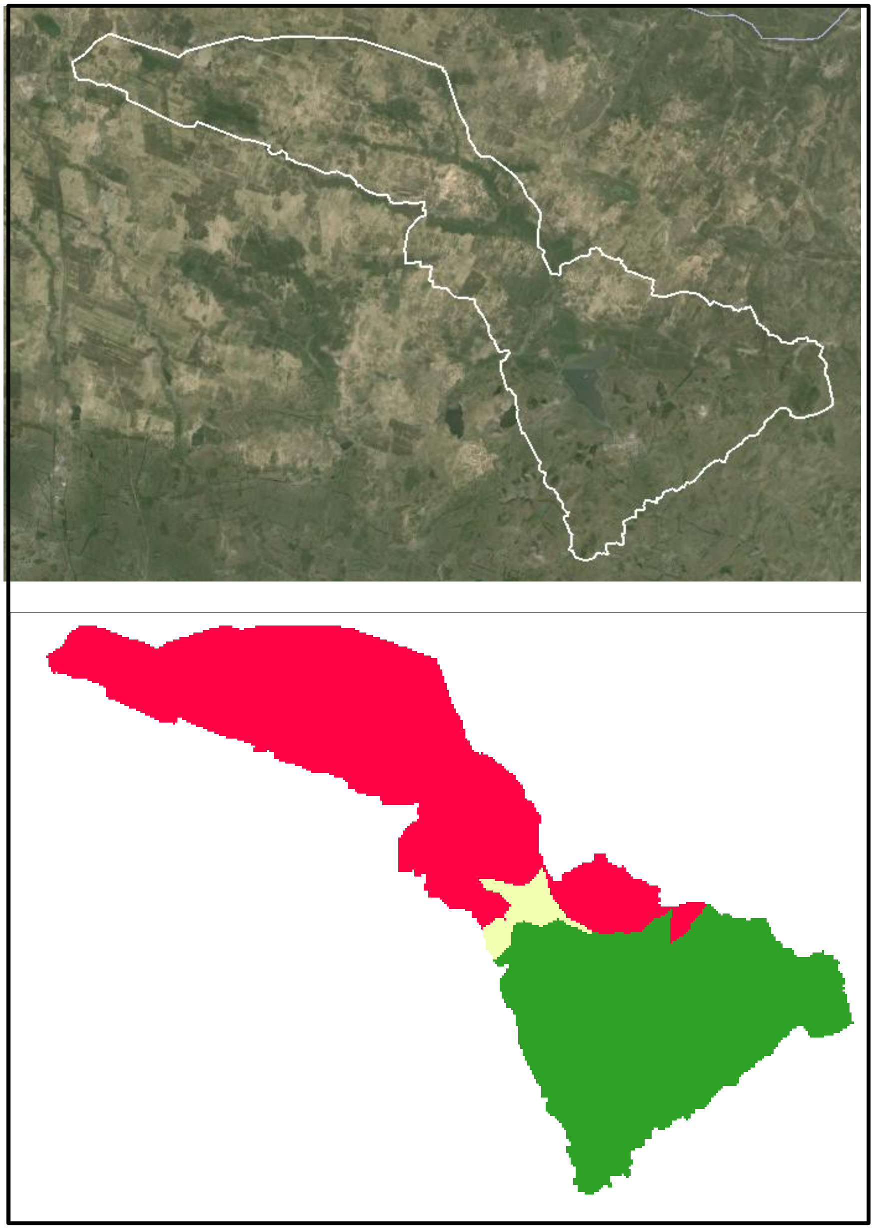

Figure 3.4 North and south sub-regions delimited from satellite imagery. Cream color indicates intermediate area that has been modified significantly in recent history.

In addition to the northern and southern sub-regions, there is an intermediate area that covers about 5 square kilometers. This intermediate area has undergone serious transformation due to its proximity to the Julong Reservoir and was part of a low marshy drainage that now is and in the past was prone to flooding. Very little in terms of human occupation was found in this region. Furthermore, this area would have not been a desirable area for habitation because flooding during most of the prehistoric period in this study may have been more severe than the present (see section 3.3).

3.2.2 Topography and Hydrology

The elevation of the northern area is generally flat and falls between 200 to 150 meters above sea level. The southern area has more varied topography. The elevations range between 260 meters above sea level at the tops of the hills, and about 100 meters above sea level in the valley bottoms (see Figures 3.5 and 3.6)

Figure 3.5 Survey area looking southeast, foothills of the Changbaishan range is about 100 km southeast of survey area

Figure 3.6 Survey area looking northwest. Dark band is the Xilamulun River approximately 100km north and west of survey area

Rainfall patterns are consistent with patterns found in this region of Northeast China. Rainfall is normally between 350 and 500 millimeters annually. Although, this is known to fluctuate to as little as 160 millimeters and up to 650 millimeters annually. Very little of the rainfall in the north is captured by river courses. The flat topography and the loose soil texture help to drain rainfall quickly into the soil which contributes to the high water table in the region. There is a generally high water table in the northern part of the survey area. According to Zheng and colleagues (Zheng et al. 2012) water tables would have been between 1-3 m prior to 1950. This is consistent with other areas in the Horqin Sandy Lands. Presently, water comes to the surface in two locations and moves west and south into the southern area of the survey zone (Figure 3.7). The floodplains are between 100 and 500 meters across. The two courses meet and create a larger floodplain that is about 1.4 kilometers at its widest. Today these two sources meet and drain into the Julong Reservoir. Prior to its construction in 1960, the two streams would have drained into a low floodplain, marsh and small pond (Figure 3.8). Between 1935 and 1938 the Japanese Army made maps of the area during their occupation of the Northeast. In 1951 the US Army Corps of Engineers used those maps to create a series of 1:250000 maps. The scale of these maps make them inappropriate for incorporation into the GIS but they roughly indicate the courses of the two streams and the marshy lowlands mentioned above. Part of the second stream course may have been in the same location but too small to be detected in cartography of this scale. The old floodplain is now part of the reservoir, partly under the water and the other part can be found just northwest of the reservoir. Control of this floodplain is the primary reason for the construction of the dam and reservoir. Water then travels into two natural river courses and two courses that are a result of modern water management. Both of the natural river courses continue to flow out of the survey area and south until they meet up with the Liu River floodplain just south of the city of Zhangwu. The “very low” gradient (0.01 m/km) (Brenden et al. 2008) and the low output of the streams provide very little water to the region.

Figure 3.7 Surface water in the northern part of the survey area which eventually flows south.

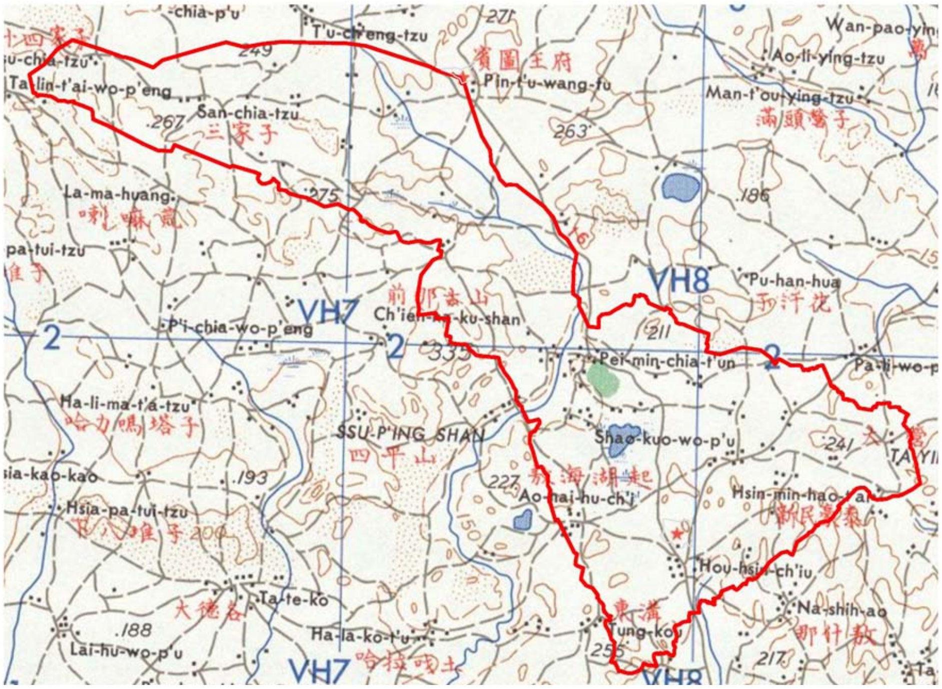

Figure 3.8 Survey area superimposed on US Army Corps of Engineers Map (US Army 1951). The georeferencing of the survey boundary contains inaccuracies due to the scale of the original 1951 map.

3.2.3 Current Vegetation Indexes

LandSAT imagery is another way by which one can reconstruct regional and sub-regional environment. The red and infrared bands from LandSAT imagery can be combined using the formula below to create a Normalized Difference Vegetation Index. The resulting image is one whose the values range from 0 to 1, 1 being the highest levels of vegetation and near 0 correspond to bare rock. The limitations of NDVI are most conspicuous when dealing with areas of dense vegetation in tropical environments. In Northeast China, this index is ideal given the moderate vegetation and relatively arid environment.

$$NDVI = ((NIR-RED)/(NIR+RED))$$

NIR = The near infrared wavelengths from LandSAT imagery; or Band 4

RED = The visible red spectrum from LandSat imagery; or Band 3

The imagery used for the analysis of Zhangwu is from September 16, 1986 (Figure 3.9). This imagery was used because of three factors. In this image the cloud cover is negligible. Cloud cover is known to alter the results of NDVI. The image was taken in the late summer, during the period of heaviest growth before harvest. Lastly, the scene was as old as possible to curb the impact of modern construction. In the late eighties and early nineties, urbanization and migration out of the countryside boomed following the reforms of Deng Xiaoping, so having data that predates that industrialization is useful. The soft wood evergreen arboriculture found in the north is a very recent phenomenon. If one uses images that include large areas of tree farming then the NDVI would produce false positives, overall higher values or at least a bi-modal distribution, thereby skewing subsequent analyses.

NDVI is also known for being sensitive to standing water. The standing water in the survey area resulted in negative NDVI values and further analysis masked those values that were less than zero, such as the Julong Reservoir.

Figure 3.9 NDVI for the values for the Zhangwu survey region without data mask

The NDVI data supports the observations from satellite photos and the survey teams. The southern area has a slightly higher levels of vegetation than the north. The average values of the two regions, 0.189 and 0.228 quantitatively demonstrate the difference in the density of vegetation when these two areas are compared (Figure 3.10). While the differences are modest, slight differences in NDVI values can indicate substantial differences in the land cover, biomass and environment of an area. The values in Zhangwu correspond to the appropriate land cover described by other researchers (Youhao 2007). In arid environments, Youhao and colleagues use a value of 0.21 to distinguish between scrub, herb and grassy species and denser growth of agricultural plants.

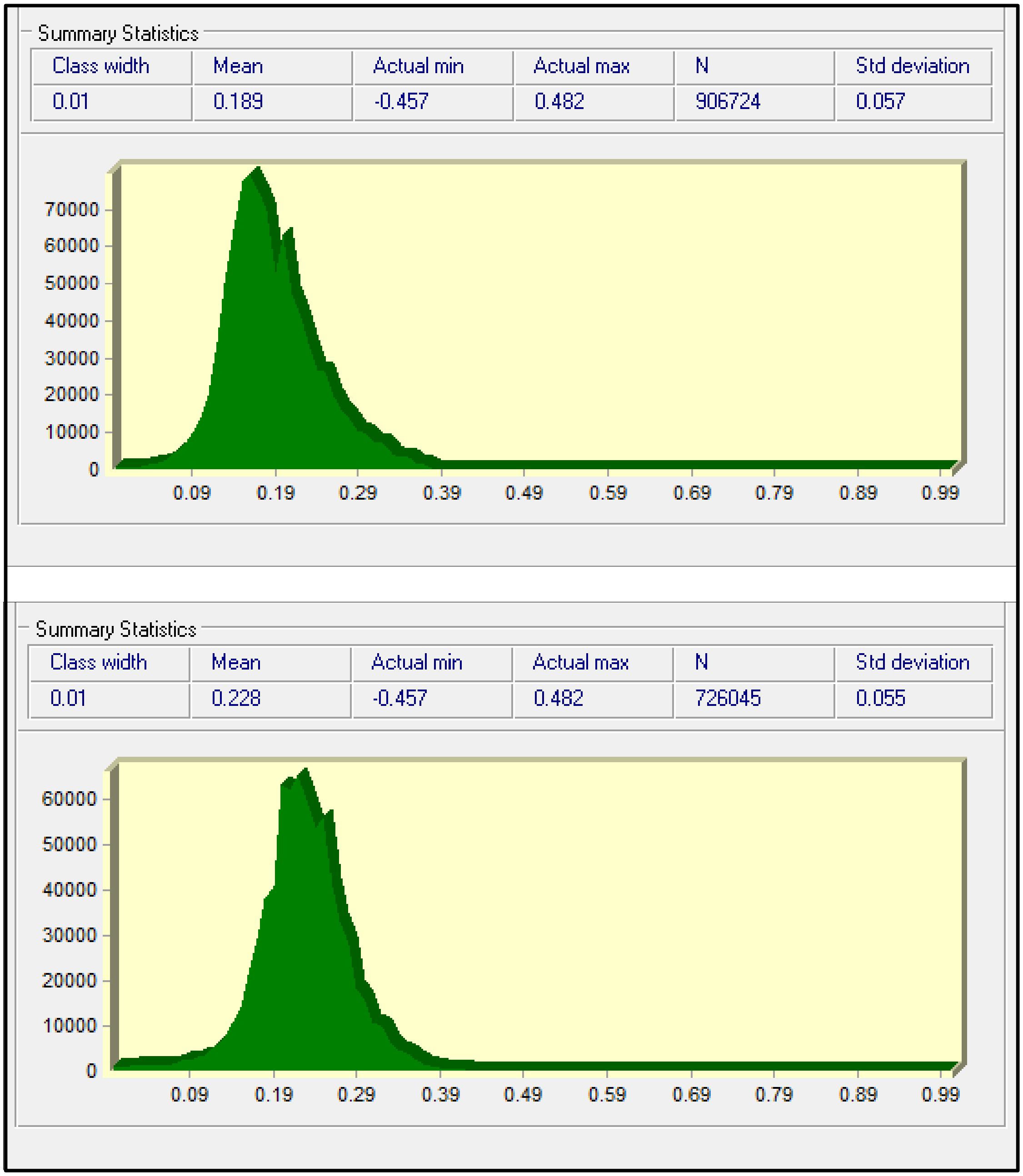

Figure 3.10 Summary statistics and normal distributions for the NDVI data in the north (top) and south (bottom) survey areas. N refers to the number of 10m by 10m cells.

3.2.4 Soil Composition and Quality

As mentioned above, the survey area falls on the boundary between two soil types which has implications for agricultural potential and natural growth. Although archaeologists have used the HWSD for analysis (see Holliday 2004) other data reveals several distinguishable soil categories. Higher resolution data collected at the county and sub-county level and compiled and digitized using a variety of maps ranging from 1:10000 to 1:50000 by the Chinese Academy of Sciences in collaboration with FAO was used as the foundation of the following soil quality data (Shi et al. 2006; Shi et al. 2007). Over the past 10 years, the preparation of this data has been ground-truthed by both the Chinese Academy of Sciences and the FAO and been used in a number of applications (Boerma et al. 1995a, Boerma et al. 1995b, Shi et al. 2006; Wei 2012; Yang et al. 2010; Xu and Yang 2010). It is from this data I construct a relative index of soil quality within the survey region. The unique soil types are described below and then assigned a productivity rank (Table 3.1). Part of the determination of agricultural productivity is the assumption that the main domestic crop is foxtail millet(*Setaria italica*) and dry farming is predominant form of agriculture.

- The least productive soil type in the region is the Calcaric Arenosol. The parent material soil consists of unconsolidated sands made up of primarily Calcium Carbonite and is highly friable. The International Soil Reference and Information Centre (ISRIC) describes their use below (FAO 2006):

  > ...most Arenosols in the dry zone are used for little more than extensive grazing but they could be used for arable cropping if irrigated. Arenosols in temperate

climate regions are used for mixed cropping and grazing but supplemental (sprinkler) irrigation is needed during dry spells.

The report goes on to specify that:

High permeability, low water storage and low biological are all conducive to decalcification of surface layer(s)...". The decalcification of the surface layer and and reconstitution as calcium carbonate within the soil matrix is what classifies this soil in the Calcaric sub-taxa. (FAO 2006)

- Slightly more productive than the Calcaric Arenosol is the Cambic Arenosol. When compared to the Calcaric soils of the same taxa, Cambic soils are more developed and less friable. The relatively consolidated nature of the pedon and higher clay content would result in better root anchoring for a number of grassy species including domesticated millet.

- Fluvisols in this region are Calcaric and the parent material is unconsolidated $CaCO_3$ or sand. The drainage is better than the "somewhat excessive" (FAO 2006) Arenosols, but still classified as "poor". The ISRIC describes Fluvisols as generally versatile.

  Fluvisols are planted to food crops and orchards and many are used grazing. Flood control, drainage and/or irrigation is normally required. (FAO 2006)

  Foxtail millet does not thrive well in waterlogged environments and is one of the reasons that this soil is ranked lower than the soils below.

- Haplic Luvisols are a major proportion of the soils within the southern area. They are the most well developed soil in the survey region and are defined by being more developed and having a higher clay content. These soils are described by the ISRIC as generally productive.

  > Luvisols with good internal drainage are potentially suitable for a wide range of agricultural uses because of their moderate stage of weathering an high base saturation (FAO 2006).

  The Haplic qualifier for this soil type indicates that this soil is not categorized into any other sub-types, such as ferrous or calcarious. However, the Luvisols in this region can be divided based on parent material. Furthermore, the parent material has implications for the productivity of the soil.

The sandy parent material certain Haplic Luvisols would make them slightly less productive than ones whose parent material is migimatite or basalt. These parent materials add acidity to the matrix which result in an overall pH that is neutral to slightly acidic, ideal conditions for foxtail millet.

Table 3.1 The proportion of soil types in the region and the associated ranks.

Dominant Soil Type	Sub type	Major Parent Material(s)	Proportion of the survey region	Soil Quality Rank
Arenosol	Calcaric	Unconsolidated Sands	5.7%	1
Arenosol	Cambic	Unconsolidated Sands	27.4%	2
Fluvisol	Calcaric	Unconsolidated Sands	39.4%	3
Luvisol	Haplic	Unconsolidated Sands and Silts	22.3%	4
Luvisol	Haplic	Migimate and basalt	5.0%	5

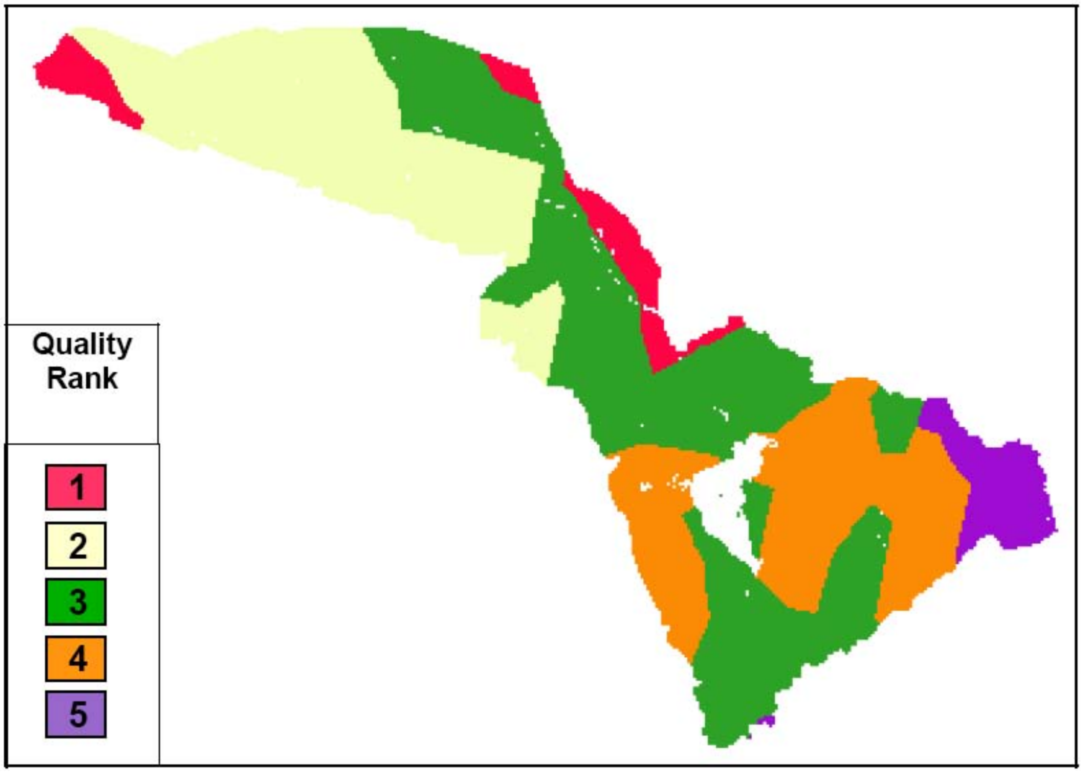

Figure 3.11 Ranks of dominant soil types in the Zhangwu survey region with the Julong Reservoir masked in white.

While some of the soils cross the boundary between the northern and southern sub-regions, a relative index of quality can be assigned to each of these sub-regions by using the following equation.

S# = Soil rank

AS = Area of soil within the sub-region

$$\frac{(S1 * ASa)+(S2 * ASb)+(S3 * ASc)+(S4 * ASd)+(S5 * ASe)}{\text{Total area of sub-region}}$$

Table 3.2 Areas in square kilometers for different soil ranks and zones.

	Soil Rank						Regional Index
	1	2	3	4	5	Total	
North	9.44	47.34	33.12	1.12	0	91.02	2.285
Intermediate	0.48	0	4.04	0	0	4.52	2.787
South	0	0	31.05	37.40	8.71	77.16	3.769
Total	9.92	47.34	68.21	38.52	8.71	172.70	2.96

This calculation results in slightly higher than average quality soils in the south and lower than average in the north. Using soils information or NDVI data, we arrive at a similar conclusions, even though these sources of data were collected independently of each other.

I have not gone into the detail above only to belabor the points made throughout the sections of this chapter. The purpose is twofold. First, arriving at the same conclusion using multiple lines of evidence strengthens the proposition that there is an unambiguous ecotone on which to carry out the following study. Secondly, and perhaps more importantly, using multiple lines of evidence puts a tighter focus on what exactly are the environmental characteristics of this particular ecotone which may affect human settlement patterns. This is an attempt to move the study beyond a simplistic idea of northern steppe and southern forest/farmland that has characterized much of the archaeology and anthropology of this region for nearly 100 years. To be clear, this is not to say that higher resolution understanding of the environmental conditions dissolves or undermines the theoretical foundations of a century's worth of archaeology. It allows these theories to be clarified tested among a variety ecotone environments, one of which is Zhangwu.

3.3 PREHISTORIC CLIMATE AND ENVIRONMENTAL CHANGE

Mentioned in Chapter 1, The environmental characteristics of Zhangwu County have changed since the Bronze Age but the contrast between its northern and southern sub-regions would still have been present. In addition the following section discusses Neolithic and historic climates. Much of the information below is derived from the synthesis of dozens paleoenvironmental reconstructions found in (Teng and Shelach 2011b:39-43). However, when other data is available closer to the survey area an attempt is made to add to the synthesis. Most of the studies that I use in lieu of or to supplement the Chifeng regional data is collected from the Horqin Sandy Lands (Qui 1995; Zhang et al. 2004; Zhao et al. 2007; Yang 2010).

3.3.1 Paleoclimate

From about 6000 to 4000 BCE the environment is notably wetter and warmer than the present. It is probable that most of the southern area would have been dominated by deciduous forest giving way to forest-steppe environments as we move north. The Holocene Megathermal may have given way to cooler conditions toward the end of the Hongshan Period but throughout this period the region would have been very productive since temperatures would have not been very much lower than present (Teng and Shelach 2011b).

During the interim between Hongshan Period and the beginning of the Early Bronze Age, climate is highly variable (Teng and Shelach 2011b) but remains wetter than present and higher levels of precipitation persist through the Early Bronze Age to about 1000 BCE (Yang 2010). Zhang and colleagues (2004) suggests a cooling period of from about 2400-750 BCE but this would still be warmer than today. This covers Early Bronze Age and most of the Late Bronze

Age. The high levels in precipitation, especially during the Early Bronze Age, may have made upland farming in the southern region particularly advantageous. Although, lowland farming in the north is certainly a possibility.

During most of the Late Bronze Age it appears to be drier than the Early Bronze Age, but grass pollen levels were quite high. Indicating that severe desertification did not take place in Zhangwu, In addition to this, Chenopodiaceae and Mongolian birch pollen, has led some to classify the region as a steppe environment with limited forest during the Late Bronze Age (Qiu et al. 1992, 1995). This indicates that the region also witnessed the increased aridity documented elsewhere for the Bronze Age (Li et al. 2006; Su and Zhao 2003; Wagner et al. 2011; Wanner et al. 2008; Zhang et al. 2005). That being said, precipitation is variable across Northeast China (Teng and Shelach 2011a and see section 3.1) and have been estimated at slightly higher than (Teng and Shelach 2011b), or similar to (Tarasov 2006; Wagner et al. 2013) modern levels. Even though the Early Bronze Age was dryer than the Neolithic and Early Bronze Age, Zhangwu did not experience the extreme desertification found in other areas (Liu et al 2002).

Much of the Iron Age climatic conditions are similar to the Early Bronze Age. Although an increase in precipitation recorded west of the Yan mountain range (Li et al, 2003, Hou 2003) may have resulted in a rain shadow or lower precipitation observed further east in northern Liaoning (Zhao et al. 2007; Qiu 1995) during the Iron Age. Other scholars have found short lived drops in temperature associated with 300 BCE and 100AD (Yang and Jin 2011). The combination of these factors may have presented slightly more risky conditions than the early Bronze Age. During this period there may have been impediments to farming in the region, especially in the north and perhaps even in southern lowland areas. The soils in the northern area may have been more sandy during this period due to dune mobilization further north (Zhao et al.

2007). Like conditions today, this makes agriculture somewhat difficult without irrigation, but still within the realm of possibility.

Much of the Liao Period witnessed the same dry conditions seen during the Iron Age. Qui and colleagues (1995) estimate that dryness gave way to wetter conditions around 600 CE and and continued until about 1000 CE. Increases in precipitation combined with the warmer conditions associated with Medieval Warm Period (800-1100 CE) would have resulted in favorable conditions for agriculture during the later part of the Liao Period.

3.4 COMPARING THE ZHANGWU AND CHIFENG REGIONS

The combination of soil types that occur in Zhangwu makes for generally less productive agriculture than Chifeng. In 2006, Zhangwu produced only about half the amount of staple agricultural products per square kilometer that Chifeng did (http://www.cftj.gov.cn; http://zwgk.zhangwu.gov.cn) despite similar latitudes and rainfall. There are a number of reasons why this is the case.

The Chifeng region contains Cambisols which are "among the most productive soils on earth" (FAO 2006). This soil is combined with Luvisols in upland areas. They are described as "chestnut brown and loess" and "imminently suitable for agriculture" (Teng and Shelach 2011a:38).

In the lowland areas, the rivers carry water more water through the survey area than in Zhangwu. These areas would provide suitable locations for farming during short periods of drought or longer periods of climatic drying (Teng and Shelach 2011b:41). The higher river gradient combined with the size of the floodplains and river channels supply more water to areas where it could be used presently and prehistorically.

The FAO provides the public with soil quality data at a resolution of about 7 by 8 kilometers per cell at the 43rd parallel (GAEZ 2008). This data is an attempt to provide quantitative data to be used in conjunction with the qualitative data found in the HWSD. It includes the 7 following variables: nutrient retention capacity, rooting conditions, oxygen availability to roots, excess salts. toxicity and workability (constraining field management) (GAEZ 2008). These variables are ranked on a scale of one to seven (one being the best and seven being the worst). I combined all seven of these maps to create a master map with a scale of seven to forty nine. I then found an average of the cells that were inside or adjacent to any part of the two survey areas. There were 9 cells used in the calculation of Zhangwu and 29 cells in the Chifeng. The result is a slightly higher value for Zhangwu (Table 3.3) but not as high as other parts of the Horqin Sandy Lands, which produce a value of about 10.

The mean NDVI value in Chifeng is also higher than the average value for Zhangwu and higher than the southern portion of the Zhangwu survey area.

Table 3.3 Comparison of environmental characteristics

Environmental characteristic	Zhangwu	Chifeng (from FAO 2006 and Chifeng 2011a)
Major dominant soils	Luvisols, Aridisols, Fluvisols	Luvisols, Cambisols, Fluvisols
Floodplain size	0.1-1.4 km	2-8 km
River channel size	5-20 m	20-40 m
River gradient	0.1 m/km	3.5 m/km
Average FAO score (7-49)	8.9	7.5
Rainfall	350-500	330-500
Mean NDVI	0.207	0.283

Although Chifeng is considered more marginal than the Chinese Central Plains, it is imminently capable of supporting an economy based in millet agriculture for populations at near modern levels of population density. By comparison the residents of Zhangwu would have to deal with harsher conditions.

3.5 ENVIRONMENTAL SUMMARY IN RELATION TO THE RESEARCH AGENDA

The Luvisols in the southern part of the Zhangwu survey area provide more stable environments for cultivation, and one might expect grain cultivation to persist and perhaps even intensify during the Late Bronze Age, just as was apparently the case in Chifeng. Unlike the regions for which systematic settlement data are already available, then the environmental setting in Zhangwu County is right for the emergence of greater subsistence specialization. The northern area's vegetation could have supported a variety graze animals detailed in the next chapter. During the Late Bronze Age a complementary relationship could develop between sedentary communities focusing on grain cultivation in the southern sector and communities with a subsistence strategy that has a stronger emphasis on animal herding and more mobile residence patterns in the drier steppe zone to the north.

4.0 METHODOLOGY

The following methodologies detail the survey fieldwork, population determination and estimation for both sedentary and mobile societies, calculations for agricultural productivity, vector and raster map interpolations, stone tool analysis and use-wear analysis. The details of these methods are presented here in order to retain the narrative of Chapter 5 and 6. Digital data including high resolution use-wear images are available online (see Appendix A).

4.1 FIELD SURVEY METHODS

The survey fieldwork consists of a systematic survey of about 173 square kilometers lying across the boundary between the northern and southern parts of Zhangwu county (Figure 4.1). The southern sector of the survey area is large enough to include one or two Early Bronze Age small regional polities of the kind already documented for the Chifeng region (and thus to document whether Early Bronze Age regional organization is similar to that in Chifeng). The northern sector is delimited so as to extend well into the zone of Arenosols—far enough that daily trips to cultivate the better farmland in the south would be impractical. By the same token, the survey area reaches farther into the Arenosol zone making daily herding of animals from farming communities in the south undesirable.

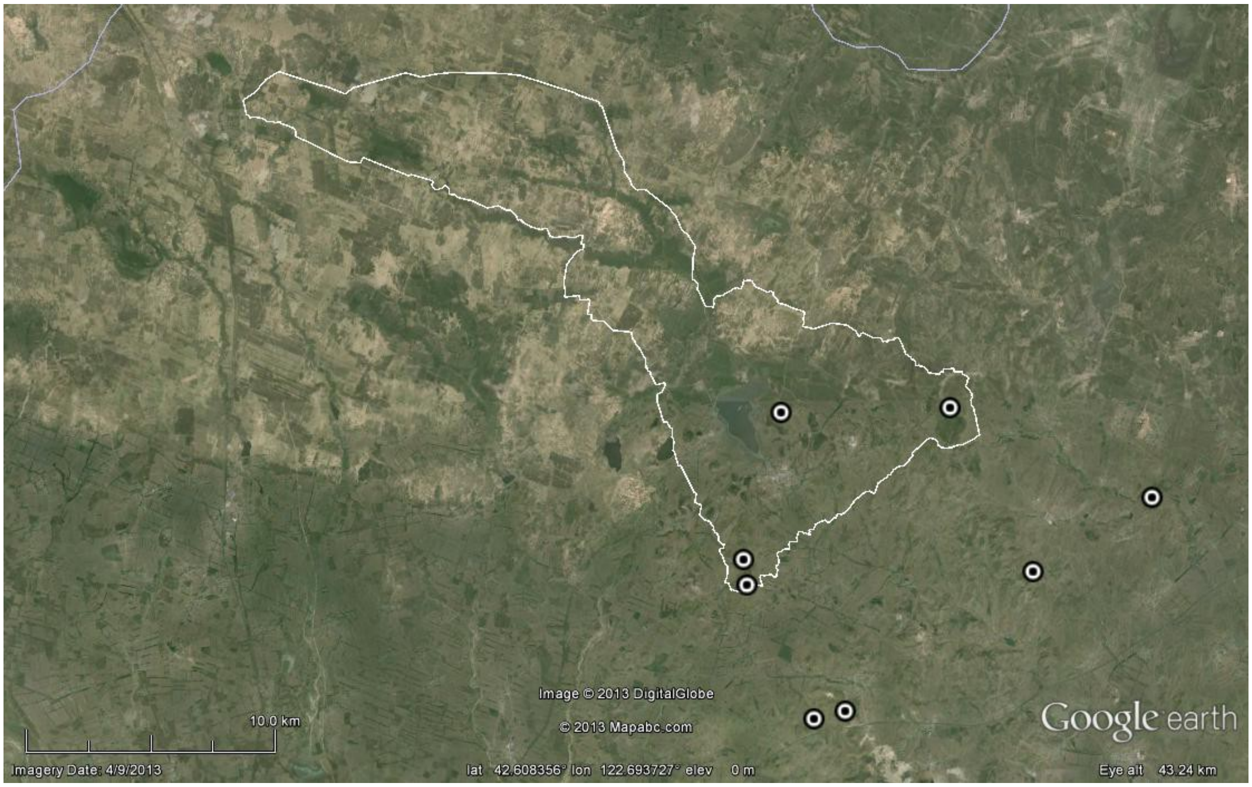

Figure 4.1 Survey area with the locations of Bronze Age Sites Identified by the 3rd Chinese National Archaeological Survey

4.1.1 Feasibility of Survey Methods for Detecting Evidence of Mobile Societies

Initial field reconnaissance in July, 2010, confirmed that surface and vegetation conditions in both the northern and southern sectors of the proposed survey area are suitable for systematic survey and surface collection by what are now well-established pedestrian survey procedures for northern China and Mongolia (Chifeng 2003; Drennan 2011; Peterson et al. 2010; Honeychurch 2004; Wright 2006). Consultation with cultural heritage officials at the Zhangwu County Museum reveals that the informant-based 3rd Chinese National Survey has recorded eight sites dating to the Bronze Age ("Shang" and "Zhou", see Chapter 2). These sites all show the characteristics of substantial sedentary occupations and are similar to those recorded for Lower and Upper Xiajiadian times in the Chifeng region. The fact that they are all in the southern part of the county is consistent with subsistence strategies emphasizing grain cultivation, as documented for Chifeng.

Prior to this survey, no Pre-Liao sites were reported for the northern part of the survey. The sites that have been recorded date to the Liao Period, when water management technology existed that would have facilitated farming in the northern sector. Small surface sites along water courses dating to the early Neolithic (prior to 4500 BCE) in the northern sector of Zhangwu county have not been obscured. In sum, geomorphological factors are as favorable for recovery of surface remains in the proposed survey area as in nearby regions of Liaoning and Inner Mongolia where surface survey has successfully documented abundant remains of settlement from 6000 BCE to the present (Chifeng 2003, 2011; Peterson et al. 2010).

The information available about sites in northern Zhangwu county thus demonstrated the feasibility of the survey. The fact that sites dating to the Bronze Age times were not yet reported for the northern sector seemed most likely attributable to the absence of large sedentary settlements with substantial traces of architecture on the surface, since such sites are by far the most likely Bronze Age sites to be reported in heritage management surveys. However, after the fieldwork was carried out, it appears that the absence of sites in the northern region may be due to the relative inaccessibility of the region. The southern region contains more than the north. Contiguous collections as large as 7.5 hectares were made in the northern region. These sites are not found in the Zhangwu county records from the Third National Survey. This should be taken as a cautionary tale for researchers relying heavily on data from the Chinese National Survey for analysis (Liu 2004; Liu and Chen 2012; Wagner et al. 2013).

Smaller more ephemeral sites are are also present in the northern sector (and found the southern sector as well). Such survey has shown itself to be an effective way to locate farmsteads, small farming hamlets (Chifeng 2003, 2011a; Peterson et al. 2010), and the ephemeral occupations of mobile herders (Honeychurch 2004; Wright 2006) in northern China and Mongolia. Hopefully this ends the misguided notion (Finkelstein and Perevolotsky 1990) that the occupation of herders cannot be detected by archaeological survey.

Small, sparse artifact scatters are of special importance to the proposed project, because this is the kind of surface evidence that occupations by peoples focusing on animal herding in a mobile residence pattern are known to leave (Frachetti 2004; Honeychurch 2004; Wright 2006). Since such surface remains are especially easily obscured by vegetation, surface visibility is an important issue to deal with in this research. Areas of cultivation present good surface visibility from March to July. Such conditions cover most of the southern part of the proposed survey area, and they occur in patches of modest size in the northern part as well. Areas of recent forestation, which are especially common in the northern sector, also provide good visibility; the trees are widely spaced, ground cover is sparse, and excavations for planting the trees have recently brought artifacts to the surface.

4.1.2 Field Survey Procedure

During the months of April, May and June 2012, the survey was carried out by a total of 15 participants from the University of Pittsburgh, Jilin University, Wuhan University, the Liaoning Province Institute of Archaeology, and the Zhangwu County Museum, divided into four survey teams of three to four each. Since all of the students were not available at the beginning of the project so there were only two teams for about the first 10 days. The teams covered 1 to 2 square kilometers per day depending on conditions and number of collection units.

Team members walked transects approximately 30 meters apart, recording locations of any evidence of prehistoric occupation. Systematic survey at 30 meters spacing has been successful in identifying the remains of specialized highly mobile herders in Mongolia (Honeychurch 2004; Wright 2006). The evidence consisted primarily of surface scatters of ceramic, chipped stone and ground stone artifacts. If at least two artifacts were encountered by the survey team within 50 meters of each other, then a collection was made. The locations and boundaries of artifact scatters were recorded and drawn on 1:5000 prints of 5 meter resolution satellite imagery (Figure 4.2). For any surface scatter larger than about 0.25 hectare (50 meters by 50 meters), the area was subdivided into into separate collection units roughly 0.25 hectare each. If sherd densities appear greater than 0.5 sherds per square meter, a systematic collection was made of all artifacts within a dog-leash circle with a radius of 1.8 meter (10 square meters) (Figure 4.3). If the systematic collection did not yield 30 sherds, then subsequent systematic collections will be made until the sample size of 30 is reached or five systematic collections have been made. If five systematic collections did not produce 30 sherds, or the initial density appears to be less than 0.5 sherds per sq m, the unit was collected in its entirety in an effort to obtain as large a sample as possible from even low-density scatters. Collecting was limited to about five minutes so that the quantity of sherds recovered will provide a rough indication of just how sparse they are. Lithic artifacts were collected unsystematically across the entire area of all collection units regardless of whether or not the ceramics were collected as a dog-leash or Because of the very low density of lithic artifacts this procedure artifacts the goal was to obtain as large a sample as possible to be later subjected to use-wear analysis.

These methods are only a slight variation on the successful collection strategies of the Liaoning Hongshan Period Communities Project (Peterson et al. 2010) and the Baga-gazriin-chuluu Survey Project in Mongolia (Wright, personal communication) and thus can provide data sets that are directly comparable.

Figure 4.2 Example of a finished field map with collection units drawn in red marker. Yellow lines are drawn every 1000 meters and a blue 50 by 50 meter box is for reference.

Figure 4.3 Systematic Collection in a 10 square meter circle.

All artifacts collected in the field were brought back to Zhangwu city each day, washed, cataloged and analyzed. Dating was based on well-established ceramic typologies found in Chapter 2 and derived from previous stratigraphic excavations and used in the same way in previous settlement study (Chifeng 2003; Drennan 2011; Peterson et al. 2010).

4.2 METHODS FOR DETERMINING POPULATION AND COMMUNITIES

4.2.1 Methodology for Determining Population with Correlates from Sedentary Societies.

In the absence of household structures which can be counted, scholars have produced population estimates from two sources: settlement size and settlement density (Sanders, Parsons and Santley 1979). It is predicated on the simple notion that, all other things being equal, larger and/or denser sites are the remains of larger populations. If there is a economy based in specialized mobile herding, then some of those things may not be equal. This issue is addressed below in section 4.2.3.

The population estimates made in this dissertation rely on the methodology detailed by the Chifeng Project (Drennan and Peterson 2011:57-79) What follows is a brief outline of those methods applied to this region and then summarized in the equation below. A 50 by 50 meter (0.25 ha) collection lot was the theoretical ideal. An average lot size of 0.21 hectares was recorded by the project. However, collection lots ranged in size from 270 up to 6700 square meters. Densities were recorded by taking the number of sherds for a particular period and dividing it by the area in the case of systematic collections. Following the methodology outline by the Chifeng project for general collections, a value of 0.25 sherds per square meter was used (Drennan and Peterson 2011:64). Observation of more than 5 sherds that would fit in a 10 square meter dog-leash caused the survey crews to make a systematic collection. This causes a base level of 0.5 sherds per square meter above which a systematic collection would be made. General collections are likely lower than this density but a density of 0.1 sherds per square meter would probably cause surveyors not to detect any sherds at all even though in theory this may be as many as 250 sherds (Drennan and Peterson 2011:63). Therefore, 0.25 sherds per square meter is an estimation to calculate the low density of general collections.

To calculate a measure of both area and density, or a area-density index, the areas of the collection lots measured in hectares were then multiplied by the sherd density of a particular period. The area-density index is then divided by the number of centuries for the respective periods to produce a relative measure of population. This relative measure can then be multiplied by population estimates derived from counting households. Figures are based on the correlations between surface material and countable house structures. The figures used in the Chifeng regional survey and this dissertation are 500 and 1000 (Drennan and Peterson:77) to calculate a minimum and maximum population estimates. The entire process can be summarized in the equation below.

$$P = ((d*a)/c)*x$$

P= population

d= sherd density in number sherds per square meter

a= area of sherd scatter in hectares

c= number of centuries

x= Figures calculated for converting relative population estimates to absolute population estimates (Drennan and Peterson 2011:71-79)

4.2.2 Local Community and Supra-local Community delineation

Discussing population only at the level of individual collection lots fails to recognize that many of these collection lots are contiguous and would have formed meaningful human communities. Archaeologists often refer to these as “sites” but the nature and characteristics of “sites” are highly variable. This has prompted some to abandon the term all together (Dunnell and Dancey 1983). Although I try to avoid the term, I do not think that this term should be deleted from our vocabulary. I think, rather, that it is necessary to delineate communities at different spatial scales, since human communities exist at different scales. The choice of what to call them -sites, villages, occupation areas, or settlements- should be carefully chosen, especially in the cases where there may be different forms and scales of habitation patterns much like you would expect if sedentary farmers and mobile herders live in proximity to each other.

The method and rationale for delineation of communities is detailed by Peterson and Drennan (2005; 2011). The maps of sherd lots are converted into one hectare cells with an extrapolated density for that hectare. These can be represented visually by using the density as an elevation The surfaces of these density maps can be smoothed mathematically with varying degrees. This creates peaks and valleys in the maps of density. The unsmoothed density map groups collection lots that are adjacent or very close to each other into small clusters. At higher levels of smoothing, the clusters of collection lots created by sherd density become much larger, allowing us to see any forms of supra-local patterning. The diversity of different patterns produced through this method has been explored productively for a number of regions. It is employed here to delimit and characterize local and supra-local community patterns.

4.2.3 Methodology for Determining Potentially Mobile Population in the Late Bronze Age

The potential for the emergence of specialized mobile herding in the Late Bronze Age is central to the research agenda in this dissertation. Therefore it may not be appropriate to use methods of determining population where the correlates are sedentary Neolithic and Bronze Age societies. It may be more appropriate and accurate to use methods developed for mobile societies.

Houle (2010) determined the Bronze Age population of the Khanuy valley through ethnographic observation and the mobility patterns described by Simukov (1934). Houle states:

> ...although there are no fences or visible delimiting features, herders were found to consider an area of about 2 hectares “theirs”. This area also includes terrain with no structures and corresponds to what they perceive as adequate space for them and their animals (Houle 2010 :63).

This forms the basis for his definition of an “occupation area” and his subsequent population estimates. After taking a number of factors to account for the mobility patterns specific to his region, he ultimately arrives at an estimate of between 64 to 160 people or an average 112 people living in a total of 66 hectares of occupation or 1.7 people per hectare. Houle calculated sherd density based on the excavation of test pits and I am relying on surface collections. Therefore, the density of sherds will not be comparable without more data. In addition to this, since the periods are the same length, it was not necessary to adjust the calculations to account for that. If the periods were not the same length then the figure would need to be adjusted. We should be able to use settlement areas assuming the densities in both cases are very low (which is certainly true of Houle's case [2010 :50]). If the sherd densities are very high then there wouldn't be much of a discussion about mobile residence patterns since this is the type of evidence consistent with sedentary living. Area alone can provide a useful proxy determining population although incorporating density would be preferable. Since Houle includes a good deal of empty space in his definition of a site or “occupation area” (Houle 2010:64-66) it is important to note that is different than contiguous collection lots. Therefore, I used the areas of local communities derived from the methods in 4.2.2 to best estimate the area which a potential herder or group of herders would consider theirs. The area delineated as a local community is much more analogus to Houle's definition of occupation area (Figure 4.4). This works out to be two or three households creating a local community of about three to four hectares. The areas derived from the local community interpretation can then be converted into population estimates simply based on Houle's ratio of 1.7 people per hectare of occupation.

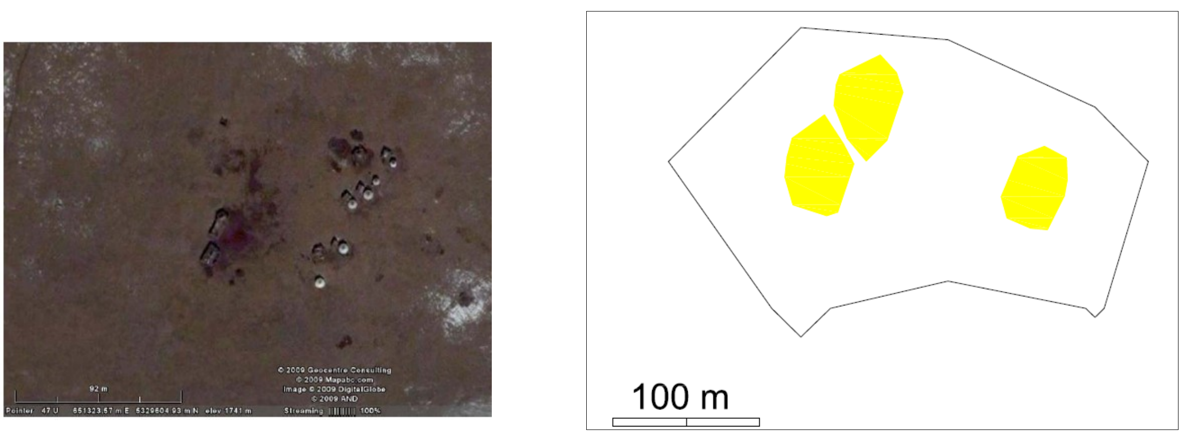

Figure 4.4 An example occupation area from Houle 2010:64, Figure 3.5 (left). Small local community from Zhangwu survey (right). Black line delimits the local community created through the methods in 4.2.2, collection lots in yellow.

This all, of course, assumes that if herders are seasonally mobile they are remaining within the survey area, just like the original case (Houle 2010:26). If herders are seasonally mobile and leaving the survey area during part of the year, then the population estimates would have to account for that. If the archaeological evidence only represents a portion of the year then the number of occupied decades would decrease, thereby increasing the overall population represented by the same area of occupation. Said another way, using the equation in section 4.2.1, as c decreases, P will increase, if the product of $(d * a)$ is equal.

Different mobility patterns result in the occupation of a particular region for different lengths of time. Humphrey and Sneath (1999:220-225) describes a number of mobility patterns that Simukov (1934) observed ethnographically. Some of these patterns could be possibilities given the environmental characteristics of Zhangwu. The broad plains of the northern area could be used for summer residence if the "Steppe" pattern was followed. Alternatively the protection provided by the hills in the south might make a winter occupation a viable pattern option following the "Eastern" pattern of mobility. Of course if there is both winter and summer occupation this would follow the Khangai pattern.

Table 4.1 illustrates the population estimates for the small Zhangwu community in Figure 4.4 using different methods and assuming different patterns of mobility. The average sherd density of the three collection lots is 0.18 sherds per square meter. The total area of the collection lots is 0.7 hectares. The size of the local community is 4.6 hectares.

Table 4.1 Population estimates for a small local community given different methods and mobility patterns. Minimum and maximum estimates in parentheses.

	Estimated populations		**Mobility Pattern** (Humphrey and Sneath 1999, after Simukov 1934)
Mobility restricted to within survey area	8	(5 - 11)	Khangai
Summer residence (3 months)	32	(21 - 43)	Steppe
Winter residence (8 months)	12	(8 - 16)	Eastern
Sedentary (Drennan and Peterson 2011)	15	(10-20)	None

As you can see the different methods do not produce results that are vastly different from one another. However, there are differences that can be measured. Whether or not the differences in population as a result of the different methodologies have implications for the reconstruction of Late Bronze Age societies is a subject taken up in Chapter 5. However, if there is a pattern of seasonal mobile residence, the diversity of environments found within the survey area would allow for both summer grazing in the north and winter residence in the south. In other words, a seasonal mobile form of residence is possible within the survey area like the Khangai pattern. It is also possible that Steppe and Eastern patterns may have been present.

4.3 GIS MAP INTERPOLATIONS AND ENVIRONMENTAL VARIABLES

After field maps were digitized in vector format, all of the maps were converted into raster format with cells (pixels) equivalent to 10 meters by 10 meters. The interpolations and correlations that follow are preformed at this resolution. Two data masks are employed during correlations. The first mask is the boundary of the survey region. With this mask, values outside of the survey area are not counted. The second mask is used when NDVI data is part of the regression analysis. The low values associated with standing water due to its light refraction (see section 3.2.3) require a mask of values lower than -0.01.

4.3.1 Settlement Maps and Linear Regression

The results of the survey allow the settlement patterning to be mapped in a number of ways. First is a simple density map, where the collection lots are assigned a value according to density. Settlement can also be mapped by calculating the distance between survey lots to create a map where settlement is given a value of zero and areas between settlements are assigned ever increasing values (Figure 4.5). This produces a map with low values around those regions where settlement is clustered together and overall higher values where settlement is more sparse.

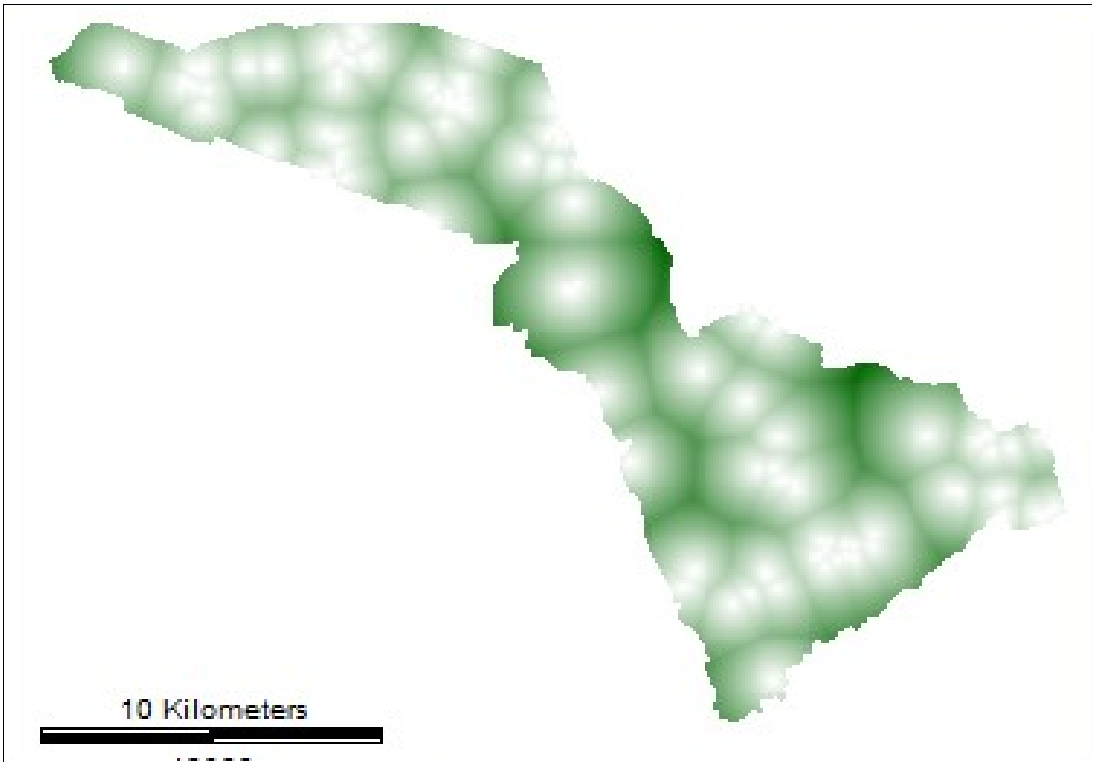

Figure 4.5 Example Distance Map for Hongshan period settlement.

In order to understand the relationship between two variables or two maps a correlation can be used. By using the distance maps created above the pixels become cases in a correlation low values are on or nearby settlement and high values are further from settlement. My use of this particular technique stems from the notion, common among survey archaeologists, that it is just as important where sites *are not* located as where they *are* located. The empty space between settlements is equally important in creating patterns. If the patterns produced by the locations of settlement for two maps are similar then one would expect a strong correlation. By the same logic, if the pattern of settlement is similar to other geographic patterns there should be strong correlation. Therefore the patterns observed from settlement location can be measured for its correspondence to the location of other maps and variables. Before comparing settlement maps to other forms of geographic data it is important to explain how and why correlation between two settlement maps yield interesting data.

In order to understand changes from one period to the other, I used settlement distance maps from two periods with a mask around the survey area. If pattern of settlement is similar in either the period before or after then it stands to reason that there may be an interesting principle at play. Some of the factors that caused people to settle on a particular location within a landscape in the first period may be the same factors that caused people to settle in those locations in the second period. In other words, if there are major shifts in the overall nature of the economy from the Early to Late Bronze Age then there ought to be shifts in the overall pattern of settlement from one period to another, resulting in a low or negative correlation.

This method allows for a robust measure of persistent habitation through time. If one only measured the continued habitation of collection lots through time, then you would not take into account a settlement which moved a very short distance to a new collection lot. At the resolution of the survey methods described in the previous sections that could be as little as 50 meters. But for all intents and purposes, a settlement that moves 50 meters should be understood as continuous occupation.

There are some limitations to using this method. One might have a concern about comparing populations of different scales. If one compares a region with a high population with one of a small population then you would surely be comparing a map with low values to one with high values. Although, using standard measures of settlement continuity this should also, of course, be a concern.

In an attempt to understand the impact of settlement size and location on the correlation between two maps I produced a series of hypothetical maps. In one of these comparisons the settlement is much larger in the first period and about one eighth the size in the second period. The two settlements occupy precisely the same location in the hypothetical survey area (Figure 4.6). The correlation based on the distance maps produces an r squared value of 99.89%.

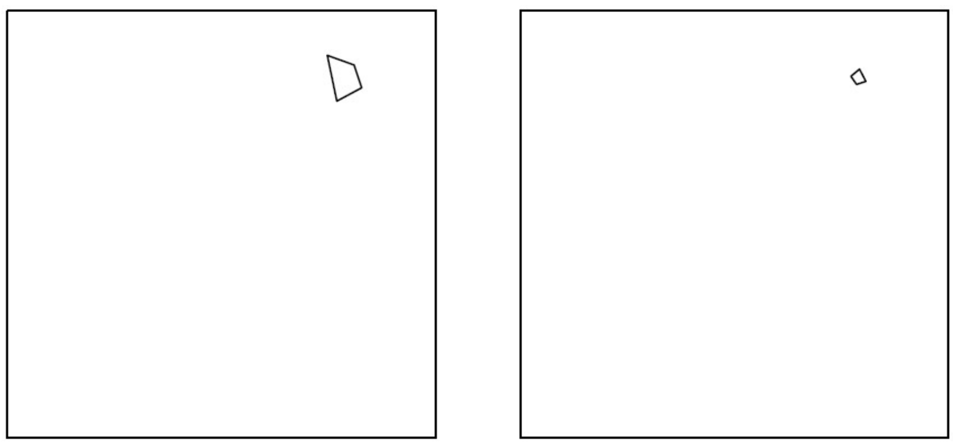

Figure 4.6 Two hypothetical periods where settlement changes size but not location

The second test deals with the number of sites rather than size. In this situation I produced one map where all of the settlement produces a clear linear pattern. This could be a case where all the settlement is located along a river or road. The second map uses the same pattern but settlements are spaced about 3 times the distance than the previous period (Figure 4.7). More specifically, the first map has 15 settlements and the second map has 5. Again, there is an extremely strong correlation ($r^2 = 99.22\%$).

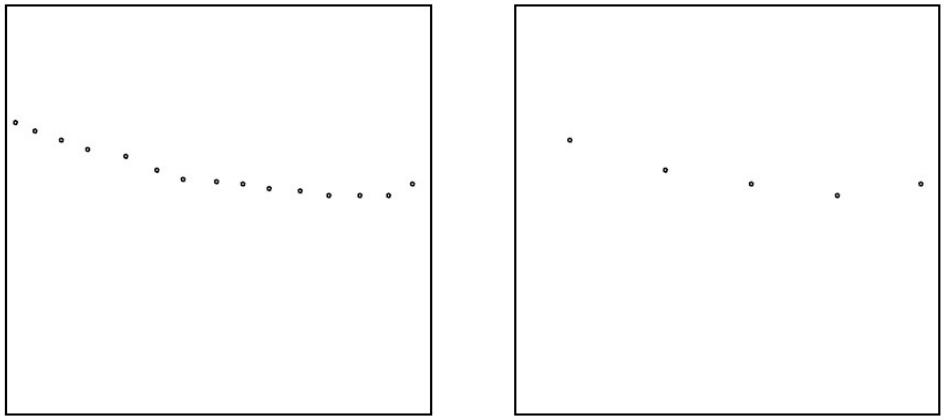

Figure 4.7 Two hypothetical periods where number of settlement decreases

With such high r squared values, one might be concerned that the method will produce strong positive correlations in all circumstances. Therefore two tests were devised to examine this notion. The first test is a hypothetical where the settlement remains roughly the same size but moves to the other side of the survey area (Figure 4.8). In this situation there is again a very strong correlation ($r^2 = 62.39$), but this time negative. This means that as the values are higher in one distance map they are lower in the other. This correlation coefficient is not as strong as the previous examples but very strong none the less. Part of the reason that this correlation is not as strong as others is because the northwest and southeast corners have moderate values in both cases meaning this area is unoccupied in both periods. Even though these maps appear to be very dissimilar, the northeastern and southwestern areas are persistently unoccupied resulting in the less-than-perfect negative correlation.

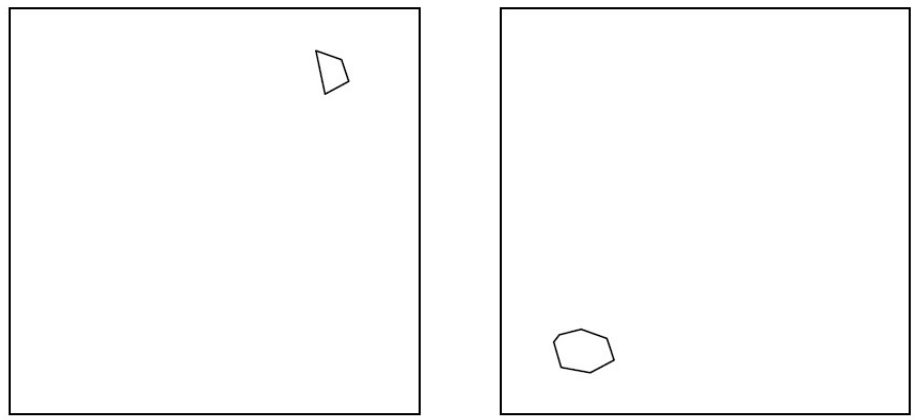

Figure 4.8 Two hypothetical periods where settlement changes location

Finally, is it possible to produce a data set where there is no correlation at all? To address this question, I used the random image generator to create two images where one percent of the area is occupied by settlement randomly distributed in the survey zone. The correlations between the distance maps generated from these two maps produces an *r* squared value of 0.000019378. This proves that random image generators are almost but not quite perfect.

Of course, real human settlement data is much more complicated than examples one can manufacture. So, in addition to the hypothetical examples above, as further proof of method, I ran the analysis in all 10 possible combinations of the 5 periods in the trajectory. The implications of some of these results are dealt with in Chapter 5. Running these analyses here allow for the method to be tested on periods with very high populations against those with very low populations and between periods with similar populations. Table 4.2 presents the results of the analysis. If we discuss population anonymously for the time being, one can see there is very little relationship between population and the correlations they produce. Note periods 3 and 4 which have nearly identical populations but a weak correlation. Also, note periods 2 and 4 where the populations differ by a factor of 10 and there is a strong correlation. I want to make it clear these are not ordered chronologically. A detailed chronologically organized trajectory which deals with population in much more detail can be found in Chapter 5.

Table 4.2 r^2 values for different patterns and population levels.

	1 14,000	**2** 7700	**3** 780	**4** 760	**5** 265
1 14,000	-				
2 7700	0.22	-			
3 780	0.08	0.12	-		
4 760	0.04	0.25	0.04	-	
5 265	0.04	0.07	>0.01	0.23	-

This survey data did not produce any strong negative correlations. This is due to factors which deter people from settling in certain regions in all of the periods and/or significant deterrents to archaeologists detecting that settlement (i.e. at the bottom of the Julong Reservoir and underneath modern-day villages). These are extremely undesirable locations for modern surveyors and/or prehistoric inhabitants. Therefore, those locations will always have higher cell values than the surrounding cells. This is an aspect of the methodology which can be refined in the future through the use of more refined data masks (see Chapter 7). Although negative correlations did not occur in Zhangwu, it does not mean that it is not theoretically possible to have a case study where the data produces this result. This would be an especially consistent of a settlement pattern where there are strong centrifugal forces pulling settlements apart. Again, this becomes an interesting topic for future research and further refinement of the methodology (see Chapter 7).

Even though it has been demonstrated that the size and number of settlements do not necessarily affect the overall pattern and therefore the correlation, there may be cases where this is true. There are potentially some forms of settlement patterning which cannot exist at certain population levels. To use an analogy, according to official rules, 22 people are required in order to play football, but you only really need at least 4 people; one might expect that the game becomes an unwieldy endeavor if you tried to play with 50. Population levels may determine or dissuade certain forms of organization and pattering. This is interesting to know and understand. By the same token it is interesting to note that certain patterns can persist despite differences in population.

4.3.2 Correlations Between Settlement and Environmental Variables

By the same rationale outlined in the previous section, the regression analysis was also used to understand the relationship between land quality and settlement. Described in Chapter 3, the region's productivity is measured by the surface vegetation (NDVI) and also the underlying soil properties, which are then ranked. In the case of the sherd density maps, a correlation would occur if the highest density lots were on average located on better soils. The same is true of a correlation with NDVI if, on average, the densest lots were on the regions with the greenest vegetation. In this situation we would expect a strong positive correlation.

As mentioned in Chapter 3, the refractive qualities of standing water create very low values in an NDVI image. Therefore, correlations using NDVI data about 5 square kilometers or about 3% of the region is not factored into the analysis. This is treated as missing data. In the correlations using the soil quality the underwater region is treated as a soil quality rank 3 or Fluvisol since that would have been the classification prior to the construction of the dam.

The distance maps test the relationship between variables slightly differently. If the settlements were predominantly located on the best soil (regardless of their density) then the overlay of these two maps positions low values from the settlement distance maps in the high productivity/high value regions. This would result in a strong negative correlation. If this was the case, a strong negative correlation would mean a strong relationship between the settlement pattern and NDVI or productivity of the soil.

Lastly, rivers and interpolated distance maps were also analyzed to understand if there is any correlation between them and settlement patterning. Rivers were digitized based on the satellite imagery used for field maps and cross referenced with Landsat imagery. The river was drawn through the deepest part of the reservoir which I presume was the prehistoric river channel.

4.3.3 Absolute Measures of Productivity

Modern farming practices have no doubt shifted since the prehistoric periods. Despite this one can estimate the productive capacity of staple crops. Foxtail millet is presumed to be the staple crop during the prehistoric periods in this research's trajectory. From 1961 to today estimates of millet yield range from over 3300 kilograms per hectare in western European nations to as little as 250 kilograms per hectare in sub-Saharan nations (FAO 2005). The estimates I use come from Nepal and is estimated at 300 kilograms per hectare. However, the actual prehistoric yields may have been higher. These estimates are used in an attempt to demonstrate a lack of resource scarcity. They are deliberately lower than what is probable prehistoric conditions. This raises the standard of proof for the environmental pressures proposed by many scholars as the catalyst for social and economic change (An et al. 2004; Huang et al. 2003; Jin 2002; Liu and Feng 2012; Wu and Liu 2004; Xiao et al. 2004).

If we use the above mentioned deliberately low levels, and if the current survey area was under near complete cultivation of millet, it could feed an estimated 8,650 people. While this is again a deliberate underestimation, it means that if populations are lower than this then it is unlikely there are stresses at the regional level. Using historical data for millet yield and consumption Qiao (2007) calculates a slightly more conservative estimate for nutritional requirements at 1.6 hectares per person. Qiao's estimates put the maximum regional population at about 10,800 people although for the reasons mentioned above this is likely also to be an underestimation. This is especially likely since climatic conditions during the Hongshan, Early Bronze Age, Late Bronze Age and Liao Periods were more conducive to agriculture than present (see Chapter 3). That being said, stresses may manifest within or around dense communities, this topic is addressed in Chapter 5.

Domesticated animals could also have contributed a serious proportion of calories to the diet in prehistory, especially during the the Bronze Age. Therefore, it is useful to know how many livestock the region could support.

Stocking rates are highly variable depending on environment. These are often calculated using Livestock Units (FAO), Dry Sheep Units (Australia), *Bod* (Mongolia) or Animal Units (United States). All of these provide a standard measure of grazing animals based on the their mass and the amount of graze and fodder they eat. I will again use the FAO as my standard and discuss either Livestock Units or sheep and use the reconstructions from Chapter 3 as a guide. Table 4.3 provides the conversion for different animals according to the FAO. One rule of thumb is one Livestock Unit per acre or about 2.5 LU per hectare (Weikard and Hein 2011) or 25 sheep per hectare. The Meat and Livestock Association of Australia (MLA) estimates about 10 or 11 sheep per hectare given lyme grass pasture (see Chapter 3) with an initial dry mass of 2500 kg per hectare with sustainable grass regrowth, grazed for 200 days out of the year (MLA 2013). The Colorado State University stocking rate calculator (Colorado 2013) estimates about 12 adult sheep per hectare for 7 months of grazing. The Adelaide & Mt Lofty Ranges Natural Resources Management Board estimates when annual rainfall is 500 millimeters 4 to 8 sheep per hectare is sustainable depending on the quality of pasture. The pasture today is not the highest quality in China but also not the worst (Shi et al. 2013). Taking into account the higher levels of rainfall throughout much of the prehistory trajectory, an estimate of 6 sheep per hectare is reasonable and sustainable practice. This works out to be about 0.6 LU per hectare, very close to Frachetti's (2008:96) estimate of 0.428 LU/ha in a normal steppe environment and 0.71LU/ha (Frachetti 2008:94) for meadow environments. Although Frachetti's goal is to underscore the notion that stocking rates are highly variable, the figures above fit within that range of variability.

Table 4.3 Conversion between different animals according to FAO livestock Unit Scheme. Recreated from (FAO 2005)

Animal	Livestock Unit Value
North American Cattle	1.0
African and South East Asian Cattle	0.5
Horse	0.8
Camel	1.1
Pig	0.2
Sheep	0.1
Goat	0.1

Using the figure of 0.6 LU per hectare, the survey area could sustain up to a maximum of 10,300 LU or 103,000 sheep. The average sheep can provide 75,000 calories and 10% of the flock can be culled annually and maintain sustainability. Payne (1973) states a culling rate of 20-15% and most of the culling from males under 3 years. If we use 10%, and if an average sheep or goat can yield 25 kilograms of meat and other edible products, the sustainable human population is about 900 or 5.2 people per square kilometer if the population was relying only on domesticated animals. This figure would, of course, be higher if we account for secondary products. Dairy products have been shown to contribute about five times the proportion of calories than those produced from the slaughter of animals. Therefore, if the herd composition contained cows and goats the regional population could reach levels as high 4500 people sustaining themselves solely on domesticated animals. What this demonstrates, is that the natural environment could have been a constraining factor, at the regional level, in terms of animal husbandry, although this level is fairly high. If regional densities are much higher then 26 people per square kilometer then the subsistence economy would need to be mixed or involve inputs from outside the region. However, this is much higher than what is generally recorded for societies which derive the majority of their subsistence from domesticated animals.

It is important to note that using either domesticated animals or plants, stresses to subsistence could occur if population is very dense in some locations. The figures above assume an even distribution of population throughout the survey area. The actual distribution of population during different period will be discussed more directly in Chapter 5. For now these figures establish some rough thresholds for population based on characteristics of the environment.

4.4 LITHIC ANALYSIS

The use-wear analysis was carried out at the Liaoning institute of Archaeology during early July 2012. Lithic artifacts from the single-component sites yielding either Early or Late Bronze Age ceramics were selected further analysis. Using the lithics from single component settlements avoids the problem that lithics from surface collections at multi-component sites are difficult to assign to a particular period. The chipped stone tools will be analyzed macroscopically using the approaches described by Andrefsky (2005). All lithic artifacts were examined microscopically for striations, polishes, micro-chipping and other evidence of use-wear. Use-wear analysis of lithic artifacts collected from the surface is regarded as risky by some (Knudson 1979; Nash 1993). Since damage from trampling or farm equipment consists mostly of chipping, the use-wear analysis proposed here will focus especially on striation, rounding and polish. The use-wear analysis will also be microscopic, at which scale chipping from use is most easily distinguished from that resulting from taphonomic processes.

All of the stone tool debitage from all periods was categorized into several categories defined below. A complete piece of debitage or tool was not necessary to make the following determinations as long as the specimen exhibited the defining properties. In other words, what some scholars define as flake fragments or blade fragments are defined here as flakes and blades.

The following list is roughly in order according to the stage of production.

Shatter- angular debitage without a clear bulb of percussion and blocky in form

Primary Flake- a flake with a clear bulb of percussion and cortex

Secondary Flake- a flake with a clear bulb of percussion and no cortex

Complex Flake- a flake with a clear bulb of percussion and thinning flake removals

Blade- an elongated flake with parallel margins, this category includes microblades

Core- Stones in which flakes are removed in one or more direction

Bullet Core- A formal unidirectional core for the creation of microblades

Tool- Any stone tool artifact that does not fit into the category above

The subtypes of the tool category are listed below:

Awl/ Drill- a tool with a point extending from a shouldered body; macroscopic microchipping usually found on the bit end

Axe/ Hoe- Either chipped or ground elongated stone tools generally larger than 15cm

Bifacial point- A bifacially worked point triangular in shape

Groundstone knife- an edged implement sometimes with holes on the non-edged side

Quern stone- a flat or slightly concave stone used for the processing of plants

Scraper- a tool used to separate a skins from flesh; characterized by an edge with retouch removals resulting in a less acute angle. The most common forms are small "thumbnail" types

4.4.1 Use-Wear Methodology

A monocular light microscope capable of observing 10,20,80,200, 400 and 800X magnification was fitted with a 3.5 megapixel video and still camera. Observations were preformed on a 14 inch, 1366 x 768 resolution monitor (Figure 4.9). The images were displayed in a 13 centimeter window on the computer screen using Debut Video Capture Software Professional v 1.64. The 13 centimeter images displayed on the computer translate to a field of vision 2 millimeters wide at 80X and 0.7 millimeters wide at 200X. Therefore, when referring to the magnification I am referring to the lenses used not the actual size of the images.

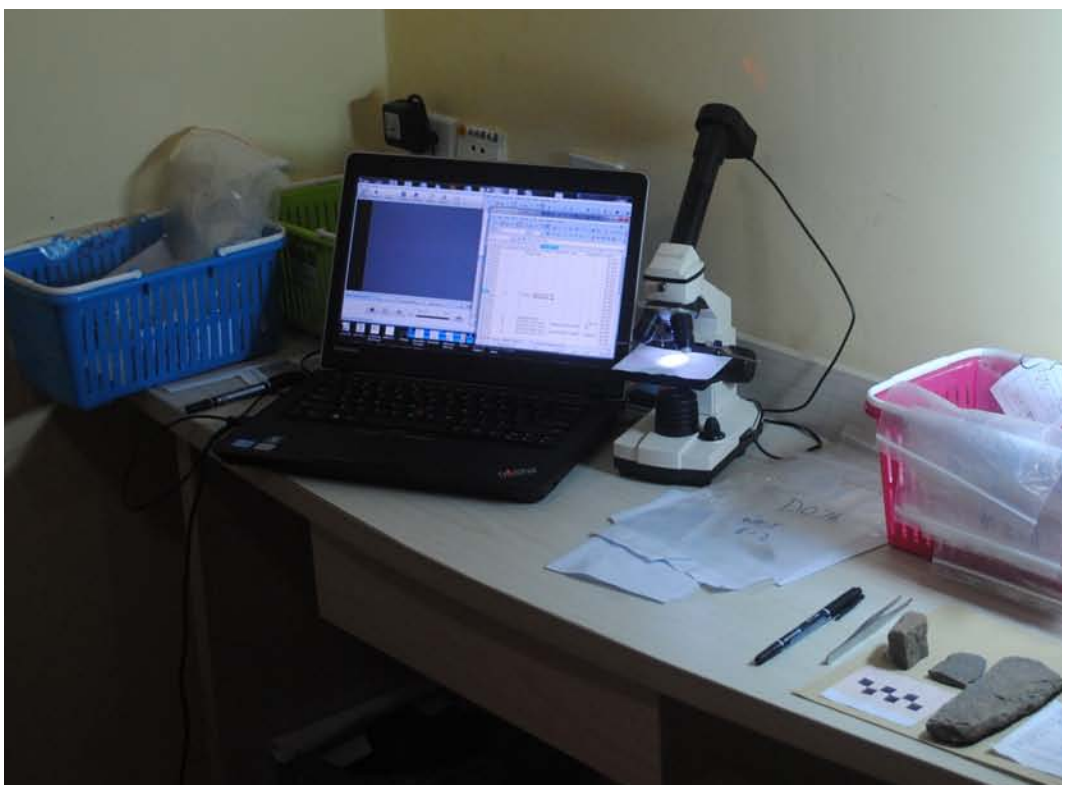

Figure 4.9 Use-wear observation station

Artifacts were cleaned using a simple water and detergent mix, rinsed and then let air dry. Following the methods of Keeley (1980), some propose washing artifacts in mild hydrochloric acid and sodium hydroxide but this is considered harmful by other scholars (Plisson and Mauger 1988; Rondon Boras 1990) and should not be considered standard practice according to Odell (see discussion, Odell 2004:150-151). The artifacts were scanned at 20X and/or 80X. The scanning took about 15 to 30 minutes per artifact depending on the size. If an instance of use-wear was located then a digital photograph was taken at 80X and sometimes 200X. In addition to basic provenience information, the characteristics of the use-wear were recorded. Those characteristics are:

- Type of wear: polish, striations, micro-chipping. In the case of micro-chipping the type of termination (hinged or feathered) is also recorded.
- Direction Information: parallel or perpendicular and in the case of micro-chipping the location of the flake termination
- Location: location of the use-wear on the artifact.

The determination and the ability to distinguish between two types of activities are important to the research agenda in this dissertation: the processing of animals or scraping and the cutting of agricultural grasses. Clemente and Gibaja (1998) point out that sickles used for cutting cereals will have use-wear which is parallel to the blade edge (see also Ibáñez et al. 2008). The two activities most commonly associated with longitudinal use-wear are cutting and sawing. Unidirectional striation versus multi-directional longitudinal striation is what distinguishes cutting from sawing. All of the longitudinal striations in this study are unidirectional indicating cutting rather than sawing. On the other hand, striations that are perpendicular to the tool's edge, also referred to as transverse striations, have been described as indicative of scraping (Lombard 2006; Smallwood 2006).

Figure 4.10 Example of light longitudinal striations;
(field of vision is 2mm wide)

Polish is found on both animal processing tools and agricultural tools. However, in the case of agricultural tools it is not often found in combination with rounding or micro-chipping. Polish as a result of scraping of hides and skins on the other hand is often combined with rounding (Odell 2004:147). Therefore in those cases where the direction of use-wear was not detectable (no striation or micro-chipping) the tools with rounding and polish were categorized as scraping tools and the tools with polish but without rounding were categorized as used in the cutting of grasses.

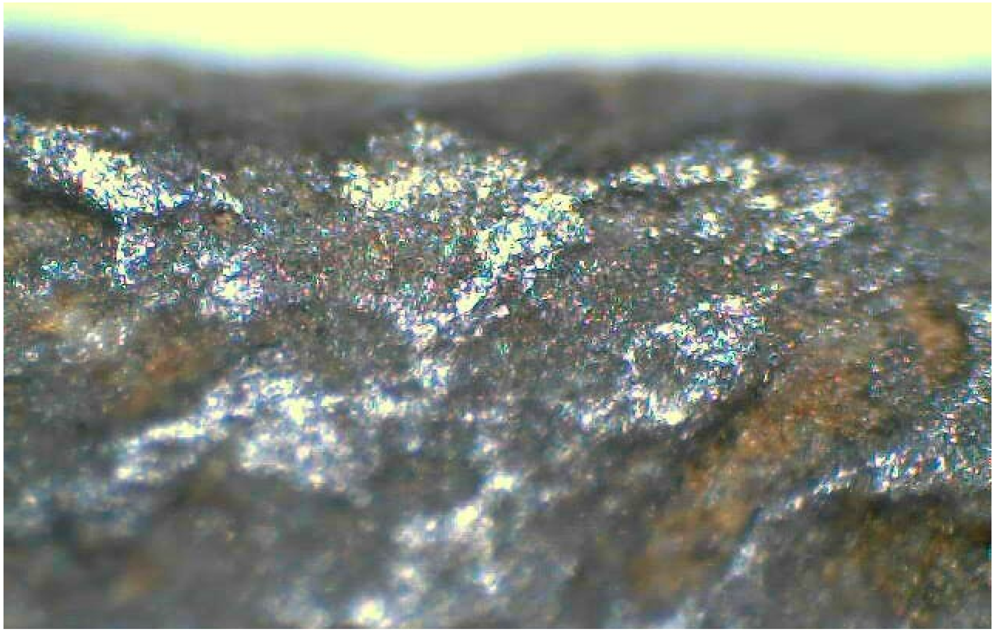

Figure 4.11 Example of polish, presumed to be plant polish based on other information; (field of vision is 0.7 mm wide)

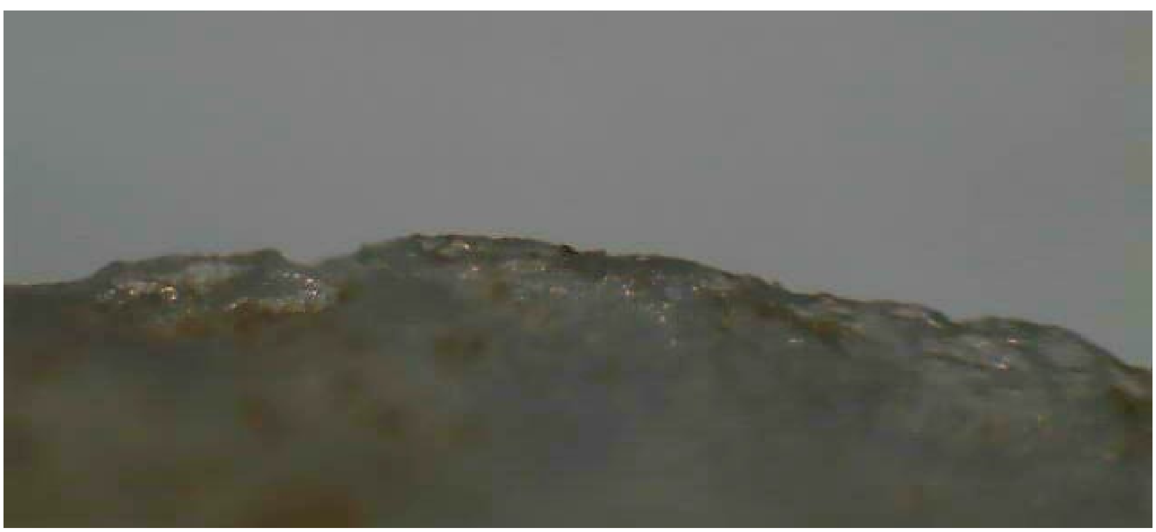

Figure 4.12 Example of rounding and no evidence of other use-wear; (field of vision is 2mm wide)

Indications of the hardness of a worked material come primarily from the presence or absence of micro chipping and types of flake terminations found in the cases where there is evidence of micro-chipping. This follows the methodology detailed by Odell (1980). He states that if a tool is used on the hardest materials it will produce hinged terminations more often than softer materials which result in more abundant feathered terminations. Even softer materials, such as flesh or soft plant matter, will often result in little evidence of micro-chipping and use-wear will most often take the form of light striations and/or polish.

4.5 SUMMARY

Interpretation of the data produced from the methods above is a multi-stage process. It relies primarily on two separate lines of evidence. The first is the nature and distribution of Early and Late Bronze Age settlements. Sedentary farming villages of Lower and Upper Xiajiadian times are often large and present relatively high surface artifact densities (Chifeng 2011b). Some such sites were already known from the southern sector of the survey area, and it is anticipated that more will be identified. There may also be the remains of smaller hamlets and farmsteads, as in Chifeng. Communities that had strongly increased their reliance on animal herding would be expected to live in more dispersed and/or mobile fashion, resulting in small sites with much lower densities of artifacts. The survey methodology has already demonstrated its ability to recognize such sites if they are present (Frachetti 2004; Honeychurch 2004; Wright 2006; this study). The methodologies detailed above will serve to help understand the character of these small settlements as well as the larger settlements in the region.

The results of the stone tool analysis in Chapter 6 will illuminate some of the economic activities within communities, but it must be coupled with a clear understanding of the settlement pattering and the demographic scale of communities from Chapter 5. These two streams of data come together before arriving at final interpretations of economics and mobility.

5.0 SETTLEMENT PATTERNS THROUGH TIME

The trajectory of past occupation in Zhangwu spans at least 6500 years. During this time there are significant changes in the size and organization of population. The most pertinent to this dissertation's research agenda are any changes associated with the transition from the Early Bronze Age to the Late Bronze Age. The project did however record and collect information about habitation before and after these periods. This information not only provides a broader context of the Bronze Age, it also allows for better understanding for settlement patterning through comparison. Much of this data will be available online for future researchers interested in specific periods which this dissertation does not provide adequate treatment of (see appendix A for online resources)

Much of what we know and understand about changing human settlement patterns in Northeast China is the result of two research projects. Regional settlement survey was carried out in the Upper Daling region in 2009 (Peterson et al. 2010; Peterson and Lü 2013) and in the Chifeng region between 1998 and 2007 (Chifeng 2003, 2011a; Linduff et al. 2004). Throughout the this chapter I make multiple references to those research projects, especially the Chifeng region. By comparing these data sets one can see where broader generalizations about human settlement patterning can be made and what patterns may be a result of the unique qualities of each region.

The interpretations made in this chapter stem from the methods and analyses found in Chapters 3 and 4. The outline of this chapter follows the chronological framework laid out in Chapter 2. While reference is made to economic change as it relates to settlement patterning during the Bronze Age, the topic of Bronze Age economics discussed in more detail in Chapter 6.

5.1 PERIOD OF INITIAL OCCUPATION AND HONGSHAN OCCUPATION (4500-3000 BCE)

The first evidence of prehistoric occupation may come in the form of stone tools and debitage. Nine non-contiguous collection units were made that did not contain any prehistoric pottery. There are a total of 23 stone artifacts recovered from these units (Table 5.1). This presence of blades and blade cores may indicate an Upper Paleolithic occupation of the region or potentially small hunting camps (Binford 1980) associated with any number of prehistoric periods. In either scenario, the sum total of the occupation is just under 1.8 hectares with settlements ranging from 0.08 ha to 0.3 ha. Without ceramics, population cannot be estimated using the methodology in Chapter 4, but such an ephemeral presence most likely amounts to a family or two sporadically occupying the landscape.

Table 5.1 Stone tools and debitage found without ceramics.

Shatter	Primary flake with cortex	Secondary flake	Complex flake	Blade	Flake core	Blade core	Axe
9	4	5	1	1	1	1	1

The first evidence of clearly datable prehistoric habitation within the survey area is during the Hongshan period (4500 to 3000 BCE). The initial regional population is estimated at about 750. The density of regional occupation can be estimated at 3-6 people per square kilometer. Most of the population occupies the northern zone (Table 5.2). In the southern zone, small farmsteads made up of 1-3 households are the predominant form of settlement.

Table 5.2. Population Distribution during the Hongshan Period

	Population	Proportion of regional population	Population density per sq km
Northern area	646	84.7%	7.1
Southern area	117	15.3%	1.5
Total	763	100%	4.4

Small local communities occupy a number of locations throughout the north and south region (Figure 5.1). Daily face to face interaction characterizes the nature of these communities and they are delimited using the methodology detailed in Chapter 4. The largest of these might be considered a village or hamlet with a population of about 200 people. Four other large local communities range in size from about 85 to 40 individuals. In addition to these settlements with denser occupation, there are a number of small settlements which are dispersed throughout the region of one to two households. These small settlements of one to two households account for about one third of the regional population (Table 5.3).

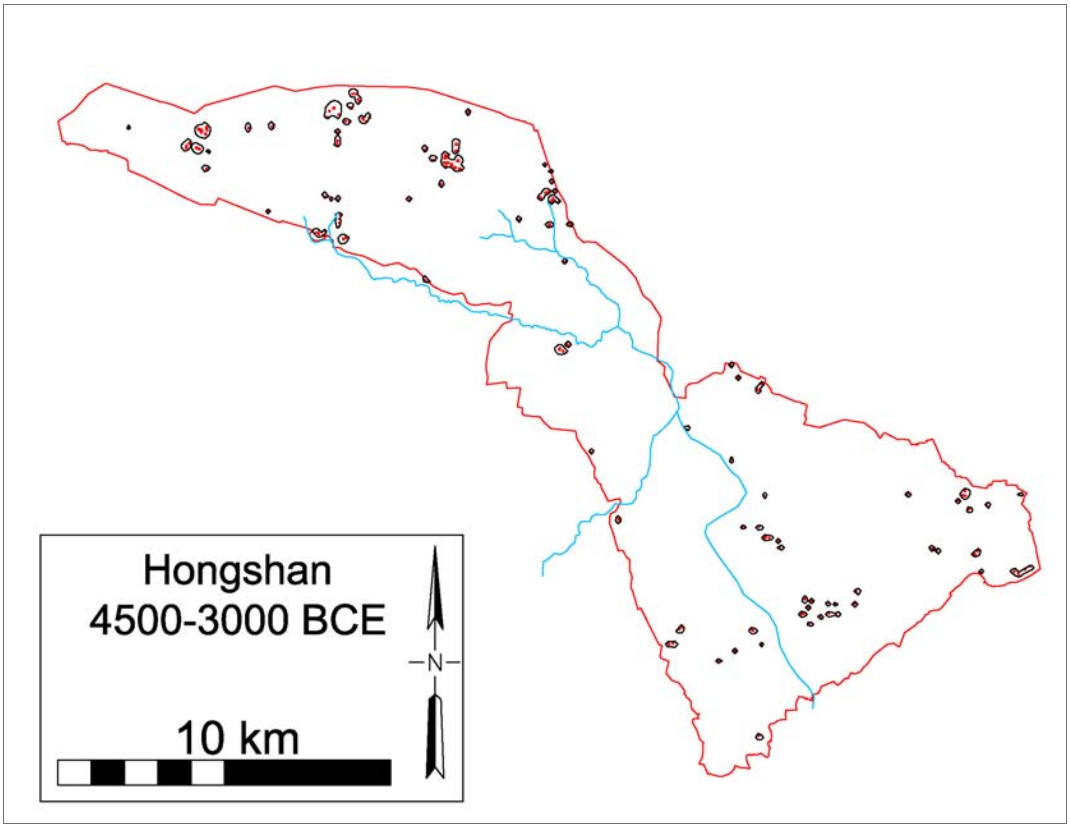

Figure 5.1 Delineation of Hongshan Period local communities

The size and scale of these settlements are consistent with the types of local communities that have been found during the Hongshan period in other regions. The five largest communities generally follow the patterns found in Chifeng (Chifeng 2011b). They have populations of up to a few hundred people. The communities in Zhangwu are slightly smaller in both area and population density. Therefore, in Zhangwu the overall local community population levels are slightly lower, despite a higher regional density. This means, in Chifeng people are living in larger communities and in Zhangwu a higher percentage of the population are living in individual farmsteads or small local communities of a few families. The percentage population living in small farmsteads is higher than in Chifeng (Table 5.3).

Table 5.3 Local community distribution for the Hongshan Period

Population of local community	Number of communities	Total Population	Percent of the regional population Zhangwu	Percent of the regional population Chifeng
1-10	75	247	33%	7%
10-100	8	312	41%	35%
100-1000	1	204	27%	58%
Total	84	763	100%	100%

In addition to the local communities consisting of a number of households, we also see integration of several small local communities. There are five supra-local communities formed by clusters of local communities surrounding the five largest local communities mentioned above (Figure 5.2). It appears that these five larger local communities had enough social gravity to draw in other households and communities. None of these supra-local communities are very much larger than the other ones. Even though the northern most community has a slightly higher population, at about 260 people, it does not appear to have incorporated the other three nearby supra-local communities within it. The other supra-local communities have between 60 and 130 people. The supra-local communities range in size from just over one kilometer across up to about four kilometers on a side. These are generally smaller than the areas described for the Chifeng region (Chifeng 2011b).

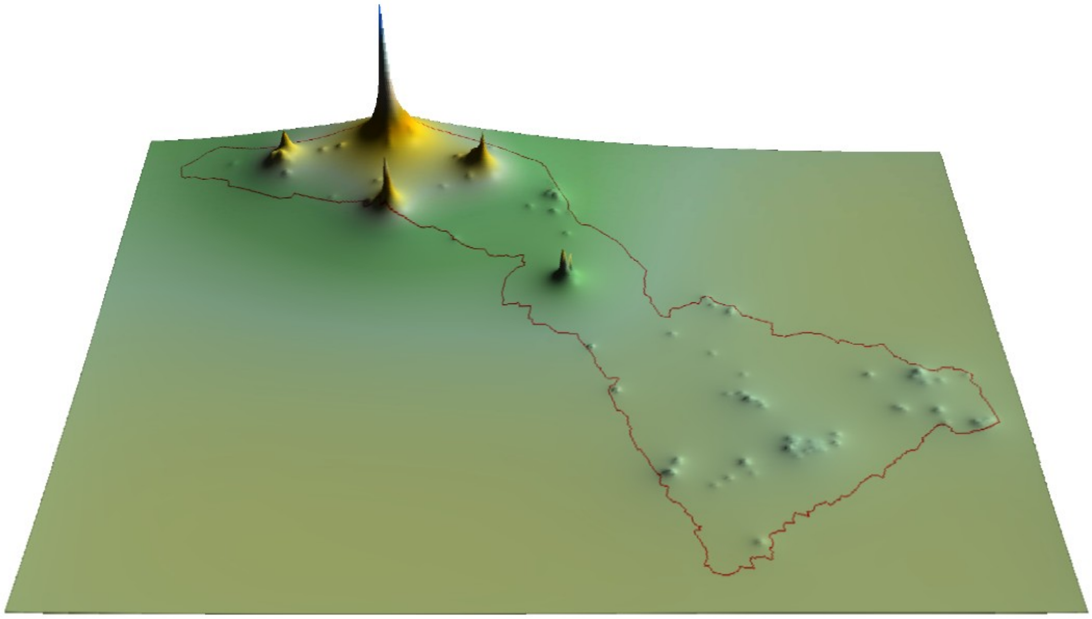

Figure 5.2 Smoothed density surface for the Hongshan Period. Peaks represent a supra-local communities with populations of between 60 and 260.

5.1.1 The Potential for Environmental Factors Influencing Settlement Pattering

Access to productive resources to maximize agricultural production does not seem to be attracting households to the southern part of the region. There is very little correlation between settlement location and a number of environmental variables that might indicate a desire to maximize agricultural production (Table 5.4, Table 5.5). The Spearman's Rank correlation between soil quality and population density is weak, although the significance is low due to the small number of ranks (r_s = 0.3, p =0.2). However, despite the relative marginal environment of the region and habitation on less productive land, it does not appear that the carrying capacity was being reached during the Hongshan period.

Table 5.4 Results of linear correlation between Hongshan occupation and productive capacity using methods, maps and variables outlined in Chapter 4.

Independent variable	Dependent variable	R value	Percent of variability explained
Quality of soil for cultivation	Hongshan settlement density	-0.0063	< 0.01%
Quality of soil for cultivation	Hongshan distance to a settlement	-0.0394	0.16%
NDVI 1986	Hongshan settlement density	-0.0009	< 0.01%
NDVI 1986	Hongshan distance to a settlement	-0.0483	0.23%
Distance to water	Hongshan settlement density	0.0017	< 0.01%
Distance to water	Hongshan distance to a settlement	-0.1181	1.40%

Table 5.5 Soil quality rank and population density rank

Soil quality rank (1 worst - 5 best)	Hongshan period Population density rank (1 1ow – 5 high)
1	1
2	5
3	3
4	2
5	4

Using the highest population estimates, one can see that the highest density of occupation for any of the supra-local communities during the Hongshan period would have been about 50 people per square kilometer or one household for every 10 ha within the supra-local community. If one assumes the main grain crop was millet (Zhao 2011: 34), after accounting for fallow, seeds and loss, we arrive at a low annual yield estimate of 150kg per hectare and a high annual consumption estimate of 300kg per person (Panter-Brick 1997), each household of five in the densest location, would have just enough available land to sustain themselves. If we use the most stringent estimates, the population we see during this period would have not been constrained by the availability of farmland. They also would not have to require tribute in the form of staple goods from other communities. The densest areas during the Hongshan period just approach the carrying capacity of the farmland immediately surrounding the settlements. Since the paleoclimate data indicates a period wetter than the present, the actual productive capacity may be actually higher than estimated here due to a longer growing season. Furthermore, it is very likely that less densely occupied locations were also utilized as farmland. The population during the Hongshan period was low enough not to be notably affected by any lack of natural resources. In other words, households had enough immediately available subsistence resources using the maximum estimated populations in even in the densest locations.

5.1.2 The Potential for Ideological and Social Factors Determining Settlement Patterning

Communities the size of the largest found in other regions do not appear in the Zhangwu region. In the Chifeng and Upper Daling region supra-local communities incorporated 400-500 individuals and up to 700 individuals, respectively (Peterson et al. 2010). This type of top tier settlement does not appear in Zhangwu. At the centers of these communities in other regions ritual architecture is almost always present. These ritual structures are not present in Zhangwu.

Niuheliang and Dongshanzui have been described as within the “Core Zone” of the Hongshan world (Peterson et al. 2010). The regions of Chifeng and Zhangwu both fall outside of this core zone. Comparisons between Daling and Chifeng revealed that there were only modest differences in the size and scale of community population despite the evidence of differences in the ritual architecture. However, ritual architecture is still present in the Upper Daling and Chifeng. The ritual component in the Chifeng and Upper Daling landscape is very closely tied to the demographic distribution (Chifeng 2011b; Peterson and Lü 2013). The most striking difference between Zhangwu and the other two regions is the lack of any ritual architecture. Despite the lack of large ritual centers and facilities we still see clustering of local communities and the formation of small supra-local communities. The supra-local formations in Zhangwu seem not to be located around the same kinds of conspicuous ritual monuments found in other regions. In addition, they do not seem to be related to agricultural production or the extraction of natural resources. There may exist interesting social or economic differences within these communities that may speak to the social or economic forces which integrate them. However, it is beyond the scope of this dissertation and would require additional fieldwork to illuminate them.

It seems to be the case that, whatever centripetal forces are drawing people into these larger communities, they are stronger in the Chifeng and Upper Daling regions. The local and supra-local communities on average are larger and more integrated than those that exist in Zhangwu. The lack of large ritual facilities which may have integrated these communities might indicate that if ritual practice is being carried out in the centers of these supra-local communities it is more modest in scale. The nature of the rituals may very well be the same but the materialization (DeMarrais et al. 1996) is commensurate with the lower levels of population.

5.1.3 Post Hongshan and Pre-Bronze Age Occupation

As mentioned in Chapter 2, the period between 3000 and 2200/2000 BCE is notoriously lacking in absolute dates and identified ceramic material. It is therefore very difficult to say much about social patterns during this time. Only two very low density collection lots with a total estimated population of about 5-9 people are in the northern part of the survey area. I do not think there is a population loss to nearly nothing only to be followed by massive growth. The evidence from Zhangwu should not be taken to indicate a demographic collapse following the Holocene megathermal (Liu and Feng 2012, Wagner et al. 2013). There is insufficient archaeological and climatic data to support this interpretation. It is much more productive to talk about a transition from the Hongshan to the Early Bronze Age assuming and hoping that this chronological gap will be dealt with in the future (see Chapter 2).

5.2 EARLY BRONZE AGE (2000-1200 BCE)

Early Bronze Age, Gaotaishan ceramics are by far the most abundant prehistoric pottery style in the Zhangwu survey area. During this period, the estimated regional population is between about 5000 and 10,000 individuals. The largest settlements during this period are much larger and denser than those we see during the Hongshan period. The population is more evenly distributed throughout the survey region during this time. The northern zone is slightly less densely occupied than in the south (Table 5.6).

Table 5.6 Population Distribution during the Early Bronze Age

	Population	Proportion of regional population	Population density per sq km
Northern area	3709	48%	40.7
Southern area	3983	52%	51.7
Total	7692 (3)	100%	44.5

The regional population increases by a factor of ten from the Hongshan period. Much of this growth is due to the founding of new settlements. The most striking difference between the locations of Hongshan and Early Bronze Age settlement is the occupation of the southern region. In this region the population growth is even more drastic. However, despite all of the new settlement, it is clear that households in the Early Bronze Age are not seeking out entirely new locations in the landscape. There is a correlation between Hongshan and Early Bronze Age settlement location (Table 5.7). So while Early Bronze Age settlement is now occupying the south, many of those locations are nearby or on top of small Hongshan settlements. These Hongshan settlements may have acted as seed populations for the much larger Early Bronze Age settlements.

Table 5.7 Location correlation between the Hongshan and Early Bronze Age using the method described in Chapter 4.

Independent variable	Dependent variable	R value	Percent of variability explained
Distance to a Hongshan settlement	Distance to an EBA settlement	0.5023	25.23%

5.2.1 Local and Supra-local Community Size and Organization

There are 168 Early Bronze Age local communities, the largest of which have a few hundred to over a thousand individuals. The largest local community has an estimated population of about 1700 people. Similar to what was seen during the Hongshan period, in addition to the large dense settlements, at the smallest scale there are a number of small local communities which are most likely individual farmsteads or a few households (Table 5.8). These smaller farmsteads account for a lower percentage of the regional population than during the Hongshan Period. This indicates greater degrees of local integration during the Early Bronze Age than during the Hongshan Period. The integration we see during this period is still somewhat different from the patterns observed in Chifeng. In Chifeng, more than 90% of the population are living in communities larger than 100 individuals and 55% living in local communities of over 1000 (Chifeng 2011b). In Zhangwu 80% of the regional population live in communities of over 100, but only about 23% of the population are living in communities of over 1000 (Table 5.8).

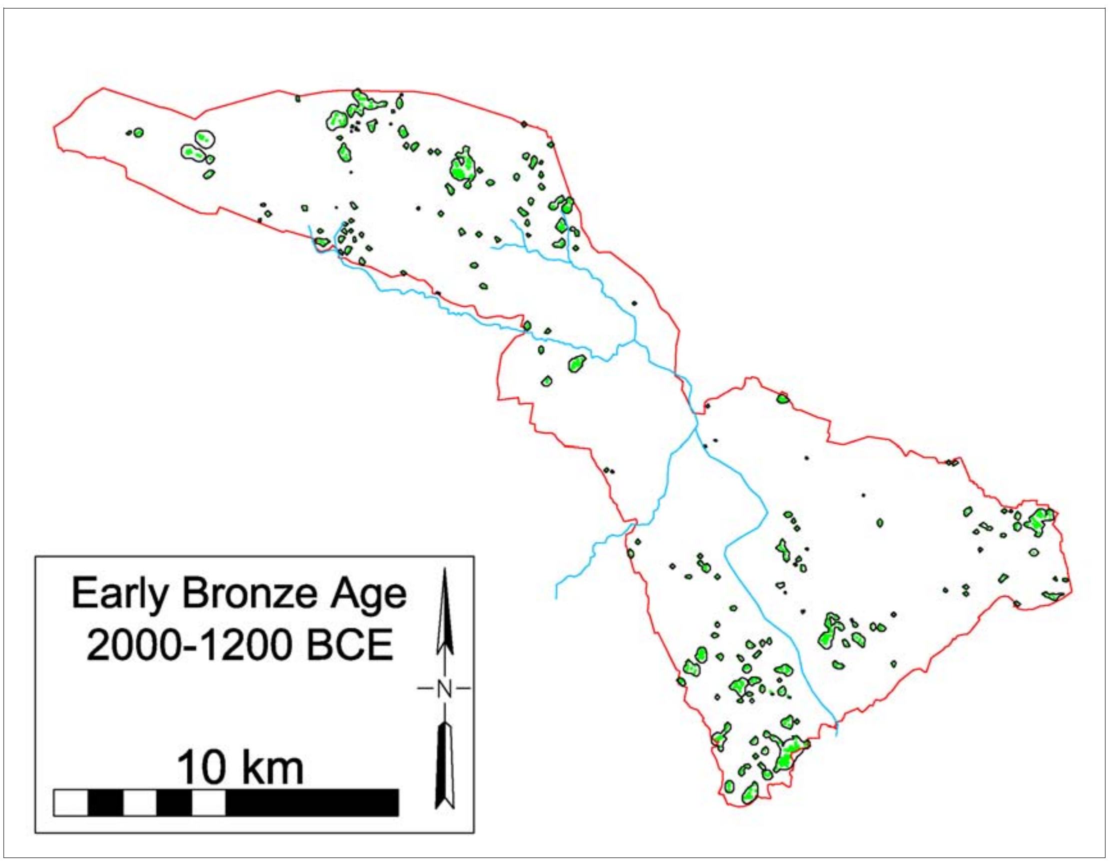

Figure 5.3 Delineation of Early Bronze Age local communities

Table 5.8 Local community distribution for the Early Bronze Age

Population of local community	Number of communities	Total Population	Percent of the regional population Zhangwu	Percent of the regional population Chifeng
1-10	111	636	8.3%	2%
10-100	41	934	12.1%	5%
100-1000	15	4380	56.9%	38%
1000-10000	1	1745	22.7%	55%
Total	168	7695	100%	100%

Three large supra-local communities can be delimited: two in the northern part of the survey area and one in the south (Figure 5.4). These three supra-local communities integrate about 70% of the regional population. A fourth spike can be seen in the middle of the survey zone. This large local community of about 525 people does not integrate other local communities and therefore not counted among the three supra-local communities. A number of small local communities exist between the two northern supra-local communities. It does not appear that these are very well integrated into either community but their regional location between these centers may be related to the resources or activities within them in these large communities. The southern supra-local community is the largest of the three and integrates several other large local communities.

The sizes of these supra-local communities are comparable to the size of supra-local communities found in Chifeng. The smaller two are about three kilometers from end to end. The largest is about seven kilometers from north to south. Population levels are on the lower end of the scale when we look at the two smaller communities with populations of about 800 and just over 1000. The largest supra-local community is in the south and the population is estimated at about 3500. This is most certainly higher since the survey boundary truncates this supra-local community severely. About half of the delimited community falls outside of the survey boundary. If one uses the existing settlement densities and assumes that the largest local community is the center of the supra-local community a rough estimate of population can be made. It is plausible that an additional 1700 individuals lived in this supra-local community just outside the boundaries of the survey. If this is the case, then this supra-local community would be in the range of the larger communities found in Chifeng, (Chifeng 2011b) at just over 5000 people.

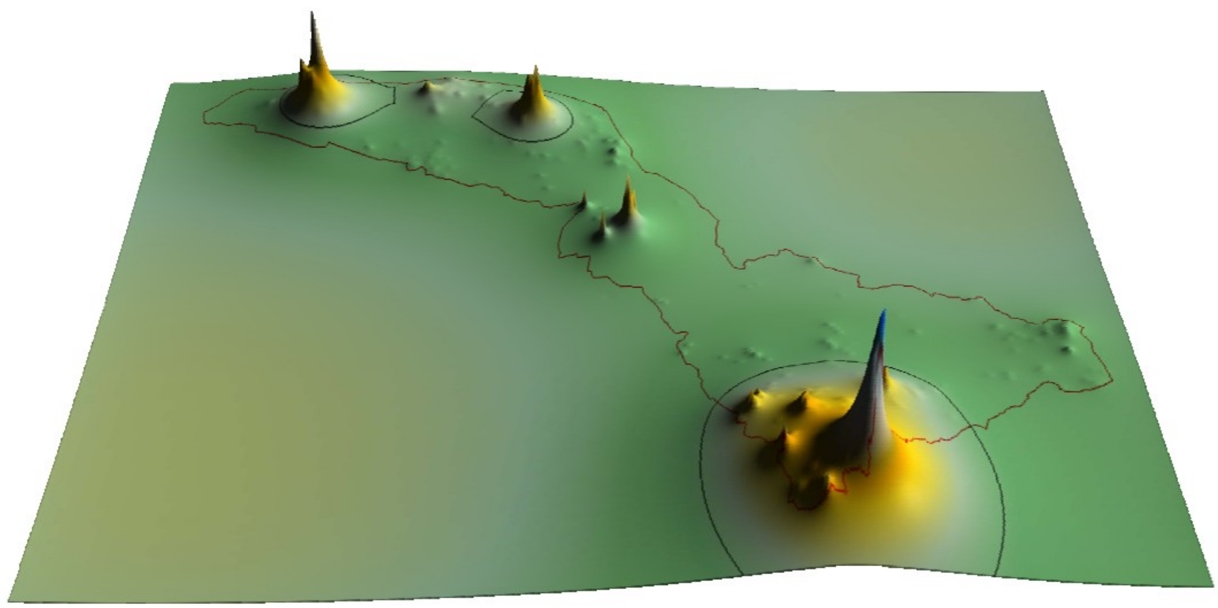

Figure 5.4 Smoothed density surface for the Early Bronze Age

5.2.2 The Potential for Environmental Factors Influencing Settlement Pattering

Despite more settlement occupying the more productive southern area than during the Hongshan Period, again, very little of the settlement density or location is explained by environmental variables (Table 5.9, Table 5.10). Large areas of productive farmland in the southeastern region are largely unoccupied and there are high density settlements in the north (Figure 5.4). The Spearman's Rank correlation between soil quality and population density is even weaker in this period, again the significance is low due to the small number of ranks ($r_s = 0.3$, $p > 0.2$).

Table 5.9 Results of linear correlation between Early Bronze Age occupation and productive capacity

Independent variable	Dependent variable	R value	Percent of variability explained
Quality of soil for cultivation	EBA settlement density	-0.0029	< 0.01%
Quality of soil for cultivation	EBA distance to a settlement	-0.1063	1.13%
NDVI 1986	EBA settlement density	-0.0038	< 0.01%
NDVI 1986	EBA distance to a settlement	0.0996	0.99%
Distance to water	EBA settlement density	0.0009	< 0.01%
Distance to water	EBA distance to a settlement	-0.1910	0.04%

Table 5.10 Soil quality rank and population density rank

Soil quality rank (1 worst - 5 best)	Early Bronze Age Population density rank (1 low – 5 high)
1	1
2	4
3	5
4	2
5	3

If one uses more conservative estimates of millet production and consumption (Qiao 2007) than were used for the Hongshan period, in the largest supra-local communities the population would have required that land beyond the delimited boundary be farmed in order to sustain itself.

However, there are a few factors which may make the region relatively more productive. The wetter climate during the Early Bronze Age would allow for exploitation of the upland environments in the south. The relatively smaller floodplains might also have been less of an impediment to lowland farming than is the case in Chifeng (2011b:123). In addition, intensification of agriculture (Morrison 1994) could also be a strategy to increase the production of staple grains. Early Bronze Age land clearing tools have been associated with agricultural intensification (Wang 2013a). Furthermore, the incorporation of domesticated animal economies could have increased the carrying capacity of the region during the Early Bronze Age (Chifeng 2011b:124). This may explain the lack of correlation between prime agricultural land and settlement location if the focus is split between the two economies. But, if resources are becoming scarcer due to high population density then it also makes good sense not to build houses and structures on that land that can be used for cultivation. During the Early Bronze Age, high population density would have presented subsistence challenges, but a number of environmental and social factors offset them.

5.2.3 Violence and Conflict for Resources

The size and density of communities from Zhangwu are consistent with the characterization of Early Bronze Age settlement patterns found in other parts of Northeast China (Chifeng 2011b). First, there is a significant increase in the regional population from the Hongshan period. In addition, there is more integration into local and supra-local communities. These communities are roughly the same size and scale. The lack of fortifications is the most striking difference between Zhangwu and Chifeng.

Fortification walls are a major component of the Bronze Age landscape (Chifeng 2003; Shelach 2009b; Wang 2013a). Both Chifeng and Zhangwu have similarly sized regional and community populations as well as similarly sized regional and community population densities. Chifeng is, however, a much more productive region than Zhangwu. If resource scarcity is a primary factor inducing conflict we would expect more conflict in Zhangwu than Chifeng. What we see rather, is the opposite. Zhangwu has less evidence of warfare despite the lower amounts of natural and agricultural resources. Even if there was scarcity of resources there was little conflict over them intense enough to warrant the creation of fortifications.

5.3 LATE BRONZE AGE (1200-600 BCE)

Three ceramic styles, Upper Xiajiadian, Upper Xinle and Shiertaiyingzi, provide the settlement evidence for the period from 1200 BCE to 600 BCE, or the Late Bronze Age. At this time there is a decrease in the size and number of local communities. This translates into a drastic decrease in the regional population. There are a total of 37 local communities. The regional population drops back down to about 500 to 1000 individuals. This is comparable to the population levels during the Hongshan period. Regional densities are again very low and again settlements of one or a few households dispersed across the landscape are the predominant form of habitation in the southern part of the survey area (Table 5.11). The major difference between the Hongshan and the Late Bronze Age is that, even though the majority of the population is living in the northern area, they are organized differently.

5.3.1 Tuchengzi

In the northern part of the survey zone there is a single local community about one kilometer east from the modern village of Tuchengzi. About 60% of the regional population live within this settlement (Figure 5.5). The Tuchengzi settlement is roughly 20 hectares in size with a community population of about 450 people (Table 5.12). The other 40% of the regional population is spread out over the survey area in settlements of one to five families. The people not living within the Tuchengzi settlement are roughly divided equally between the northern and southern regions (Table 5.11).

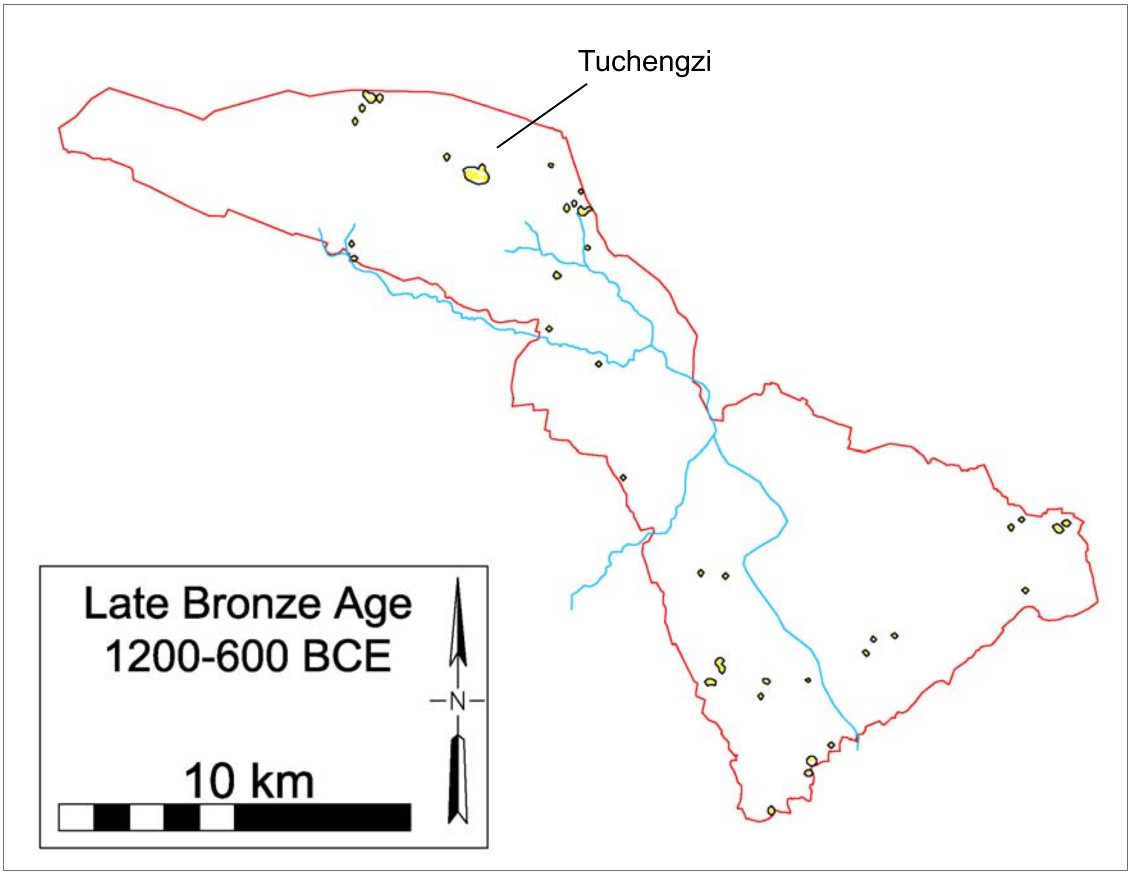

Figure 5.5 Delineation of Late Bronze Age local communities

Table 5.11 Local community distribution for the Late Bronze Age. Values in parentheses are calculations not counting the Tuchengzi settlement.

	Population	Proportion of regional population	Population density per sq km
Northern area	599 (131)	76.9% (16.8%)	6.5 (1.44)
Southern area	180	23.1%	2.3
Total	779	100%	4.5 (1.80)

Table 5.12 Local community distribution for the Late Bronze Age

Population of local community	Number of communities	Total Population	Percent of the regional population Zhangwu	Percent of the regional population Chifeng
1-10	28	165	21.2%	0.5%
10-100	8	146	18.7%	2.5%
100-1000	1	468	59.9%	21%
1000-10000	0	0	0	66%
10000-100000	0	0	0	10%
Total	37	779	100%	100%

Some of the Late Bronze Age settlement patterning can be explained by the remnants of Early Bronze Age settlement. There is a correlation between the Early and Late Bronze Age locations that explains about 12 percent of the variability in settlement location. In addition to this moderate correlation, there is also evidence that indicates that Late Bronze Age local communities are occupying slightly different locations in the landscape.

About nine percent of the settlement location is now explained by the proximity to stable sources of water. For the only period in the trajectory, proximity to water explains some of the settlement location information. When the Tuchengzu settlement is removed from the analysis the correlation remains at about the same level (Table 5.13). This means that the locations of the smaller settlements are determining the correlation.

Nine percent of variability in settlement location is also explained by quality of soil for cultivation. The Spearmans rank order correlation between population density and soil quality is moderately strong and significant ($r_s = 0.5$, $p = 0.1$). Again, this relationship becomes stronger when the high density Tuchengzi settlement is removed from the analysis ($r = 0.7$, $p < 0.01$). This indicates that some of the small settlements are the ones gravitating toward better soils. As demonstrated in Chapter 4, water and soil quality are not entirely independent, but the correlation between soil productivity and distance to water only account for 8% of the varibility since Fluvisols are not ranked as high or as low as other soils. All of these correlations which suggest a a tendency to occupy better farmland are moderately strong but they are stronger than any other prehistoric period we have explored so far.

The Tuchengzi settlement is situated within 500 meters of a border between Cambic Arenosols and Calcaric Fluvisols. As described in Chapter 3, the majority of the Fluvisols in the region are formed as a result of the high water table and are much more expansive than the current floodplains and water courses. These Fluvisols are not the most productive soils in the region due to the sandy composition but they are more suitable than the Cambic Arenosols which are more suitable for grazing (see Chapter 3). The environmental reconstruction for this period indicates that the change in temperature and rainfall transformed this landscape into extensive grasslands in the northern part of the survey zone giving way to forested regions in the south (see Chapter 3, Qiu et al. 1992, 1995). So, Arenosols may have been more consolidated than present but would have still lacked the characteristics of a very productive soil for the purpose farming. The settlement pattern indicates that populations did not disperse into the grassland environment, described by Qiu and colleagues, in order to maximize production of an economy based on herding (Anthony 2007; Frachetti 2004, 2008; Kohl 2007). The pattern shows that many of the settlements moved closer to well watered locations on soil that is better for cultivation.

Table 5.13 Results of linear correlation between Late Bronze Age occupation and productive capacity

Independent variable	Dependent variable	R value	Percent of variability explained
Distance to a EBA settlement	Distance to an LBA settlement	0.3570	12.30%
Quality of soil for cultivation	LBA settlement density	0.0019	< 0.01%
Quality of soil for cultivation	Distance to an LBA settlement	-0.3017	9.10%
NDVI 1986	LBA settlement density	-0.0901	0.81%
NDVI 1986	Distance to an LBA settlement	-0.0020	< 0.01%
Distance to water	LBA settlement density	-0.00005	< 0.01%
Distance to water	Distance to an LBA settlement	0.2982	8.90%
Distance to water	Distance to an LBA settlement (no Tuchungzi)	0.2778	8.87%

Table 5.14 Soil quality rank and population density rank

Soil quality rank (1 worst - 5 best)	Late Bronze Age Population density rank
1	1
2	3
3	5
4	2
5	4

5.3.2 Lack of Supra-local Community Integration

The smoothed density surface creates a large district which incorporates 15 other local communities around Tuchengzi (Figure 5.6). However, it is not entirely accurate to define this as a supra-local community. There is very little clustering of settlement around the large local community. 14 out of 15 of the local communities are further than two kilometers away from the settlement. 80 percent of the "supra-local community" are living within the Tuchengzi settlement. If you remove Tuchengzi from this district the population densities are comparable to everywhere else in the survey region even slightly lower than the southern region. While the 15 local communities may have interacted with the Tuchengzi settlement, it does not appear that there are strong centripetal forces pulling local communities toward this village.

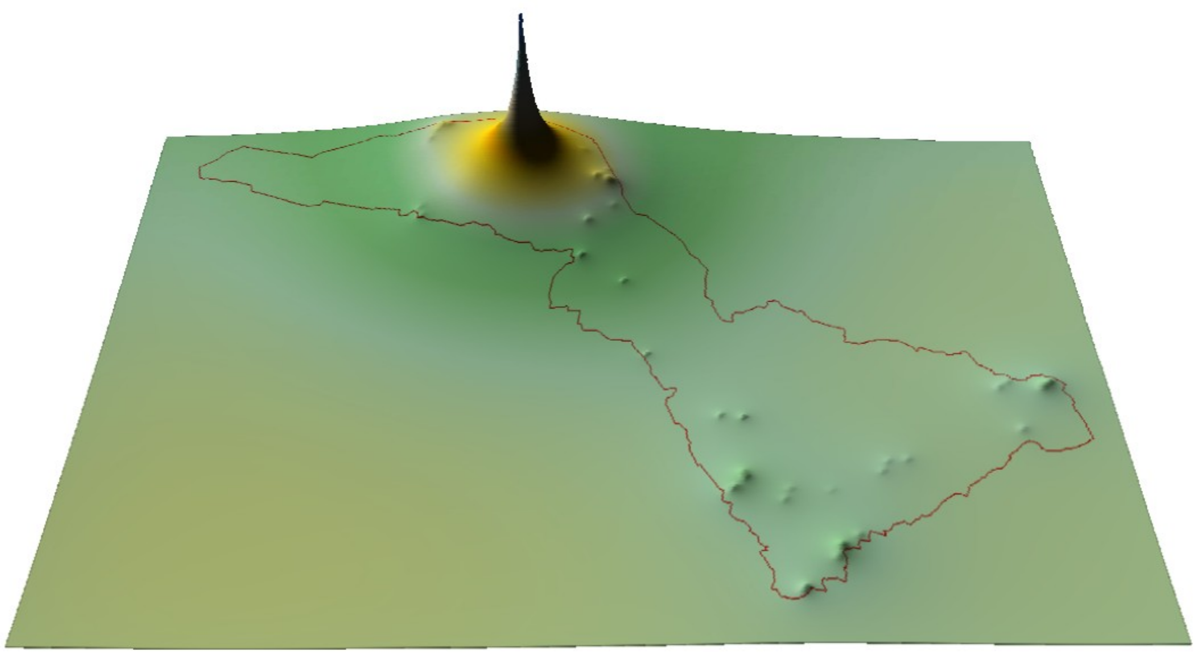

Figure 5.6 Smoothed density surface for the Late Bronze Age

When this period is compared to the results of the Chifeng survey, we see very little in the way of similarities. The size of the Tuchengzi settlement in Zhangwu is smaller in both area and population than an average settlement in Chifeng (Chifeng 2011b:126). Even though a majority of the regional population is living in the large local community in Zhangwu, 80 percent of the Chifeng population are living in local communities that are larger than this (Chifeng 2011b:126). Very little of the population are living in small dispersed settlements during this period in Chifeng. As mentioned above, small settlements of less than 100 people account for 40 percent of the population and all but one of the local communities. In contrast, local community integration is extremely strong during this period in Chifeng and small settlements of less than 100 account for only three percent of the population. The most striking difference is that during this period in Chifeng, population reaches its prehistoric maximum. In Zhangwu, the regional population density is about one sixteenth of what was found in Chifeng.

The Late Bronze Age brought on a shift in the location of settlement at both the local and regional scale. Regional depopulation in Zhangwu is difficult to explain without some form of migration; low birth rates are not enough to account for this shift. At the local scale, many of the communities that remain through the Late Bronze Age sought out locations more conducive to farming.

5.3.3 Explanations for Depopulation

Whenever there is significant depopulation of a region, there are a few commonly cited causes. Political collapse, warfare and violence, resource scarcity, disease and external political pressure are often discussed (Cohen 1975; Hassan 1978). The overwhelming decision made by the majority of the Bronze Age inhabitants was to leave the region in favor of other locations. And, unlike Chifeng, there is little evidence for persistent warfare and violence (see 5.2.3).

There is however, strong evidence for a shift in climate which would have lowered agricultural yields when compared to the Early Bronze Age. However, since the region may have been wetter than present, farming is certainly a possibility, especially in the southern region (see Chapter 3). By using the calculations from Chapter 4, even if agricultural yields declined from the Early Bronze Age, a modest catchment of 2 kilometers around Tuchengzi would sustain the settlement at the rate of 2 hectares of farmland per person. Since this catchment is largely unoccupied and flat, there are few obstacles to using this area for farming, herding or both.

If the catchment were utilized for grazing it could support just over 750 Livestock Units (LU). Mentioned in Chapter 4, Livestock Units are a way to standardize measures of animals based on the amount of food they consume (FAO 2005). 750 LU means that each of the 90 families at Tuchengzi would have the resources to support 8.3 LU. In other words, this would mean each family could sustain a herd of just under 90 sheep and goats or about 18 cattle and not have to pasture their animals not very far from the settlement. It is useful to note that this estimation of sheep is above the threshold for ethnographically documented self sustaining herds (Cribb 1991). Although, it is also very reasonable to assume that if this community relied on domesticated animals, households would be trading livestock between each other for breeding.

Of course, a mixed domesticated animal and plant economy could also sustain the households within the settlement. Even though the region is less productive when compared to the wetter warmer conditions during the Early Bronze Age it has not reached the level at which human populations could not farm and/or utilize the region for grazing. That being said, during the Bronze Age there are adjacent forested regions to the south where fertile valleys and uplands would have been less risky to farm than Zhangwu. In the Chifeng region, for example, topography allows for small scale migration to mitigate the impacts of changing climate. The increase in risk rather than capacity may best explain the regional depopulation. From this research it is not clear where populations migrated to; it is clear the regional environment could have sustained higher regional populations than estimated. However, if local populations were much larger than Tuchengzi they may have begun to face challenges to subsistence.

5.3.4 Settlement Evidence for Subsistence Economics and Mobility

Although population density is much lower than the Early Bronze Age there are elements of the settlement pattern that suggest that the northern sub-region was not entirely populated with mobile herders. As discussed in Chapter 3, the region would have become more arid and grassy when compared to the Early Bronze Age making it ideal for the herding of animals especially in the northern sub-region. Despite this, 90 percent of the population opted not to change economic practices but rather voted with their feet. The remaining ten percent may have been engaged in the herding of animals and the possibility exists that these remaining households are mobile. The exception is the Tuchengzi settlement which is too large if the inhabitants were seasonally mobile. Aggregation sites of mobile communities in Mongolia have been documented ethnographically as large as 10 to 12 households (Mearns 1993, 1996). The Tuchengzi settlement is about an order of magnitude larger than this. Furthermore, if we assume that Tuchengzi was not continuously occupied this would increase the estimated population to levels even higher than ethnographic estimates of herding settlements (see discussion Chapter 4.2.3) . Therefore, it is very easy to conclude that the settlement most likely had a sedentary population, which leaves potentially 300 people living in 36 local communities who may have had been specialized mobile herders or about 4% of the Early Bronze Age population.

The regional density, not counting the Tuchengzi settlement, is roughly equivelent to a number of ethnographically documented cases where the population is predominantly living in mobile settlements of a few households. According to the FAO, in the 1960's, Mongolian population density would have been at roughly 0.8 people per square kilometer. Others have estimated the population density of Eurasian pastoralists at about 0.9 (Krader 1955) 1.5 (Masaknov 1995) or usually less 2.0 (Murdock and Wilson 1972) people per square kilometer. Cioffi-Revilla and colleagues (Cioffi-Revilla et al. 2010) estimate values at between 1.5 and 2.5 people per square kilometer. These are all roughly equivalent to modern Mongolian density of 1.74 people per square kilometer. Houle (2010) calculated a regional density for Bronze Age herders of 5.6 and 4.9 per square kilometer. While this region this may represent a uniquely high density, if we use the some of the calculations and methods from Houle (see Chapter 4.2.3) we arrive at a base population estimate of 163 or a density of 0.94 people per square kilometer. This estimate could of course be low and would be higher if seasonal mobility takes the households outside of the survey region (see discussion Chapter 4.2.3). For example, if one assumes that Zhangwu is used primarily for summer pasture then the population density would increase to 3.8 people per square kilometer.

Returning to the methods described for sedentary populations (Chapter 4.2.1, Drennan et al. 2003; Drennan and Peterson 2011), the population density of small settlements in Zhangwu can be estimated at 1.80 people per square kilometer (Table 5.12). If the residents in Zhangwu (with the exception of Tuchengzi) are seasonally mobile then they are within the population density spectrum for both ethnographically and archaeologically documented mobile communities.

While a low population density is not conclusive evidence for the existence of mobility, it should be understood that given only the settlement evidence, it is certainly a possibility. The size and density of the local communities in Zhangwu during the Late Bronze Age is consistent with communities of specialized mobile herders. It is also consistent with a pattern of dispersed farmsteads, especially given the move toward better farmland that would be easier to irrigate. Given the patterns of settlement and regional population density, it is important to seriously consider the possibility that the *low density component* of the Late Bronze Age settlement patterns could be the material remains of specialized mobile herders, sedentary farmers or anything in between. This possibility will be investigated more directly in the next chapter with a closer look at Bronze Age economics.

These thoughts, of course, ignore the largest settlement and 60% of the population which is clearly not seasonally mobile but may be situated to take advantage of both pasture and farmland as a means of minimizing risk. The settlement's larger population would itself also be a means of minimizing environmental risk. Sharing of food within the local community provides households with a social safety net in times of scarcity (Hegmon 1991, Hayden 2009).

5.4 IRON AGE (600 BCE-200 CE), ON THE MARGINS

There are two styles of ceramics indicative of Iron Age (600 BCE to 200 CE) habitation. These are referred to by archaeologists as Xianbei and Warring States/ Han. Whether or not these styles of pottery can be directly attributed to the historically defined polities is the subject of debate (see Chapter 2). However, it is generally accepted that this period was politically unstable. In most of East Asia, including the Northeast, this period is characterized by political conflict by large polities spanning territories in the hundreds of thousands of square kilometers. The State of Yan is not the largest of these polities but it would have still spanned a territory of over 100,000 square kilometers. Yan was incorporated into the Qin Empire in 221 BCE and after a brief period of relative independence following the fall of the Qin was incorporated into the Han polity where it remained as the northeast frontier. Just outside the Yan border, the communities living in Zhangwu during this period would have been potentially part of one or a number of larger polities throughout this 800-year period. Presumably these would have been the Yan, Qin and Han polities as well as those (unnamed or xenonymed) in conflict with them (see Chapter 1 and 2). It is during this period that political forces outside of the survey area may have had an important impact on the settlement patterns.

5.4.1 Iron Age Population Levels

During this period, the trajectory reaches its regional population minimum. The regional population is estimated between 175 and 350 individuals with a strong tendency to occupy the northern area (Figure 5.7) (Table 5.15). There is a single settlement within the survey region which is larger than 15 individuals. It is located slightly north of the Tuchengzi settlement which characterized the Late Bronze Age. However, this settlement is much smaller, with an estimated population of about 65 people. This settlement also incorporates a lower proportion of the regional population than the Tuchengzi settlement. The rest of the habitation in the region can be characterized as small settlements of one or a few households (Table 5.16). This is in stark contrast to Chifeng where only small proportion of the population are living in communities of less than 100 people (Table 5.16). There is very little apparent supra-local integration during this period that is visible at the scale of this research. The large northern settlement may have incorporated four other households which would bring the population to just under 80 (Figure 5.8). This small center may have exhibited some political influence locally but it is more likely that much larger polities are having an impact on the region. During this period, supra-local and supra-regional polities would have controlled areas much larger than the survey region.

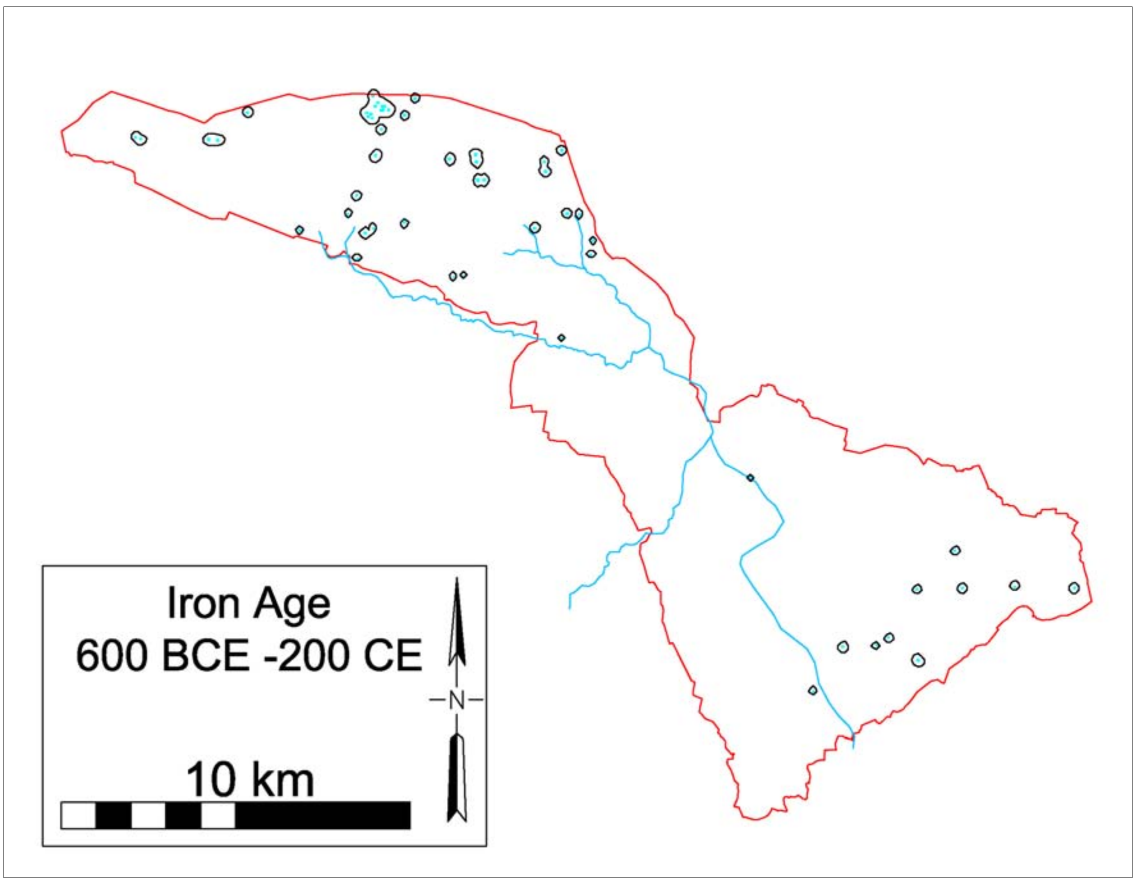

Figure 5.7 Delineation of Iron Age local communities

Table 5.15 Population distribution during the Iron Age

	Population	Proportion of regional population	Population density per sq km
Northern area	219	83.0%	2.4
Southern area	45	17.0%	0.58
Total	264		

Table 5.16 Local community distribution during the Iron Age

Population of local community	Number of communities	Total Population	Percent of the regional population Zhangwu	Percent of the regional population Chifeng
1-10	28	142	53.7%	2%
10-100	8	122	46.2%	14%
100-1000	0	0	0	40%
1000-10000	0	0	0	44%
Total	38	264	100%	100%

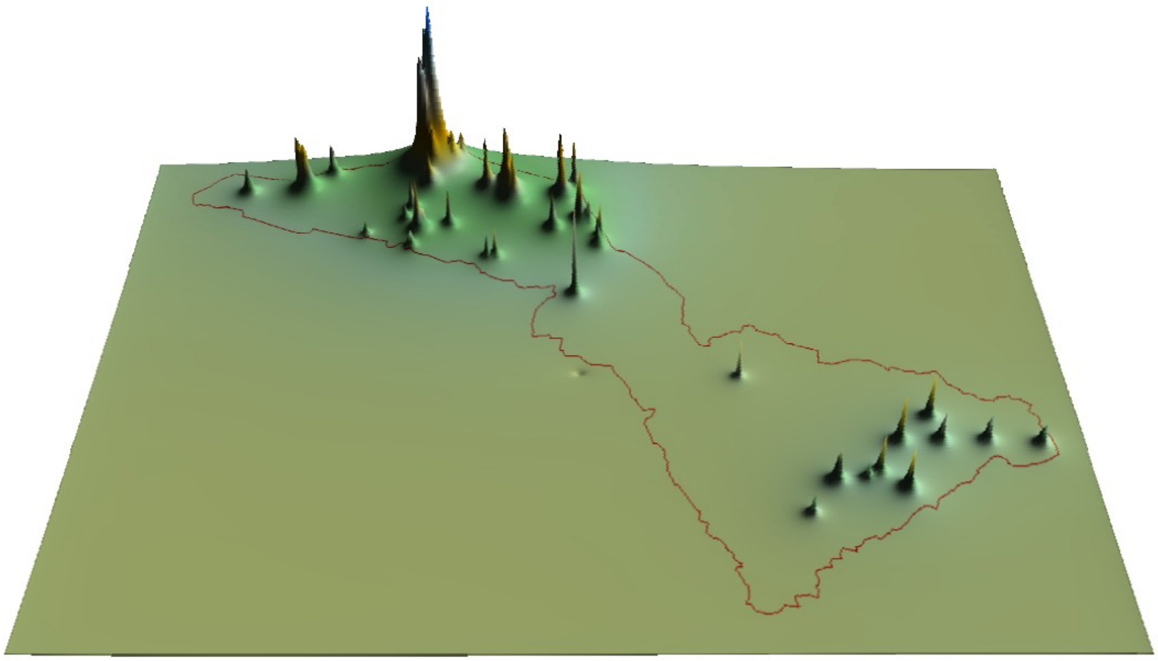

Figure 5.8 Smoothed density surface for the Iron Age. Each spike represents one to three households with the exception of the northern spike that is the large northern community.

The climate during this period may have been slightly drier than the Late Bronze Age (see Chapter 3.3 and Zhao et a1. 2007). This would have caused impediments to farming unless there was significant investment in water management. This type of investment is not unheard of for this period. The state of Qin, in Sichuan, built dams and irrigation channels to maximize the agricultural potential of the region (Huang 2002). Unlike Sichuan, Zhangwu may have also faced serious political impediments as well as environmental ones.

5.4.2 Early Iron Age Political Tension

The state of Yan is thought to occupy the area south of the Great Wall in Liaoning province and the survey region falls slightly north of the Great Wall. The remains of the Great Wall can be found about 32 kilometers southwest of the survey region, just south of the modern city of Zhangwu (Feng et al. 1996) (Figure 5.9). The region could have been particularly contentious during this period of political unrest to warrant the construction of fortifications. The city of Zhangwu is, and was, an important crossing for the Liu River and is the location for several forts and a beacon tower during the Ming Dynasty. An important river crossing just north of the Great Wall would have made the region contentious as various parties vied for control.

Figure 5.9 Ming Dynasty beacon tower in the background and remnants of the Warring States Period Great Wall (and ditch) in the foreground. (Zhangwu 2012)

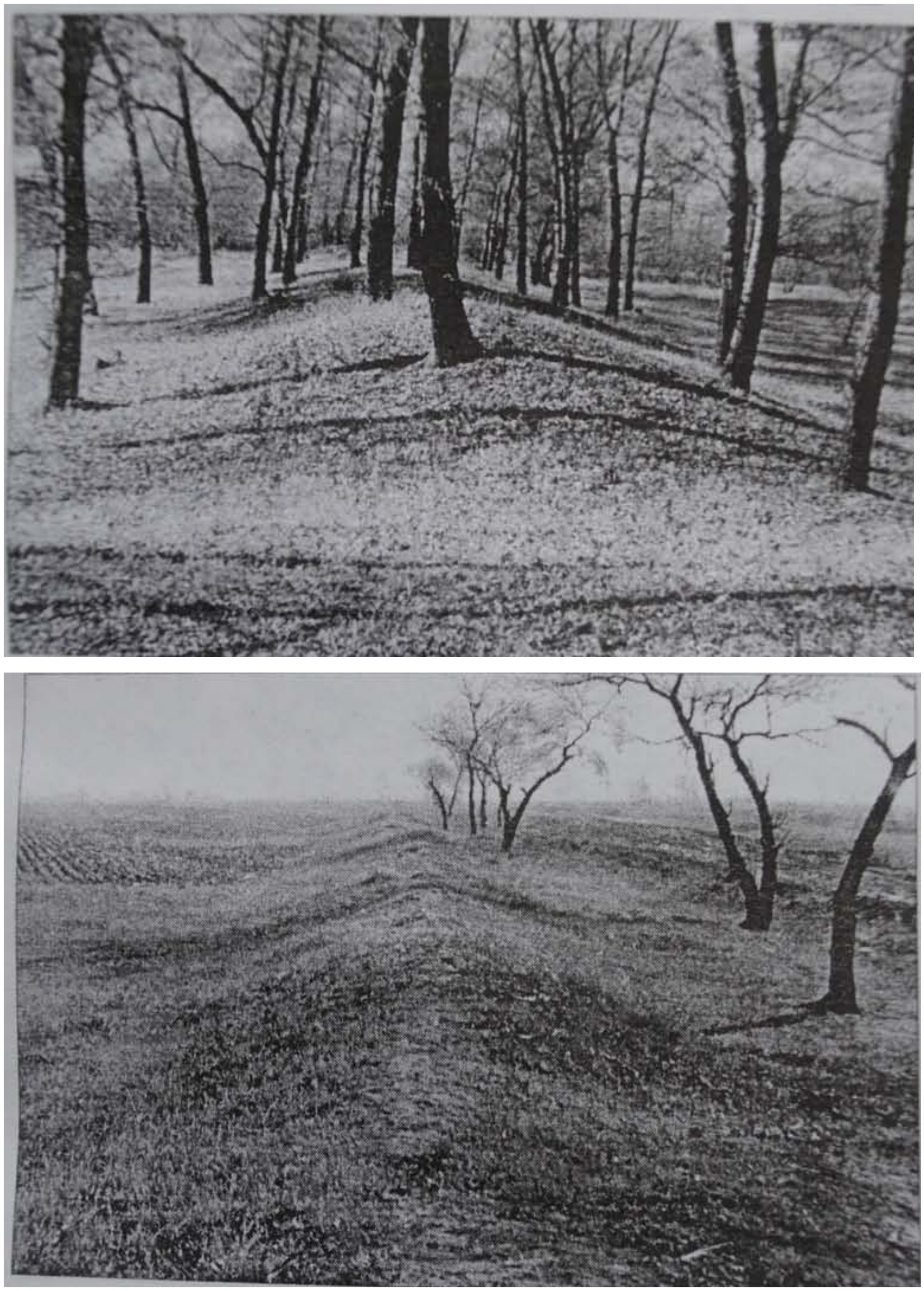

Figure 5.10 Remains of Warring States period wall in Zhangwu county (from Feng et al. 1996 figs. 1 and 2)

Population replacement and founding of settlements are part of the political process and statecraft during the Warring States period (Li 2006). Movement of people and the founding of settlements would have been, in part, determined by political pressures to exploit resources (Indrisano 2006; Indrisano and Linduff 2013). Since the region would have been and is currently lower in productive capacity than many other adjacent regions (see Chapter 3), then it would have been a less likely candidate for state sponsored settlement. In sum, the most reasonable explanation for the extremely low population levels is due to strong social forces pulling people to larger settlements and more productive locations. Since the region is less conducive to maximizing agricultural production than other areas and the region may have been close to violent conflict there is little incentive to occupy the region and a few very good incentives to leave. The combination of political and environmental stress is the likely cause of the regional depopulation.

The forces which determine the settlement patterning during this period may have been largely influenced by factors that are outside the survey region or its immediate vicinity. The continued environmental stress and proximity to a contentious border make this area less than desirable for habitation and resulted in both population decline and overall low population levels.

5.5 LIAO (200-1200 CE), APPROACHING MODERN PATTERNS

During the final period covered in this research there is a rebound in both climate and population. The climate becomes more conducive for agricultural production. Political unrest may have taken place during this period, but northern Liaoning would have generally enjoyed more political stability compared to the Warring States period and also compared to other parts of China and Asia during this period.

The regional population now reaches about 14,000; the settlement is generally distributed very evenly throughout the survey area. There is a low density blanket of settlement throughout much of the survey region. Local communities were difficult to delimit and blend from one to another (Figure 5.10). This results in "communities" which are five to six kilometers in length and this really stretches the limits of a definition based on face to face interaction. Therefore, it makes the label of "local community" somewhat misleading. It is better to characterize habitation pattern as hamlets which blend into each other. They are slightly denser in some areas but not clustering into clear villages. At the supra-local scale, however, two large districts are apparent.

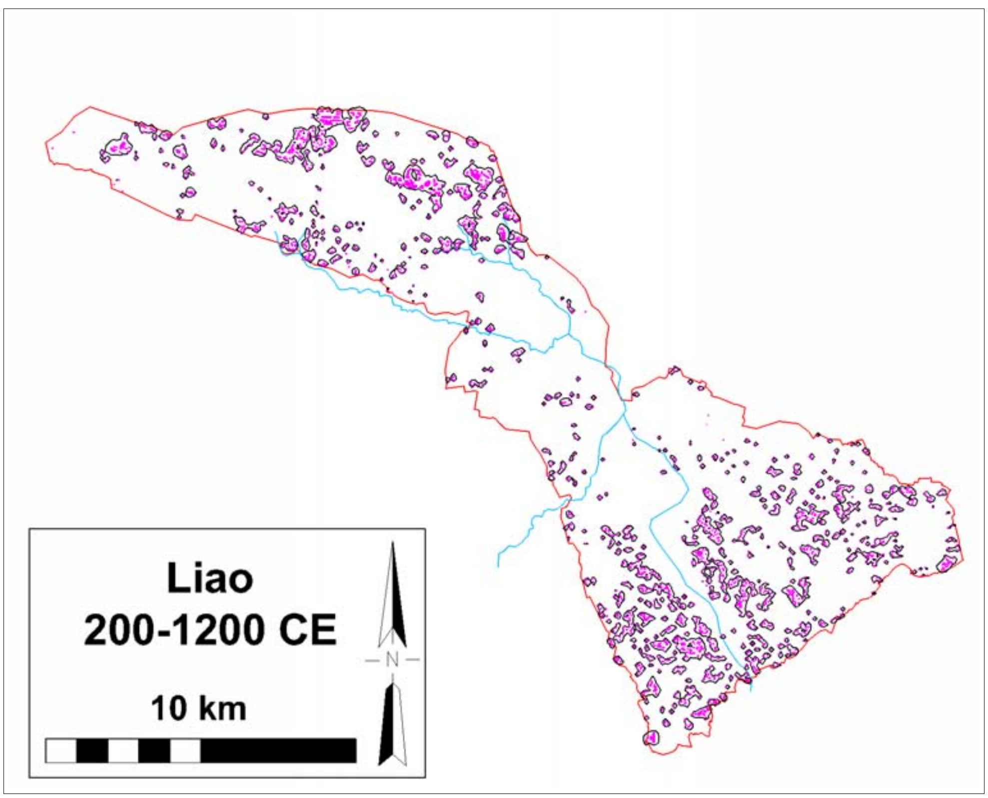

Figure 5.11 Delineation of Liao Period local communities

5.5.1 Similarities Between Liao and Modern Occupation

The pattern of settlement appears very much like the modern pattern. Several families and extended families generally live adjacent to their farmland. These small villages rarely exceed a few hundred people with a few reaching toward about 1000. The spacing between these settlements is most likely due to the relatively low yields in the region. If settlement became denser there might not be enough land for households to sustain themselves. The modern population is slightly more compact locally and regionally. Modern infrastructure like road access, telecommunications and electricity may account for some of the higher local community densities than the Liao pattern. At the regional scale, modern rural population density is about 100-110 people per square kilometer. This is slightly higher than the archaeologically derived calculation of just over 70 during the Liao Period, but these similar densities may be due to the region reaching its productive capacity. In the modern occupation pattern, the areas where settlement becomes slightly denser we see non-farming occupations emerge.

About 95 percent of the modern population within the survey area are farmers. The two areas where we see non-farming occupations are in the towns of Houxinqiu and Sihecheng (Bintuwangfu). These include primary school teachers, middlemen, local government representatives as well as merchants who supply farming equipment to the surrounding population. These towns are connected by a road running north to south which serves as the main artery for many of the villages. This road and the two towns are clearly visible on the US Army Corps of Engineers map, drawn prior to the current governmental system (Figure 5.11). As discussed in Chapter 4, these maps lack the accuracy to be involved in any serious analysis but they are useful for indicating the presence or absence of pre-modern features. The change of Sihecheng's name also gives us a clue into its historic importance. The last two characters

(Wang 王 and Fu 府) are a reference to a noble's residence. The changing of place names was a common practice in China during the Cultural Revolution a means of "destroying the four olds" (Chan 2010).

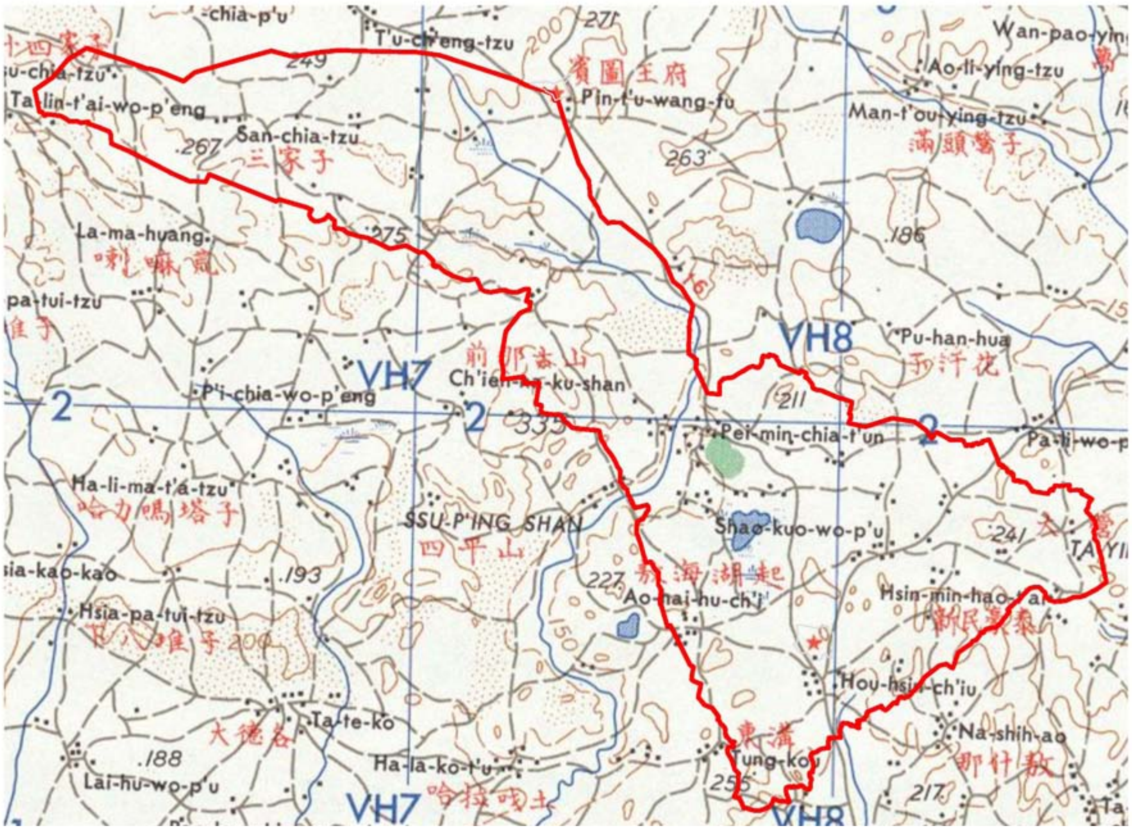

Figure 5.12 Locations of two towns before dam construction, political importance indicated by red stars.

The smoothed density map (Figure 5.12) indicates two clear peaks. These peaks appear to correspond to the locations (from satellite imagery, not the map above) of Houxinqiu and Sihecheng. When the distance map from these two modern towns is measured against the values derived from the Liao dynasty smoothed surface there is a very strong correlation. The values from the smoothed surface and the distance maps explains 60% percent of the variability.

Therefore, it is reasonable to assume that the locations of these modern towns were the centers of the surrounding population during the Liao period and probably served many of the same functions that they do today. These locations would have had craftspeople, merchants and middlemen and potentially a local government official or tax collector or two. In a recent BBC documentary about a rural Chinese village (Bell 2012), the narrator opens with the almost cliche, "...life here hasn't changed much for hundreds of years." The situation I just described are some of the circumstances to which she is referring. The similarities in the location of the post dynastic centers and the Liao pattern of settlement distribution might indicate a good deal of similarity between the socio-economic circumstances.

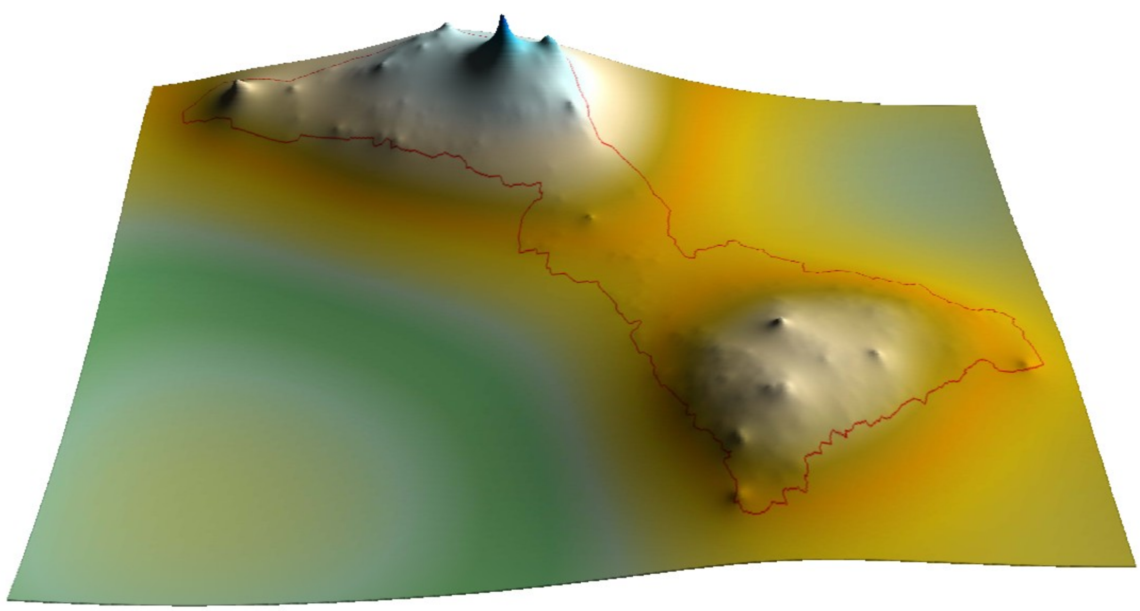

Figure 5.13 Smoothed density surface for Liao period occupation.

5.6 SUMMARY OF THE CHANGING SETTLEMENT PATTERNS

The trajectory of the human settlement in this region bears some similarities to what we have learned from the Chifeng and Daling regions. Its deviations are promising opportunities for continued comparison. The differences between the environments of Chifeng and Zhangwu (see Chapter 3) make for fertile ground to understand the role of productive resources in the regional organization of population. Throughout all of the periods represented in Zhangwu, there is a higher percentage of small settlements. This persistent pattern of lower levels of consolidation could be a result of productive limitations of farmland adjacent to settlement. Denser settlement with larger populations would be most vulnerable to those limitations (Drennan 1988). The substantial increase in regional population from the Hongshan Period to the Early Bronze Age is nearly identical to the patterns observed in Chifeng (Figure 5.13). The pattern couldn't be more dissimilar when comparing the Late Bronze Age demographic trends. Population does not rebound until the Liao Period, at which point it is approaching modern levels.

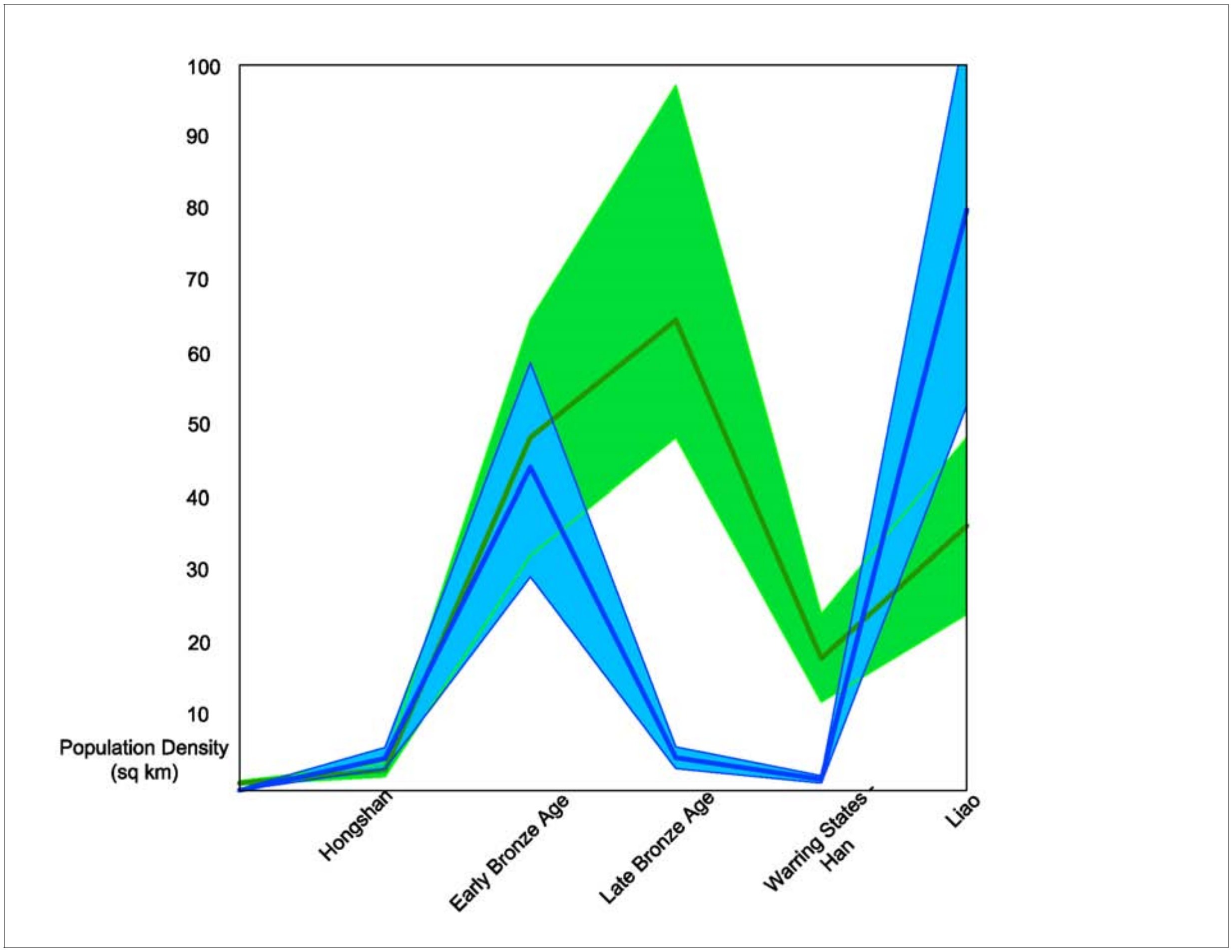

Figure 5.14 Population density with shaded minimum and maximum population estimates for Zhangwu (blue) and Chifeng (green).

A greater focus on domesticated animal economies could have increased the carrying capacity of the region during the Early Bronze Age (Chifeng 2011b:124). By and large, the strategy by which communities mitigated risk associated with such high population density is leave the region to seek out more productive regions thereby lowering population densities to more sustainable levels. Clearly a good deal of depopulation occurred in Zhangwu. The degree to which economic change occurred to mitigate risk is the subject of Chapter 6, but for the first time (and only time) in the prehistoric trajectory, stable sources of water and proximity to productive soils explain some of the settlement pattern. This suggests that there is a preference to exploit those locations which could be easily irrigated and farmed rather than settle exclusively in expansive grasslands. However, if productive farmland was the predominant determinate then the largest settlement should be found in the southern region rather than straddling a soil boundary in the north.

In the Iron Age, the environmental pressures felt during the Late Bronze Age became coupled with political pressure. Iron Age households dotted the landscape at a very low density. Many of the households most likely moved to less politically contentions regions (Cook 1973; Furguson and Whitehead 1992:27; Turner 1985). Finally, during the Liao Period population rebounds and the settlement pattern most resembles the modern pattern.

The trajectory of settlement patterning has a good deal of variability. However, there does not seem to be a point during the Bronze Age when the landscape is dominated by small ephemeral sites in the northern sub-region. Specialized mobile herders may be a component in a larger system. The results of Chapter 6 might also indicate that there is little specialization and local communities may engage in both farming and herding subsistence practices.

6.0 BRONZE AGE SUBSISTENCE AND SPECIALIZATION

The settlement evidence indicates a major shift in the patterning of human habitation when we compare the Early and Late Bronze Age. The most conspicuous element of this shift is the dramatic decrease in the regional population. Besides depopulation, there is evidence to indicate there are changes in the patterning of human occupation. This may suggest that there is a shift in economic practices during the Bronze Age. The evidence from artifact distribution and lithic use-wear addresses the economic practices directly. A number of collection units were both predominately single period and included stone tools and/or ceramic spindle whorls. In addition to the examination of diachronic change, the lithic analysis and the use-wear evidence will provide data to show whether there is a difference in economic practices between the northern and southern zones during the Bronze Age.

The local community, a collection of households who would have interacted daily (Murdock 1949, Flannery 1976), is the smallest economic unit which this dissertation is equipped to discuss in terms of economic differentiation or specialization. In order to best understand household or intra-settlement differentiation, one would need to carry out additional fieldwork, which would include smaller scale surface collection and excavation. Therefore, the lithic tools that were analyzed by the methods described in Chapter 4 are grouped together and organized by local community.

The economic complementarity models described by Linduff (1995, 1997) and Shelach (1999) suggest that it is much larger populations, larger than individual households and communities, that are engaging in exchange of products. According to these models, entire local communities would have been altering their economic practices during the Bronze Age across large regions. The model goes on to suggest that subsistence specialization by entire communities would be conspicuous across multiple communities by the Late Bronze Age and be coupled with an increase in mobility. At this point, these specialized mobile communities would acquire agricultural products primarily through exchange with specialized sedentary agricultural communities or by raiding such communities (Barfield 1989, 2002; DiCosmo 1994, 1999).

6.1 ARTIFACTUAL EVIDENCE FOR ECONOMIC ACTIVITIES

6.1.1 Agricultural Tools

Axes, hoes, quernstones and semi-lunar reaping knives are tool types that, when found in greater quantities, are commonly associated with farming during the Early and Late Bronze Age in Northeast Asia (Nelson 2002; Wang 2004, 2007, 2013a). Greater proportions of axes and hoes have been associated with land clearing and the intensification of agriculture in Northeast Asia during the Early Bronze Age (Wang 2013a:92). Four stone axes were recovered from single-component Bronze Age settlements (Table 6.1). All of these are associated with Early Bronze Age settlements from the southern part of the survey zone. Three quernstones were also recovered by the survey teams (Table 6.1). All of these were also found in the southern part of the survey area. One is associated with the Hongshan period, another can be attributed to the

Early Bronze Age and the last quernstone comes from a mixed Early Bronze Age and Liao context.

Ground stone knives or “semi-lunar reaping knives” are commonly associated with the cutting of grains in both Northern China and Korea (Nelson 1993, 2002). Four ground stone knives were found at single-component Bronze Age sites, and three of them were recovered from the southern part of the survey zone. These three agricultural tools are from Early Bronze Age settlements. The final knife was recovered from the northern area and dates to the Late Bronze Age. There is little to no scholarly debate about whether or not ground stone knives are primarily used for the cutting of agricultural grasses, but it should be noted that all four had evidence of plant polish and lacked evidence of chipping or striations. It can be presumed that these would have been used for the cutting of soft plant material such as millet or other grasses. Several others were found in mixed Early Bronze Age and Liao contexts. All of these were found in the southern area (Table 6.1).

Another common tool associated with the cutting of grains during the Neolithic and Bronze Age in Northeast China is the microblade sickle. Unfortunately all of the formal microblades found by the project were either from collections without ceramics or mixed Hongshan and Early Bronze Age contexts. These are found in both the northern and southern areas of the survey zone.

6.1.2 Tools Related to Animal Economies

Evidence of scraping will be examined in detail through use-wear analysis. However, a number of scrapers as a formal tool type were recovered by the project. While only one of these scrapers is from a mixed Early Bronze Age and Liao context, it is useful to note that it was found in northern part of the survey area (Table 6.1).

There are also three spindle whorls which date to the Early Bronze Age. Two of these are from the southern part of the survey area and the other from the northern part. If these tools are related to the production of wool thread then this activity was taking place in both the southern region as well as the north (Table 6.1).

Table 6.1 Formal tool types recovered from Bronze Age settlements

	Axe/ Hoes	Quernstones	Groundstone Knives	Scraper	Spindle Whorls
Early Bronze Age Tools in the North	0	0	0	0	1
Early Bronze Age Tools in the South	4	3	3	0	2
Late Bronze Age Tools in the North	0	0	1	1	0
Late Bronze Age Tools in the South	0	0	0	0	0

6.1.3 Summary

Before examining the microscopic evidence in detail, there already appears to be a variety of activities related to different types subsistence taking place throughout the survey area. Among the axes, hoes, ground stone knives and quernstones, there seems to be a strong trend toward the southern region. This is not without exception, since one ground stone knife was found in the northern region. The evidence from microblades and spindle whorls produce a pattern where both agricultural activities and those more related to the processing of animals are found in both northern and southern contexts. However, it is useful to note that the microblade evidence is from a mixed context. To further investigate any patterning of activities specific to the Bronze Age, use-wear analysis will provide additional evidence.

6.2 USE-WEAR EVIDENCE OF ECONOMIC ACTIVITIES

A total of 39 stone tools had evidence of use-wear were collected from 17 single component Early and Late Bronze Age communities (Table 6.2). 14 of the communities are in the northern area and 3 are in the Southern part of the survey zone (Figures 6.1 and 6.2). 36 tools with 39 instances of use-wear were from Early Bronze Age contexts. Three tools can be associated with Late Bronze Age. With the exception of the ground stone knives, all the tools in this analysis could be defined as expedient tools (Binford 1973) or utilized flakes, and do not fit into formal tool type designations.

Table 6.2 Tools with evidence of Use-wear

	Number of local communities	Number of Tools	Plant	Animal	Other or indeterminate
Large Early Bronze Age settlements in the north	3	17	4	8	5
Medium Early Bronze Age settlements in the north	4	5	3	1	1
Small Early Bronze Age in the north	2	9	1	7	2
Large Early Bronze Age settlements in the south	1	2	2	0	0
Medium Early Bronze Age settlements in the south	1	1	0	1	0
Small Early Bronze Age in the south	1	1	1	0	0
Large Late Bronze Age settlements in the north	1	2	0	2	0
Small Late Bronze Age settlements in the north	1	0	1	0	0

6.2.1 Late Bronze Age Use-wear Evidence from the Northern Part of the Survey

The majority of the stone tools with evidence of use-wear come from the northern area. The degree to which this area was utilized for agricultural production and/or animal husbandry can be assessed by looking at spatial patterning of tools with evidence of wear. The primary types of evidence that address the research question most directly are the cutting of agricultural grasses and scraping hides.

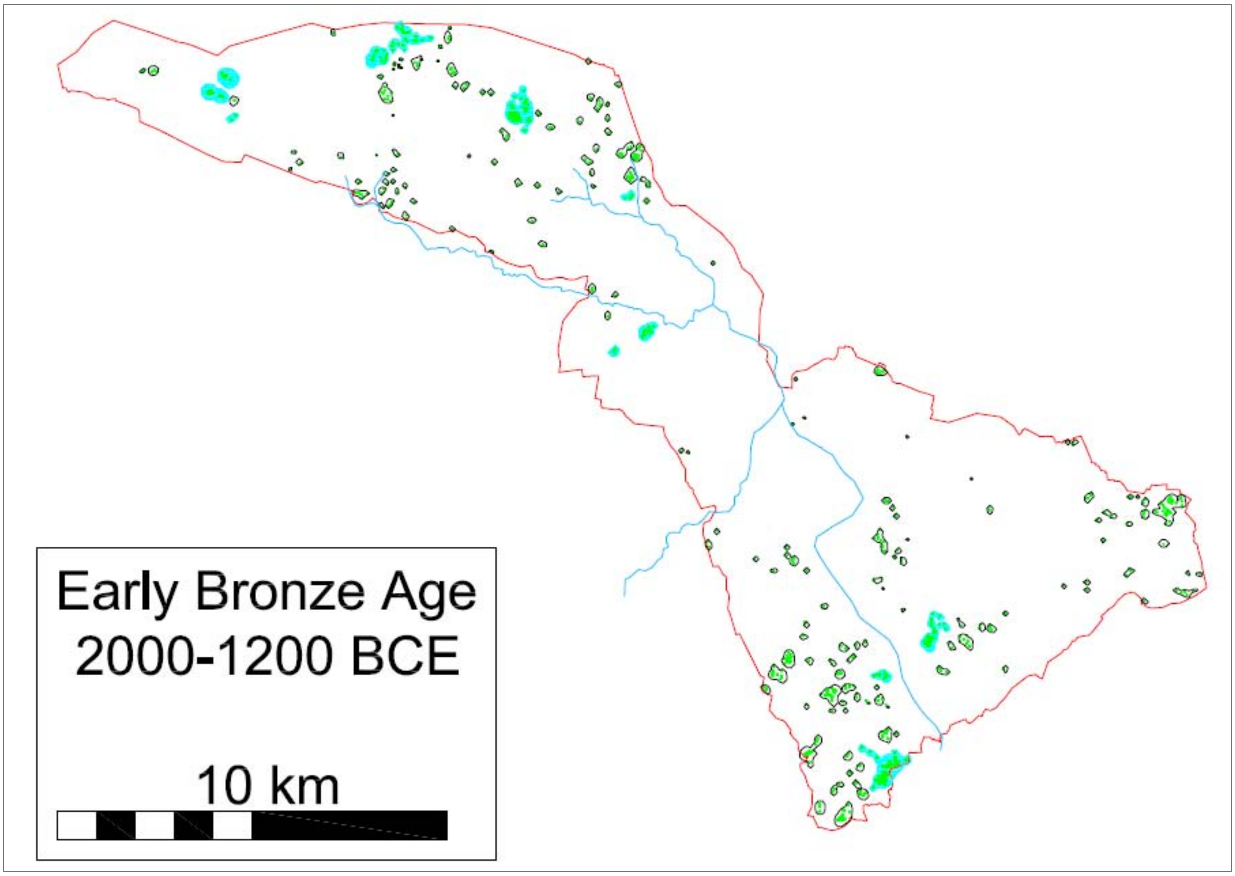

Figure 6.1 Early Bronze Age local community delineation.
Communities with use-wear evidence highlighted.

A number of stone tools with evidence of use-wear were retrieved from two large settlements in the northern section of the survey zone (Table 6.3). Both of these local communities have populations of about 750. In these two communities the evidence of use-wear presents a picture of varied economic practices. Both of these communities have evidence of cutting plant material and scraping hides. The majority of the evidence from the largest communities indicate a high proportions of tools used in processing of animals. An additional settlement with a population of just over 500 people also yielded use-wear evidence indicating cutting bone, which is consistent with the butchery of animals. There is also another tool from this local community whose use-wear indicates drilling or piercing. However, a population of 500 is about eight to ten times larger than most herding communities, making it very unlikely that these communities were made up of mobile herding specialists.

Table 6.3 Early Bronze Age use-wear from large local communities in the northern sub-region

Lithic Type	Collection Unit	Local Community ID	Estimated median local community population	Presumed Use
Primary flake	B599	EBA 1	750	Cutting soft/medium plant material
Primary flake	B586	EBA 1	750	Scraping soft material, hides
Secondary flake	B586	EBA 1	750	Cutting soft plant material
Secondary flake	B586	EBA 1	750	Drilling wood or bone
Secondary flake	B586	EBA 1	750	Cutting soft plant material
Complex flake	B586	EBA 1	750	Scraping soft material, hides
Secondary flake	B573	EBA 1	750	Scraping soft material, hides
*same tool as above	B573	EBA 1	750	Cutting soft material, flesh
Primary flake	B585	EBA 1	750	Scraping soft material, hides
Primary flake	B585	EBA 1	750	Scraping soft material, hides
Primary flake	B585	EBA 1	750	Scraping soft material, hides
*same tool as above	B585	EBA 1	750	Scraping soft material, hides
Secondary flake	B585	EBA 1	750	Scraping soft material, hides
Complex flake	B585	EBA 1	750	Cutting soft plant material
Secondary flake	B556	EBA 1	750	Scraping medium/ hard materials, wood or bone
Secondary flake	B556	EBA 1	750	Scraping soft material, hides
Secondary flake	B598	EBA 1	750	Cutting hard material,hard woods or treated bone
Secondary flake	B364	EBA 2	750	Cutting hard material wood or treated bone
Complex flake	C147	EBA 3	525	Drilling or piercing
Secondary flake	C150	EBA 3	525	Scraping or cutting hard materials, wood or bone

Several medium-sized local communities with populations between 100-200 indicate both the processing of animals and agricultural production (Table 6.4). These tools have evidence of cutting plant material as well as scraping animal hides and butchering animals. In this size range, in some local communities we do not find both tool types within one community. While this could be evidence of local community economic specialization, it is more likely a result of the small sample size.

Table 6.4 Early Bronze Age use-wear evidence from medium sized communities in the northern sub-region

Lithic Type	Collection Unit	Local Community ID	Estimated median local community population	Presumed Use
Primary flake	B472	EBA 4	175	Scraping soft material, hides
Primary flake	D009	EBA 5	135	Cutting soft plant material
*same tool as above	D009	EBA 5	135	Cutting soft plant material
Secondary flake	D009	EBA 5	135	Scraping soft material, hides
Secondary flake	B353	EBA 6	120	Scraping or Whittling medium/hard material
Primary flake	A388	EBA 7	110	Cutting soft plant material

The smallest communities with populations of about five households repeat the pattern of a mixed economy, but again with a trend toward more animal processing in the north (Table 6.5). There is more evidence of scraping animal hides than any other activity. EBA 8 is potentially a community of specialized herders given the high proportion of scraping activities. This type of small specialized community does not characterize the region or the northern sub-region.

Table 6.5 Use-wear evidence from small local communities in the northern sub-region

Lithic Type	Collection Unit	Local Community ID	Estimated median local community population	Presumed Use
Primary flake	B611	EBA 8	30	Cutting soft/medium wood
Secondary flake	B611	EBA 8	30	Scraping soft material, hides
Secondary flake	B611	EBA 8	30	Scraping soft material, hides
Secondary flake	B611	EBA 8	30	Cutting soft material, unclear
Secondary flake	B611	EBA 8	30	Scraping soft material, hides
Secondary flake	B611	EBA 8	30	Scraping soft material, hides
Secondary flake	B611	EBA 8	30	Scraping soft material, hides
Secondary flake	B345	EBA 9	25	Cutting soft plant material
Complex flake	B345	EBA 9	25	Cutting medium/hard material wood, bone

The nature of the economic practices among communities in the north does not seem to be affected by the size of the settlement. One would expect that if there is a trend toward the use of these grasslands for the extensive herding of animals, coupled with an increase in residential mobility, then there would be a tendency to see smaller settlements with greater indications of processing hides and production of fabrics. This does not at all seem to be the case. Animal processing occurred in high proportions at the largest settlements and the smallest. The majority of the tools appear to be related to the processing of animals, but not at the complete exclusion of agriculture.

6.2.2 Early Bronze Age Use-wear Evidence from the Southern Part of the Survey

The largest local community in the region had a population estimated at about 1750. Despite its size it only yielded two artifacts with evidence of use-wear. These two artifacts are both ground stone knives and the use-wear evidence suggests that they were used for the cutting of soft plant material, such as agricultural grasses.

A medium-sized community of about 300 just northwest of the large community produced evidence of scraping animal hides. A much smaller settlement yielded a ground stone knife that has evidence of plant polish on the blade edge.

In the southern area, the tools recovered and the evidence from use-wear suggest perhaps more intensive farming than in the north. Communities in the southern zone are also engaging in domesticated animal economies. Much like what was seen in the northern zone, a tendency towards more animal husbandry in small communities does not seem to be the case. (Table 6.6).

Table 6.6 Early Bronze Age use-wear evidence from southern part of the survey zone

Lithic Type	Collection Unit	Local Community ID	Estimated median local community population	Presumed Use
Ground stone knife	D137	EBA 10	1750	Cutting soft plant material
Ground stone knife	D125	EBA 10	1750	Cutting soft plant material
Complex flake	A058	EBA 11	300	Scraping soft material, hides
Ground stone knife	B020	EBA 12	45	Cutting soft plant material

6.2.3 Use-Wear Evidence from the Late Bronze Age

The Late Bronze Tuchengzi settlement yielded two tools with evidence of use-wear. About three and a half kilometers northwest of this settlement, there is another settlement of about four to five households where the only Late Bronze Age ground stone knife was recovered (Figure 6.2) (Table 6.7).

The tools from the Tuchengzi settlement reveal evidence of cutting medium hard material and also soft/medium materials. The use-wear is indicative of what one might encounter when a cutting knife comes in contact with bone frequently but also used to cut soft tissues (Odell 1980:101). The size and density of the Tuchengzi settlement is too large to be associated with seasonal mobility (see Chapter 5). While the processing of animals is taking place here, the size and scale of the settlement is not consistent with seasonal mobility or the seasonal aggregation, commonly seen with specialized mobile herding.

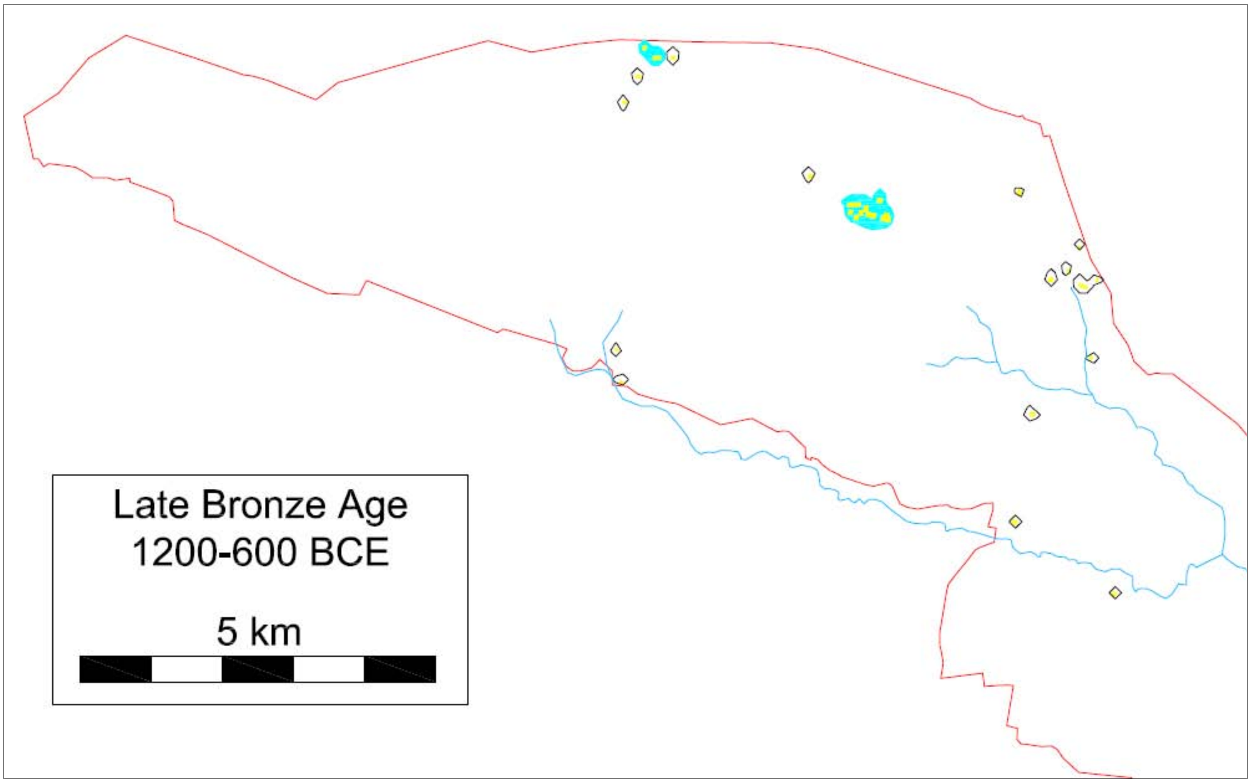

Figure 6.2 Late Bronze Age local community delineation in the northern part of the survey zone. Communities with use-wear evidence highlighted.

Table 6.7 Late Bronze Age use-wear evidence form the northern part of the survey zone.

Lithic Type	Collection Unit	Local Community ID	Estimated median local community population	Presumed Use
Secondary flake	B595	LBA 1 (Tuchengzi)	450	Cutting medium/hard material (Butchery)
Complex flake	B595	LBA 1 (Tuchengzi)	450	Cutting soft/medium material (Hides)
Ground stone knife	A383	LBA 2	25	Cutting soft plant material

The sample sizes of stone tools for Early Bronze Age allow us to recognize with moderate statistical confidence (between 80 and 95%) that the differences we see in the proportions between the northern and southern regions are real (Figure 6.3). This, in concert with the distribution of tools without use-wear, add credence to the differences between the north and south (Table 6.8). However, the sample size for the Late Bronze Age makes it difficult to say with statistical confidence that the use-wear patterns we observe are not just due to the vagaries of sampling. It is certain that both the processing of animals and plants are taking place in the northern zone during the Late Bronze Age. It is difficult to say, however, if this is at the same or similar proportions we saw in the Early Bronze Age.

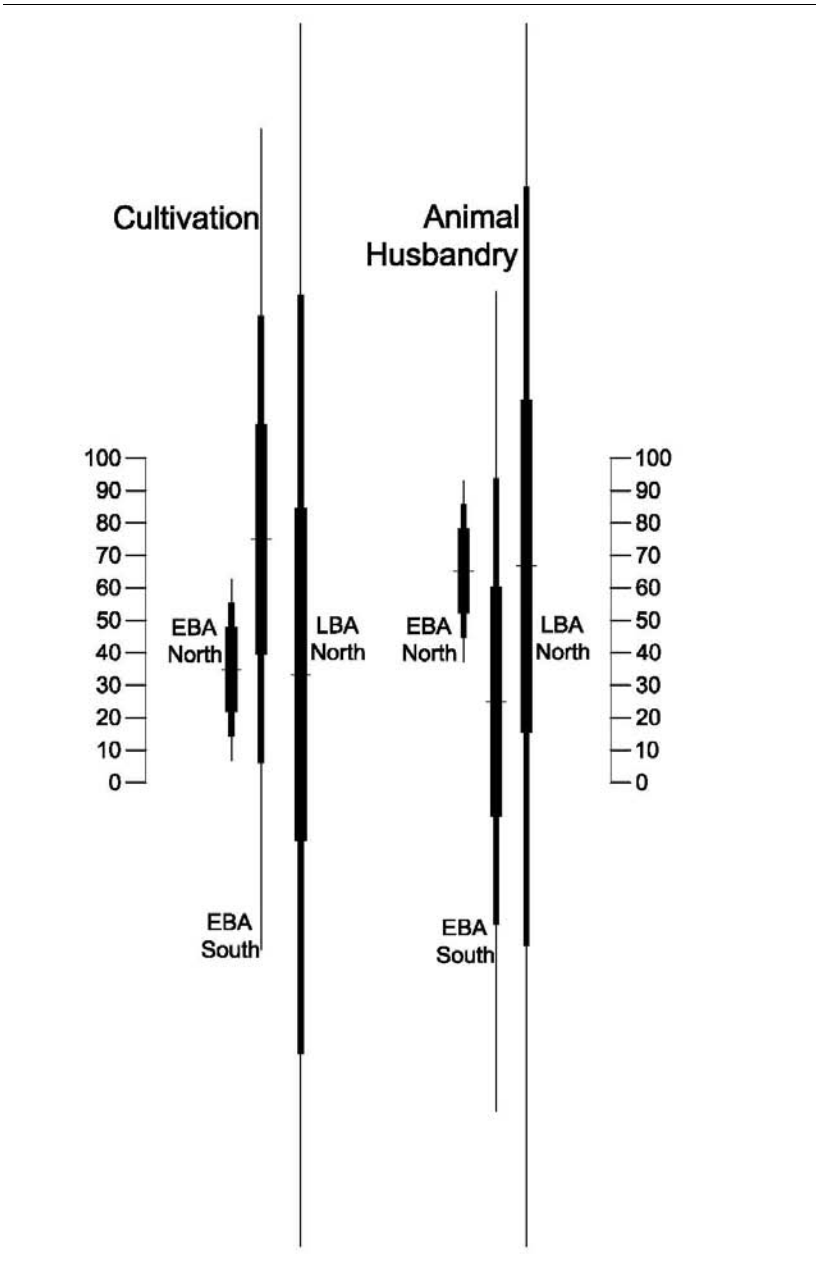

Figure 6.3 The proportions of tools related to cultivation and animal husbandry with confidence bars at 80, 95 and 99%

Table 6.8 Proportions of tools associated with cultivation and animal husbandry.

	# tools	plant	animal	total
Early Bronze Age settlements in the north	23	35% (8)	65% (15)	100%
Early Bronze Age settlements in the south	4	75% (3)	25% (1)	100%
Early Bronze Age total	27	41% (11)	59% (16)	100%
Late Bronze Age settlements in the north	3	33% (1)	67% (2)	100%
Late Bronze Age settlements in the south	0	0	0	0
Late Bronze Age total	3	33% (1)	67% (2)	100%

6.3 ECONOMIC ACTIVITIES AND DISTRIBUTION

There does not appear to be an area or period during the Bronze Age in Zhangwu when agriculture completely disappeared from the range of economic activities. It is clear that mobile herding never completely replaced sedentary agriculture in this region (or the northern and southern sub-regions). However, during the Bronze Age, especially the Early Bronze Age, there may be a pattern which suggests a differential use of the landscape.

In both the northern and southern parts of the survey area, there is evidence for mixed economies. The balance of that mixture varies between the north and south. In the northern zone there is a relatively greater emphasis on animal processing. What we find in the southern part of the survey area are communities that appear relatively more engaged in agricultural activities. It is premature to say if either or any of these activities were more intense (Costin 1991) than others, but not knowing this opens the door for exciting and interesting future research detailed in Chapter 7. That being said, in either of the two areas we do not see the degree of specialization that might suggest a *compulsory* complementarity relationship between groups of local communities suggested by many scholars (Barfield 2001, Irons 1979, Jagchild and Symons 1989, Kazanov 1994). In many cases, it seems that agricultural goods or animal products could be obtained within one's own local community. If agricultural goods or animal products could not be obtained from one's immediate neighbors, they could certainly be acquired from within the sub-regional environmental zone.

Again, the evidence points to a mixed subsistence economy that relies on both domesticated plants and animals. The relative degrees of these economies are a natural result of the sub-regional environmental conditions. In the Early Bronze Age, both regions would have been suitable for farming, although conditions in the southern region make it slightly more favorable. The northern zone would have been birch forest-steppe giving way to heavier birch and oak forest in the south. The topography and higher quality soils in the south would have made this area more attractive to farming (see Chapters 3 and 5). In an economy where dry farming is the main form of subsistence (Zhao 2011:34), the southern region of the survey area is especially attractive during the wetter Early Bronze. The hilly topography would also allow for upland farming during periods of lowland flooding. The flat topography of northern region is less attractive for this same reason. It is, however, ideal conditions for relatively greater numbers of animals. The high groundwater table in the north (Zheng et al. 2012) would cause small springs to appear on the landscape during periods of heavy rainfall. These temporary oases would be a boon to grazing animals and their caretakers.

The type of animal care that is consistent with the settlement evidence is one that the herding of animals would take place during the day or over a few days at distances of a few kilometers. However, the residential patterns are of these herders would be sedentary. This is especially consistent with patterns in the Early Bronze Age where regional population densities are 10 times the highest estimates for mobile societies. In ethnographic examples of this type of animal husbandry and settlement pattern, it is common that children do the majority of herding (Fratkin 1989:434; Tenenbaum et al. 2004). This allows adults to carry out farming activities in proximity to villages and farmsteads.

Faunal evidence from Chifeng indicates that pigs are the most common species therefore the possibility exists that the economy in Zhangwu is a mix of raising pigs and farming millet similar to Chifeng. Classic herd animals may have been a very minor component in the Bronze Age economy. Although there are exceptions (Kohl 2009:97), raising pigs is an activity generally not found in societies with high degrees of residential mobility. Sedentary millet farming and pig raising would be consistent with population densities and the use-wear from both the Early and Late Bronze Age period.

The agricultural product that is by far the most common in Northeast China during the Bronze Age is foxtail millet (Zhao 2011). The use-wear is consistent with this as the main agricultural product, but other types of grasses are, of course, a possibility. If the main crop is foxtail millet, then the short growing season would allow additional resources to be put into the care of animals during the off season.

There is a certain amount of economic resilience during the Bronze Age in the face of changing climatic conditions. Population is certainly affected by the declining agricultural productivity in the region but climate does not appear to affect the nature of economic practice.

However, the sub-regional environmental conditions clearly affect the nature of the economic actives of local communities as early as the Early Bronze Age. By the Late Bronze Age there does not appear to be an increase in extensive herding economies that would result in increased residential mobility. What the evidence suggests is a persistent pattern of plant cultivation and animal husbandry that changes relative intensity based on the local environmental conditions.

7.0 CONCLUSIONS

Prior to this research, there was clear evidence for large agrarian settlements during both the Early and Late Bronze Age in the Chifeng region (Chifeng 2011b, see Chapter 1). In contrast to this, a number of scholars characterize the Bronze Age as the period when the transition to specialized mobile herding took place and went on to be the predominant form of habitation and subsistence economy by the Late Bronze Age (Di Cosmo 1999, 2002; Liu and Chen 2012:297-349; Shelach 1999, 2009a). Specifically, most scholars point to textual interpretation and the proliferation of Northern Style Bronzes at about 1200 BCE as promising evidence of such a transition. This dissertation set out to investigate Bronze Age habitation patterns and subsistence economy in a region where the environmental conditions might be conducive to the transition of early mobile herders from sedentary agriculturalists.

Chapter 3 demonstrates that throughout much of prehistory, the southern sub-region has always been more agriculturally productive than the northern sub-region. Therefore the evidence that would best indicate the proposed economic transition would be the appearance of small settlements dispersed throughout the northern area especially during the Late Bronze Age. The location of these settlements would be situated on or in proximity to productive pastures. Furthermore, these settlements would produce use-wear evidence to indicate the processing of animals in greater proportions than the communities in the southern sub-region.

This concluding chapter opens by recapping and elaborating what the data from Zhangwu suggests about Bronze Age subsistence and mobility from Chapters 5 and 6. This chapter will go on to explain how, even when the Late Bronze Age settlement density appears to correspond to small camps left by mobile herders, the locational evidence suggests otherwise. It then goes on to explain some of the implications of this for both models developed in East Asia (Barfield 1981, 1989; DiCosmo 1994, 1999, 2002; Linduff 1995, 1997; Shelach 1999; Xu et al. 2002) as well as other Old World regions (Anthony 2007; Heibert 1994; Irons 1974; Khazanov 1994; Kohl 2002, 2007; Kradin 2002; Shishlina and Heibert 1998). The results of this research, like the Chifeng region, deviate from theoretical expectations about the Bronze Age emergence of specialized mobile herding (Chifeng 2011b:130). There may be regions where the emergence of specialized mobile herding occurs in proximity to large established settlements in Northeast China, but it is very likely that these areas are even further north of the survey zone, further from the regions which where millet agriculture is a viable economy. Zhangwu county is the least agriculturally productive region in Liaoning. In order to pursue theories predicated on the exploitation of marginal farmland one must explore regions in Northeast China outside of Liaoning and southeastern Inner Mongolia. This takes pursuing this research agenda out of the regions where Upper Xiajiadian and Upper Xinle ceramics and many Northern Style Bronzes have been found. It also pushes the prospect of early herders even further from the Great Wall region and further still from the large polities in the Central Plains. That being said, Zhangwu, Chifeng as well as other parts of Northeast China remain fertile ground for research into prehistoric subsistence economy.

7.1 BRONZE AGE SETTLEMENT PATTERNING AND SUBSISTENCE ECONOMY

As discussed in Chapter 6, the evidence from this dissertation points toward mixed economies in Zhangwu throughout the Bronze Age. The high population densities during the Early Bronze Age may in fact require economic diversification in order to sustain itself (Halstead and O'Shea 1989). The evidence of use-wear indicating butchery and hide processing within the same communities where agricultural tools were recovered certainly speak to a mixed economy. There may be very salient reasons why diversification appears to be the strategy rather than intensification (Cowgill 1975). The investment in public works to intensify agricultural production is an alternative option given the high population density (Boserup 1965). However, the social organizational apparatus may not have been as strong as in Chifeng which might account for lower levels of local community integration (see Chapter 5) and the lack of large-scale building projects (Shelach 1999, 2009b). Organizing a workforce to carry out such projects may have been more difficult. At a smaller scale and perhaps more importantly, the investment required by households to meet the needs of the Early Bronze Age population through intensification may have been too great to yield positive returns given Zhangwu's agricultural marginality. In other words, in Zhangwu intensification is a high investment, combined with the high risk of a monocropping strategy, without a positive enough return. Economic diversification therefore becomes a viable option and appears to at least be part of the strategy.

The lower regional population during the Late Bronze Age could have been maintained through a number of pursuits, but the evidence points toward the persistence of the same type of mixed economy despite differences from the Early Bronze Age in the sizes of communities. During this period, forty percent of the regional population is made up of small local communities that would appear to be consistent with specialized mobile herding but it is the residents of these same small settlements that seem to prefer locations on better farmland and closer to stable sources of water. The only agricultural tool recovered from a Late Bronze Age context is also from one of these small communities. There is also some evidence pointing to similarities in the location of settlement from the Early to Late Bronze Age despite a drop in the regional population from about 7500 to 790. This moderate correlation between Early and Late Bronze Age settlement location provides more evidence that there are similarities in the subsistence economy when comparing the Early and Late Bronze Age. All of this evidence leads to the conclusion that, despite the relative small size and low density of settlement, due to the locations of settlement, agriculture played an important role in the Late Bronze Age economy but, like the Early Bronze Age, animals are at least contributing to the economy, if not a major part of it. Finally, small dispersed settlement is not the only form of habitation during the Late Bronze Age.

During the Late Bronze Age there is evidence for one large settlement in the Northern sub-region near the modern village of Tuchengzi. The Tuchengzi settlement may have served a number of functions which could be informed from future excavation discussed in section 7.6.1. Based on the regional survey, we know that the settlement contained the majority of the regional population and the processing of animals were taking place there. However, it is much larger than ethnographic examples of herding aggregation sites. The populations at these sites are usually about 1/10th the size of Tuchengzi (Mearns 1993, 1996).

The location of the settlement in the less productive region of the survey area poses problems to many of the theories regarding the emergence or adoption of specialized mobile herding. Many of these theories propose that it is an initial exploitation of marginal regions caused by environmental pressures that led to the greater use of animals which would better exploit those regions (Shelach 1999). If that is the case, we would expect to see Tuchengzi in the southern part of the survey area with smaller settlements budding off from it in the northern region. However, the evidence does not conform to these exceptions.

7.2 WHERE ARE THE SPECIALIZED MOBILE HERDERS?

Khazanov (1994) describes the "complete absence of agriculture" occurring in Central Asia around the seventh century BCE. Frachetti (2008:19) describes such communities as early as 3500 BCE. In Northeast China, it is convention to see a similar economy occurring around 1200 BCE (Di Cosmo 2002; Shelach 1999). In Zhangwu, a wholesale adoption of an economy based domestic animal economies during the Bronze Age would not be an accurate interpretation of the evidence. Even though higher proportions of tools related to butchery and hide processing indicate animals may have been a major element in the economy of Bronze Age Zhangwu, "pure pastoralism" (Khazanov 1994) does not appear to characterize the region or the northern sub-region. During the Early Bronze Age animals seem to be a more important part of the economy in the northern sub-region when compared to the south. However, dense settlement with populations in the hundreds or thousands is not at all consistent with dispersed mobile herders or "pure pastoralists".

There are demographic shifts throughout prehistory indicated through the size and density of settlements. Regional population does fall from the Early to Late Bronze Age and it continued to fall through the Iron Age. However, during the Late Bronze Age, much of the population are still living in a substantial settlement of hundreds of individuals. It is not until the

Iron Age that the regional settlement pattern resembles the small local communities and slightly larger sites that are consistent with mobile camps and winter aggregation settlements characteristic of specialized mobile herders.

Other scholars might make an argument that the low population density found in the Iron Age is promising evidence of specialized mobile herding. The correspondence between the archaeological evidence and contemporaneously written history is a task better suited for scholars with the specialized training required for reading and interpreting ancient texts. That being said, even in a less in-depth reading the texts, it is apparent the evidence for Iron Age mobile herding is much clearer and nearly ethnographic in the case of the Xiongnu (Chin 2012). Even though study of the Iron Age benefits from such in depth textual detail, the archaeological evidence from this project may play an important role in the task of understanding and interpreting of the texts. The archaeological evidence suggests that in this particular region, just north of the Yan and Han territory, the environment is slightly drier than the previous period and population density is only a few people per square kilometer. The armies and polities that the texts describe were clearly not residing in this region in any major capacity. The low level of occupation could likely be a buffer zone between polities (Cook 1973; Furguson and Whitehead 1999:27; Turner 1985). A no-man's-land north of the territory controlled by the Yan is not described explicitly in the classical texts but might well be a real dimension to explore. The population that is living in this region may very well be the type of specialized mobile herders many scholars envision, but this should not be news to anyone. However, one should be cautious about conflating dispersed settlement with mobile habitation patterns since the Iron Age settlement patterns would also be consistent with dispersed farmsteads.

7.2.1 Northern Style Bronzes and the Interaction Between North and South

As introduced in Chapters 1 and 2, much of the evidence for the Late Bronze Age emergence of specialized mobile herding has its foundations in history. A good deal of what has been written during the Iron Age about the Shang and Zhou polities has been reinforced through material culture, either in the form of inscriptions or the locations of sites (Li 2006). What is not been reinforced through this research in particular is the Bronze Age emergence of specialized mobile herding.

One of the major contributing factors which led scholars to suggest the emergence of mobile herding at he onset of the Late Bronze Age is the proliferation of Northern Style Bronzes. It is becoming clearer that this proliferation might well relate to the signaling of identity (Shelach 2009a) rather than anything which relates concretely to subsistence economies. The proliferation of Northern Style Bronzes roughly corresponds to some of the earliest mentions of barbarians (Yi) in conflict with named kings and polities, though there is very little historical mention of the barbarian economy prior to the Iron Age. It is assumed to be reliant on animals because of either a Confucian worldview, in the case of Sima Qian, or the influence of Marxist culture history and social evolution (Chang 1981), combined with Sima Qian's bias. According to Confucian thinking, pastoralism is uncivilized therefore barbarians must be pastoralists. This also fits into the Marxist thinking adopted by culture historians, where pastoralism precedes rudimentary forms of social organization (Cribb 1991). A more literal reading of the transmitted texts without a Confucian or Marxist projection into prehistory may in fact be a useful for understanding some of the historical material. The texts describe the people like the Yi, Hu and Rong as simply different. This difference in perceived identity is exactly what they may have been signaling through the proliferation of Northern Style Bronze. The solidarity formed by communities outside of early dynastic influence could have had little impact on the demographic or social organization. Ideational communities of this kind do not necessarily correspond to an economic or political community (Isbell 2000). In Northeast China both the results of the Chifeng region and this research demonstrate Bronze Age polities, interpreted through demographic reconstruction, are much smaller than an ideational community demonstrated through the proliferation of Northern Style Bronzes. It can also be argued that there is also a diversity of economic practices which correspond to the region where Northern Style Bronzes have been found. This region is ecologically diverse and the economic diversity may be just as marked.

Finally, returning to the research questions outlined in Chapter 1: Did some form of Khazanov's (1994) Frachetti's (2008) or Di Cosmo's (2002) "pure pastoralism" occur during the Bronze Age in Zhangwu? If so, does the evidence suggest economic complementarity between farmers and herders? At this point, it appears that Bronze Age symbols or identities of *Other* people are not reflected in subsistence pursuits. In other words, the size and density of settlements, the locations of settlements and the use-wear evidence are not consistent with a region populated by specialized mobile herders. Communities in the locations described in the previous section is more consistent with communities that divide their time between herding and farming. If this is the case, it is difficult to conclude that the interaction between farmers and herders is the force behind increasingly complex societies in Northeastern China. Because of the mixed economies that a number of communities practiced, exchange of goods between the northern and southern communities would not have been compulsory to obtain different subsistence products. Furthermore, despite the differences in the intensity of economic activities, the distribution of communities does not indicate conspicuous differences in patterns of habitation. Throughout the Bronze Age large settlements of hundreds of people occupy the northern sub-region. These are not dispersed camps left by mobile herders. If the interaction between between farmers and herders was the catalyst for the development of large states (Linduff 1995, 1997; Shelach 1999), it was at a scale beyond the ability for this study to detect. In other words, during the Shang and Zhou periods, if larger states were exchanging staples and domestic animals it may not have had an impact on the livelihoods of the people living in Northeast China. Therefore, it would difficult to detect through the survey and artifact analysis used in this study. The Shang and Zhou nobility may have been preoccupied with how to effectively deal with the *Outsiders,* but the dichotomy they saw (or later documented as seeing) is not reflected in the subsistence pursuits of the communities and small polities found in Zhangwu. This preoccupation with the *Others* and its reinforcement through Confucian philosophy may have contributed to legitimizing the actions of the state (Said 1978), even if the construction of the *Other* has little foundation in reality.

7.3 RISKY BUSINESS

In Zhangwu, subsistence economy is closely tied to the sub-regional environmental conditions. During the Early Bronze Age, greater proportions of butchery and hide processing use-wear were found in the northern sub-region although agriculture is by no means absent. The same could be said for the southern sub-region. The relative intensity seems to have shifted based on the context. This is a phenomenon that could be observed throughout many regions. In very general terms, human societies carry out subsistence economies that best mitigate the challenges of an environment. This has been discussed in terms of risk minimization and is the foundation for the logic behind Lees and Bates (1974) model. They propose that to minimize regional risk communities of farmers and herders intensified production of their respective economies and exchanged products. This led to larger farming communities and the dispersal of herding communities into more marginal areas to facilitate larger herds, ultimately leading to specialized mobile herders.

Population dispersal and nucleation are both mechanisms by which communities can minimize risk. Population dispersal in the form of mobile habitation patterns, like other forms of population dispersal, is a means of minimizing risk by generating surplus (Lees and Bates 1974). Mobile herding allows for larger herd sizes to be sustainable thereby generating more surplus. Settlement nucleation is also a means of minimizing risk through sharing and exchange. The opportunities for sharing and exchange increase when households form close knit communities. The push and pull of these two factors are some of the logic behind discussions of population stress (Bandy 2004; Carnerio 1970). They propose that human communities must find a balance in terms of size (nucleation), otherwise settlements will fission out of economic necessity unless there is a social mechanism to dissuade this.

During the Late Bronze Age, in Zhangwu, about 60% of the population opted to nucleate in a large settlement. Rather than a single major shift in habitation patterns, human communities responded to Late Bronze Age conditions with three strategies: in order of magnitude, they left the region, nucleated in a large settlement and about 300 individuals remained dispersed across the landscape.

If the conventional narrative (see Chapter 2) or the theories based on Lees and Bates' (1974) logic are to be validated with settlement data, we would want at some point during the Bronze Age to see small settlements with hide processing and butchery tools, indicative of herding camps, occupying the northern sub-region and larger farming communities occupying the south. Although there are greater numbers of farming tools in the south, it is not commensurate with differences in the settlement patterning. The Early Bronze Age population of local communities reaches up to the thousands in both the north and the south, and the high population density is nearly identical despite differences in the evidence from use-wear analysis.

During the Late Bronze Age, there are differences in the forms of settlement between the north and the south, but the large settlement we would expect to find on prime farmland is located on the boundary between pasture and moderately good farmland. The tools from this community indicate butchery was taking place there. Diversification to mitigate risk rather than specialization might be a better way to understand the evidence from both the Early and Late Bronze Age.

The risks that coincide with high population density may have been buffered with economic diversification (Halstead and O'Shea 1989). Even if the regional population could have been supported with only millet farming, herding or keeping animals (classic herd animals or other domesticates) may have been a way to supplement the economy between growing seasons. As Early Bronze Age population rose, incorporating more animals into the economic portfolio mitigates the risk of monocropping. The differences between the two sub-regions are an attempt to make those economies as strong as possible given the environmental context of the local community. By the Late Bronze Age both agricultural and animal husbandry tools indicate there may be a persistence of the Early Bronze Age mixed economy. If drying conditions affected Late Bronze Age economy in any way, there is evidence that the agricultural component may have more of a role in determining settlement location than the herding component. Seeking out productive farmland is certainly not the only factor in determining settlement location during the Late Bronze Age since most of the population is settled in the north.

Understanding that the adoption of animal economies can be subtle as communities hedge the uncertainties of food production underscores a few points. The pace of economic change may be very different based on the context. If the texts are accurate, then it means in Zhangwu specialized mobile herding was an Iron Age phenomenon and the emergence of the Xiongnu polity in this region was built on antecedents which cannot be described as mobile herding economies. Alternatively, the pace of economic change was very quick as the influence of the Xiongnu polity moved into the region. As large polities emerged in Mongolia they would have had to contend with and incorporate a mosaic of economies commensurate with the environmental mosaic that characterizes the steppe belt. The subtle emphasis of animal economies also challenges the notion that herders or "impoverished cowboys" became stuck in an economy based on animals and unable to return to farming (Kohl 2002:175). The more tentative forays into a greater reliance on animals suggest that communities were able to adapt to changing conditions without radically altering subsistence practices. Testing the water might be a better analogy than "crossing the bridge" (Kohl 2002) into new economies.

7.4 HERDING AND HERDERS, FARMING AND FARMERS

In Zhangwu, the evidence clearly indicates that both farming and herding are part of the local community economy during the Bronze Age. However, to categorize all of these communities as agropastoralist (which they no doubt were *sensu stricto*) fails to do justice to the variation. Yet the form of specialization which has been theorized (cf. Kazanov 1994) seems an inappropriate reconstruction of the data.

In response to Khazanov's notion of pure pastoralism Roger Crib rightly points out that:

> Nomadic pastoralism is a dual concept comprising two logically independent dimensions - nomadism and pastoralism. Within each of these dimensions dualisms such as nomadic/sedentary, agricultural/pastoral, the desert and the sown, perpetrate gross distortions of our ability to understand the relationship between the two. Each dimension may be viewed as a continuum, …(Cribb 1991:16)

Recognizing this continuum does not eradicate the notion that communities exist which are seasonally or sub-seasonally residentially mobile and the foundation of their subsistence economy is herd animals (mobile herders). By the same token Cribb allows the possibility for other end of the continuum, specialized communities who are residentially sedentary for many generations and derive most of their subsistence from domesticated plants. Finally, he implicitly endorses the notion that the relationship between these two extremes is something to be better understood. Unfortunately, while moving beyond dichotomies is quite fashionable and Cribb provides ethnographic examples of the muddle in the middle, little has been done to move beyond three gross categories of mobile herder, sedentary farmer and mixed. Furthermore, closer examination of mixed economies allow us to parse out the activity of herding (which can be done by farmers) from the concept of herding communities: pastoralists, nomads or herders.

7.4.1 Economic Diversity Among Eurasian "Pastoralists"

Methods and theories which allow us to move beyond simply detecting the presence or absence of herders, farmers or the catch-all "agropastoralist" will serve to elucidate the diversity of economic practice among Bronze Age communities across the Eurasian Steppe. Recognizing that many (perhaps all) economies are mixtures of domesticated plants and animals (not to mention wild resources) is the first step in understanding the extremes of this continuum. The next step is the quantification of different elements of economic practice. Finally, how does that practice or practices relate to local environments which have been over simplified as forest, steppe and forest-steppe.

Exploring subsistence economics through the quantification of different elements will allow for the existing theories predicated on the interaction between herders and farmers to be tested because it holds the logical possibility of their validity, no matter how dichotomous they appear. It also holds true the notion that there are variables which may be related to form diverse economic and habitation patterns. For example, subsistence economy and forms of habitation are distinct elements but almost certainly correlated. Determining which elements are related in what ways helps to dissolve both the notions that each case is unique or all cases are agropastoralist. Both of these conclusions are equally unproductive in pursuing the diversity of economic practice across the Eurasian steppe. Moving forward, two questions emerge. What are the circumstances (political, social, environmental) under which communities adopt certain forms of subsistence? Which leads to: what patterns can be detected in the diverse economic practices of Northeast China and the Eurasian Steppe?

The notion that economic practice is diverse across the Eurasian steppe has been taken up by recently by Bendrey (2011) who critiqued the notion of a homogenous steppe. Unfortunately, the discussion is only limited to herd composition. The study is still at a scale which characterizes large areas (entire counties) as single units. Furthermore, there is no discussion on the incorporation of domesticated plants. As a result, the steppe is still understood as dominated by herders (eight types of herders). The study does, however, underscore the diversity of steppe environments and their economic implications. I would argue that there is even more environmental diversity to be detected at even smaller scales.

Spengler (2013) has recently investigated a much smaller region and argues for diverse economic practices in eastern Kazakhstan. Based on the distribution of different types of domesticated and wild paleobotanical remains, Spengler makes the argument that there is a great deal of the diversity among pastoral communities and how they incorporated domesticated crops into their economy. A similar argument has been made for northern Mongolia (Honeychurch and Amartushin 2007) stating that by the Xiongnu period (~200 BCE to ~200 CE) the local subsistence economy was a mix between herding and farming.

Frachetti (2012) posits that institutions (political, economic, trade/exchange and ideological) link communities together across a large region. He argues that the residential mobility helps to facilitate connections across large regions. But these connections and communities are not homogenous or “uniform”. This provides Spengler with the theoretical framework to connect the communities in his study. The results of this dissertation would also certainly fit into the theoretical framework Frachetti (2012) has presented. It has the benefit of providing a framework for understanding the rise of social complexity in the steppe without relying on binary Lattimoreist concepts. This theory, however, still leaves us short of understanding how these communities are linked via these institutions. It is clear that the simplistic traditional concept of an undifferentiated pastoral "lifeway" does not unite this vast region into a single homogeneous cultural traditional or social pattern. This realization frees us to examine community economy in terms of its components and intensity-certainly some examples of which may be fairly characterized as “pastoral”. However, framing the discussion in terms of Bronze Age economic diversity rather than Bronze Age pastoralism provides the space for the examination of variability while still recognizing that there are that there are circumstances in which specialized herding is the most viable form of subsistence economy and mobility characterizes the settlement system.

There is still a lot of territory between sites across the vast Eurasian Steppe. This research has demonstrated that in a region where there were only four Bronze Age sites previously recorded hundreds of settlements exist and there is quite a lot of diversity in settlement and economy among them. Better understandings of what exactly the economies were like in Bronze Age steppe communities (Spengler 2013) is certainly a direction of future research, but also filling in those blank areas between known sites with full coverage regional survey data is equally important.

7.5 GAPS IN OUR KNOWLEDGE

This survey was designed to investigate the regional patterns of Bronze Age communities. The use-wear analysis was designed to supplement the settlement data. Even though these two lines of evidence provide a solid base on which to build an interpretation of Bronze Age economic and habitation patterns there is still more information one can gather to create an even more precise picture. Much of this evidence would further break down the idea that a single way of life dominated the steppe at any period in time.

7.5.1 Absolute Measures of Economic Intensity

During the Early Bronze Age we can be fairly confident that the sub-regional environmental conditions result in differences in the nature of local community subsistence economies. Whether or not any of these communities were more reliant on domesticated animals or agricultural products can only be measured in relative terms. The differences between the northern and southern communities could result from communities devoting most of their time and effort towards the production of millet and occasionally herding and processing animals. The time and effort devoted to animals is slightly greater in northern sub-region but still may not be the predominant economy. By the same token, this could also be a situation where domesticated animals provide the majority of subsistence in both regions and agricultural products supplement the diet, again slightly more in the south, although, given the size and density of settlement, the former is more likely than the latter during at least the Early Bronze Age.

7.5.2 The Relative Importance of Different Species of Domesticated Animals

Throughout this dissertation I have discussed the animal economies in terms of classic herding animals (sheep, goats and cows). The evidence for scraping could also result from the processing of other animals. Pigs, for example, were the main domesticate excavated at Bronze Age sites in the Chifeng region (Chifeng 2011b). In contrast, the site of Jingouzi, about 100 kilometers north of Chifeng, yielded no pigs in the faunal assemblage of Late Bronze Age strata. The carbon to nitrogen bone isotope ratios from burials at Jingouzi also point to a subsistence economy based in domestic grazing animals (Wang 2011). Given the lack of pig bones this is taken as evidence of a community relying primarily on horses, cows and sheep (Chen 2007).

Excavation is the most direct way to address the composition of the domesticated species. The survey has located a number of settlements where excavation focused on identifying the proportions of different animal species could be carried out. These settlements vary in size and density of material and could provide valuable evidence of subsistence activities.

7.6 FILLING THE GAPS AND OTHER POSSIBILITIES FOR FUTURE RESEARCH

In the Chifeng region very little of the settlement pattern and evidence of subsistence resembles the remains of specialized herders. Zhangwu presents promising locations for studying communities which may be engaged in a variety subsistence pursuits. The contrasts between these communities as well as other well documented communities, like those found in Chifeng, will begin to unpack the diversity of economic practices in Northeast China.

7.6.1 Excavation and Use-wear

The excavation of Bronze Age settlements yields a quality of data that cannot be obtained through surface survey. The quantification of faunal material from domestic contexts would address the issue posed in section 7.5.2. Just what animals were being processed at the Bronze Age sites in Zhangwu? The survey revealed communities of various sizes and investigating those different types of settlements through excavation would yield interesting results. Moreover, the excavation of small sites is often overlooked in favor of more impressive (larger) settlements. There are a number of well documented excavations from large Bronze Age settlements but there is a lack of excavations from smaller settlements. Excavation of these smaller settlements will no doubt yield productive data to compare to larger sites. However, excavation of the 20 hectare Tuchengzi site will reveal with greater clarity how animal economies were incorporated within this large local community.

In addition to excavation of Bronze Age settlements in Zhangwu, one might also want to pursue studying the use-wear on the stone tools from Chifeng. We can be very confident that the economic base of communities in Chifeng is agrarian throughout the Bronze Age. It is also far from being completely devoid of animals. Therefore, if one was to measure the proportions of use-wear from the agrarian contexts in Chifeng this would establish a baseline against which one could measure the Zhangwu material. Similar projects could be undertaken at sites like Jinggouzi, where there is very little evidence for agriculture (Wang 2011). Knowing the ratios of different use-wear evidence from these projects and others would begin to establish standards which one could use for comparison. These standards are the final piece of the puzzle to connect proportions of tools to the intensity of an economic practice, in this case, the the degree of specialization in either herding or farming activities.

7.6.2 Methodological Potential for Studying Human Environment Relationships

Standard pedestrian survey methods have been shown (again) to be an efficient means to recover the material remains of small ephemeral settlements. The future, therefore, may be more focused in how to best analyze the settlement patterns they form. The similarities and dissimilarities between different patterns of settlement could lead to new ways of understanding the numerous changes of the human past which manifest themselves in the form of human habitation patterns. The prospect of finding more correlations through the regression analysis described in Chapter 4 will allow for more refined testing of human environment relationships.

As I mentioned in Chapter 4, using masks to filter data is one way to begin to understand the information which might be missed by a survey archaeologist. It will only serve to improve the quality of data and the testing of our models. Modern villages may obscure some of the archaeological remains and treating those areas as missing data more effectively could help to predict what remains are being missed. Mathematical filters and masks which convert the LandSAT wavelengths of modern structures and standing water into proxies of the prehistoric environment, for example, would allow for a higher resolution study of human environment relationships.

Models of human environment relationships can be tested with a quality of data that was not available 5 or 10 years ago. In the 1940s, when Lattimore conceived of an environmental divide corresponding to a demographic divide in China the subject of ecology was in its infancy and archaeology was just coming of age. We are now at a point where the quality of regional environmental data out-paces our understanding of ancient human societies in those regions. The known complexity of an ecosystem must be coupled with better and more accurate understanding of human societies. In concrete terms, this means more accurate measures of demography, settlement patterning and their relationship to the environment.

We are also at a point where thousands of small ephemeral (as well as large dense) settlements have been documented for the Bronze Age in a number of environments across North Asia. If one understands which environmental variables are important to human patterning can allow us to understand huge swaths of territory which are presumed to be occupied by specialized mobile herders. For example, NDVI data was very useful in delimiting the northern and southern sub-zones but using this data to find correlations with settlement was less productive. The soil typologies produced better results in that regard.

One of the biggest challenges to documenting the settlement pattern of mobile people is dealing with a pattern of habitation which may be much larger than the average regional archaeological survey. Some forms of seasonal transhumance may encompass a pattern of more than 100 kilometers in diameter (Humphrey and Sneath 1999:253). This would mean a survey of about 7800 square kilometers. Some of the variables and correlations found in this study are promising first steps to building our understanding about the environmental variables that correlate to human settlement patterns. Better ways of predicting and understanding the patterns of small ephemeral sites could lead to less full-coverage for a very large region and appropriate sampling strategies.

7.6.3 Regional Survey

Even though sampling a large area is a promising prospect, continued full coverage survey throughout northern China and Mongolia in various contexts will continue to illuminate the relationships between human settlement, subsistence economy, environments and social organization. It is clear by now that across a single archaeological culture there are numerous combinations in the patterns of human settlement, subsistence economy, environmental context and social organization. How these interact with one another to form patterns can be explored productively throughout Northeast China. Expanding the current survey, although tempting, might be less productive than exploring a new region or regions with the knowledge produced from this project.

The ecotone environments that are promising to the the further testing and development of models which discuss the emergence of pastoralism from an agricultural antecedent may be found in the much harsher environments of northern Inner Mongolia and western Gansu. The lower levels of precipitation and shorter growing seasons in these regions make farming a much riskier endeavor. That being said, one would need to be cautious about choosing a region where agriculture is nearly impossible since that would test models related to the emergence of mobile herding from hunting and gathering antecedents (Wright 2006; Frachetti 2008). However, any exploration into Bronze Age economy and demography would yield useful information to further refine the future choice of regions.

Right now, there are a growing number of explorations into prehistoric regional demography in Northeast China. This project has produced results which indicate a drastic decrease in the population at precisely the time when there is an marked increase in population in Chifeng and Daling regions. Is either population increase or decrease characteristic of the larger macro-region? Full coverage regional surveys are underway in regions roughly 350 kilometers north of Zhangwu at the eastern edge of the Horqin Sandy Lands and at another project 100 kilometers west of Zhangwu. The results of these surveys, combined with what we learned from completed archaeological surveys in Northeast China, will begin to productively address patterns of demography at the macro-regional level. Analysis of these regions will also yield a detailed accounting of how local and regional conditions temper subsistence economies.

APPENDIX A

ELECTRONIC ACCESS TO DATA AND ARTIFACT IMAGES

The data collected by this research is available online through the University of Pittsburgh Center for Comparative Archaeology. The intent is that this data can be used for comparative purposes. To give the public greatest ease of access simple file formats and small files are used, with the exception of use-wear images. The database of collection lots and sherd collections is available as tabular data. Photographs of the stone tool artifacts are available as JPG files. The settlement maps are organized by period and are available as AutoCAD DXF files. The use-wear images are provided in high resolution JPEG files.

The University of Pittsburgh Center for Comparative Archaeology Database is currently available online at:

http://www.cadb.pitt.edu/

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