ENVIRONMENT, CHRONOLOGY AND RESOURCE EXPLOITATION OF THE PASTORAL NEOLITHIC IN TSAVO, KENYA

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THESIS

Submitted as partial fulfillment of the requirements
for the degree of Doctor of Philosophy in Anthropology
in the Graduate College of the
University of Illinois at Chicago, 2005

Chicago, Illinois

This thesis is dedicated to the ancestors, from whom we have much to learn if we are to sustain human life on this planet indefinitely.

ACKNOWLEDGEMENTS

I would like to thank my thesis committee for their unwavering support and assistance. A work of this scale cannot be produced without the mentorship of scholars who have such a range of experience in both the geographic area and subject material discussed in this thesis. I would especially like to acknowledge Dr. Chapurukha Kusimba who oversaw this project from start to finish and provided me the opportunity to work in Tsavo in the first place. Without him, this project never would have gone anywhere.

Institutional support was provided by the Office of the President and Ministry of Education of the Republic of Kenya. Further support was imparted by the National Museums of Kenya, the Kenya Wildlife Service, the British Institute in Eastern Africa and the Office of Cultural Affairs at the United States Embassy, Nairobi. Turtle Bay Resorts of Malindi generously allowed our crew to occupy a retired tented camp inside Tsavo East National Park for a month. Kenya Wildlife Service let us pitch tents in the park and offered us seemingly luxurious accommodations in Manyani.

Field crews were of invaluable assistance throughout the survey and excavations. In particular, I would like to acknowledge the assistance of Ali Abdulla, Samuel Kahinju and Simon Katisya of the National Museums of Kenya. I would also like to recognize Paul Watene’s (National Museums of Kenya) identifications of the lithics and Simiyu Wandibba’s (University of Nairobi) assistance with the ceramics. Paul Wahiu was an outstanding field supervisor for both the 2001 and 2004 field seasons. Will Ellerby from the British Institute of Eastern Africa ran and processed the total station data and was a crew supervisor in 2004. Peter Hansen gave up a year of his life to accompany me in the field in 2001 for survey and excavations. He was a rock of support and always the "glue of the crew" when morale was running low. *Uko freshi, Pita!* Mr. Clive Ward, who has extensively walked the banks of the Galana River and is the "man who walks with ice," has been a generous informant and first pointed me toward Kahinju and Mtembea kwa Barafu. My dear friends George and Steve of New Generation Stores in Voi provided logistical support of the survey and excavation crews and always provided a nice home to rest and discuss all matters of Kenyan society and current headlines.

None of this would have been possible without the support of the Kenya Wildlife Service and in particular the wonderful people of the Manyani Ranger Field Training School. There are too many individuals to be able to thank absolutely everyone individually, but I would like to identify Wandeto, Muli, Dominick, Michael Nicholson, Kimani, Mushiri, Kathuva, Masimba, Kirui, Salim, Kisio, Maganga, Mohammed Kheri, and especially Commandant Robert Muasya. Muasya's faith and support in the Tsavo Archaeological Research Program was unparalleled and he was always there to get us out of a jam. Likewise, the support of Dr. Richard Bagine and Dr. Samuel Kasiki were critical to the completion of the project.

Funding for the project was provided by Fulbright International Institute for Education (2000/2001), the University of Illinois Provost's Award (2001) and a National Science Foundation Dissertation Improvement Grant (2003/2004). Dr. Steve Forman and the staff at the Luminescence Dating Research Laboratory (Jim Pierson, Jeanette Gomez, Greg Komperda and Cara Croughan) were so instrumental to the analysis of the results. The support of the laboratory went above and beyond the desire to help just another graduate student, but was done for a much nobler cause—to advance science.

Finally, friends and family are always important sources of strength and support through the trials and tribulations that accompany an endeavor of this magnitude. However, there is no one that deserves more appreciation than my long-suffering wife, Kristina, who courageously crossed a river full of crocodiles, got drug-resistant malaria several times, kept the budget and the menus straight, ran the field lab, was charged by an angry hippo, did the tool and ceramic illustrations, sat in bandit country for umpteen hours while I rebuilt some doodad on the car or ran to get that doodad and was always on my side even when I was wrong. Nobody could have ever asked for more than I did from a companion and nobody has ever been as completed as I am with her. *Nakupenda, bibi.*

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LIST OF ABBREVIATIONS

^{14}C years B.P.	Radiocarbon years before present
AMS ^{14}C	Accelerator Mass Spectrometry radiocarbon dating
B.P.	Before Present
cal years B.P.	Calibrated years before present
EIA	Early Iron Age
EIW	Early Iron Working
ENSO	El Niño Southern Oscillation
ESA	Early Stone Age
EYM	Enkapune ya Muto
FAO	Food and Agriculture Organization
GRIP	Greenland Ice Core Project
GISP2	Greenland Ice Sheet Project 2
IRSL	Infrared Stimulated Luminescence
ITCZ	Intertropical Convergence Zone
LGM	Last Glacial Maximum
LSA	Late Stone Age
MAAD	Multiple Aliquot Additive Dose
MAM	March April May
MHCO	Mid Holocene Climatic Optimum
MNI	Minimum Number of Individuals
MSA	Middle Stone Age
mtDNA	Mitochondrial Deoxyribose Nucleic Acid

LIST OF ABBREVIATIONS (continued)

NAO	North Atlantic Oscillation
NISP	Number of Individual Specimens Present
NGO	Non-Government Organization
OSL	Optically Stimulated Luminescence
PN	Pastoral Neolithic
PPNA	Pre-Pottery Neolithic—A
PPNB	Pre-Pottery Neolithic—B
SASES	Standardised African Sites Enumeration System
SO	Southern Oscillation
SOI	Southern Oscillation Index
SST	Sea Surface Temperature
TARP	Tsavo Archaeological Research Program
TIW	Triangular Incised Wares
USDA	United States Department of Agriculture
XRD	X-ray Defraction
YD	Younger Dryas

SUMMARY

Archaeologically detectable human occupations along the Galana River inside Tsavo National Park, Kenya begin around 6,000 years B.P. and continue until 1,300 years B.P. This time period in East Africa is widely known to predate and include the Pastoral Neolithic—geographically and temporally linked early cattle-herding cultures comprised of autonomous communities with loose cultural connections to one another. Data from some sites located in the Great Rift Valley, Lake Victoria Basin and Central Kenyan Highlands indicate that after 3,000 years B.P., residential mobility patterns increased and pastoralists adopted a strong dependence on maintaining and culling herds of domesticated animals. There was also a regional shift from stone tool production to iron working technologies beginning after 2,000 years B.P. This pattern is not borne out in Tsavo, where artifact analyses indicate that the sites' inhabitants had restricted mobility, relied primarily on exploitation of an endoaquatic resource base and continued to produce stone tools throughout the 4,700-year period when the sites were occupied. Regional and global proxy data indicate subdecadal periodicity in El Niño/La Niña pressure oscillations and more-arid-than-present conditions in East Africa during the late Holocene. This thesis finds that exploitation and "domestication" of a wide array of available resources is a means of buffering against environmental uncertainty.

1. Introduction

1.1 The Challenge of Defining Pastoralism

The domestication of plants and animals and the changes that this process exerts on people is one of the most frequently addressed topics of archaeological literature. This subject is particularly interesting to archaeologists because domestication laid the foundation for the accumulation of surplus food supplies and a hierarchical social structure to manage it. As more data has been assembled from disparate regions of the world with evidence for a transition from a subsistence strategy based solely on the procurement of wild resources to one that includes the use of domesticated plants and animals, it becomes clear that the social effects of the transition manifest differently.

A consensus on the factors that led to the adoption of domesticates around the world is limited by the lack of a consistent definition of how to contrast domesticated species from wild ones. A recent critique of the concept of domestication argues that analyzing human modification of the environment ("landscape") provides a more nuanced view of the concept of domestication than that from the perspective of actual species (Terrell et al. 2003). The authors argue that viewing domestication from the perspective of speciation of organisms is not as constructive as looking at how humans interact with and manipulate the environment in order to ensure an available food source. In the case of East Africa, this perspective is especially useful because the archaeological evidence for incipient domestication of plants and animals is difficult to discern. Marshall (1994) argues that many of the archaeological sites in East Africa that have been interpreted as early pastoral campsites may have in fact been those of people who stole cattle from neighboring communities. This contention is difficult to dispute from archaeological assemblages that possess limited faunal data or show that the majority of diagnostic faunal material is from wild species.

In 2001, a team of researchers from the National Museums of Kenya and the Kenya Wildlife Service headed by myself undertook a survey along the floodplain of the Galana River in Tsavo East National Park, Kenya. This work augmented earlier surveys undertaken by Thorbahn (1979), C. Kusimba (2000) and C. Kusimba et al. (in press). Three sites that possessed ceramic and lithic technology characteristic of an early cattle-possessing culture were discovered eroding from fluvial terraces. Subsequent excavations and analyses have confirmed that the sites were occupied prior to and throughout the time period generally referred to as the East African "Pastoral Neolithic" (PN). Faunal evidence for the presence of domesticated animals was recovered *in situ* from both sites. However, contextualing these finds within current understandings of Africanist archaeology necessitates a reexamination of what the PN actually means. The Tsavo region has not traditionally been looked upon as a center of early domestication or a place in which early pastoralists dwelled for any extensive period of time.

In the Rift Valley and Kenyan Central Highlands, PN sites are marked by significant differences between material and subsistence cultures from early to later phases of the tradition. However, few sites exist with multiple temporal strata to analyze the geographical bias of changes in artifact types and subsistence strategies. The work presented here is significant to the extent that it reports findings from four sites that are within 30 km of one another possessing 20 separate occupations dating from 6,000 until 1,300 cal yrs B.P. This provides a unique vantage point from which an analysis of the changes in the subsistence, settlement and material culture can be analyzed from a time period in which the landscape is known to have undergone significant changes in both the natural and cultural environment.

1.2 Statement of the Research Questions

When designing an excavation strategy of the Tsavo sites, four crucial questions guided the scope and direction of my research. First, to what extent did climate encourage or discourage settlement along the floodplain of the Galana River? Testing this notion involved calibrating radiocarbon and luminescence ages of site occupation and abandonment against an established regional environmental chronology. It also involved looking at the subsistence and settlement strategies of the inhabitants of the sites. A diverse faunal assemblage concentrated on the exploitation of endoaquatic resources with evidence that interannual mobility was low would indicate that at least the majority of the resources the communities needed for their survival was close to their home bases. A relatively monolithic diet (especially one centered around exploitation of domesticated animals) and ephemeral occupations that indicated the sites were settled seasonally or for even briefer periods of time would indicate that the Galana River was one of many areas that prehistoric people utilized, but was not a point of permanent or semi-permanent settlement (*sensu* Chang and Tourtellotte 1993; Hoelzmann et al. 2001; Mandel and Simmons 2001; Shapiro 1984).

The second question asks to what extent was mobility an important component of survival in Tsavo? Testing this notion involved looking for evidence of long- or short-term occupations of the sites. The archaeological expression of long-term site occupations include evidence for architectural features that indicate a high degree of labor investment into the location (*sensu* Abrams and Bolland 1999; Testart 1982; Wills

2001), high densities of bulky artifacts that are not easily transported great distances such as ceramics (*sensu* Arnold 1985; Simms et al. 1997) and evidence of intensive occupations expressed through dense artifactual lenses. On the other hand, thin occupation lenses bearing few artifacts would express ephemeral site occupations (Hole 1974; Testart 1982). There would be limited evidence for tool manufacture and food processing. Furthermore, ceramics would be not be found in high quantities because they would be difficult to transport if the group is highly mobile

The third question is to what extent did the material culture of the sites' inhabitants change over time? During my initial visit to each site, multiple occupation strata were evidenced in the profile of eroded terraces. Each occupation horizon included dense concentrations of pottery, lithics and faunal material buried in a weakly developed soil underlain by parent material (C-Horizons). I was therefore interested in seeing whether the geographical and temporal changes in ceramic and lithic forms that PN people employed in the Rift Valley and the Kenyan Central Highlands could also be found in Tsavo, indicating that there was a intergeographical cultural evolution among the autonomous communities of the PN. The null hypothesis of this assertion is that technological adaptations were uniquely suited to exploit regional resource niches, and therefore would not necessarily alter in tandem with changes in technology occurring in other areas.

The fourth question is whether any evidence of precolonial exchange networks remained *in situ* and to what extent did the PN inhabitants of Tsavo participate in a long-distance exchange system that would have connected them to early Swahili civilizations? Tsavo's proximity to the coast of the Indian Ocean made it an area through which exchange items would have had to pass if they were en route from the far interior to most parts of what is today the central Kenyan coast. The Galana River would have been a perfect conduit to the ancient port towns of Malindi, Kilifi/Mnarani and Gedi from upcountry not only for its ability to assist in navigation, but also as a readily available source of water flowing through the notoriously dry coastal plains. Thus, trade items recovered *in situ* in the form of glass beads, cowry shells and iron implements would be considered as evidence that the inhabitants of this region were involved in the circum-Indian Ocean exchange network documented historically since the first century of the Common Era (Casson 1989; Freeman-Grenville 1966) and is detected archaeologically for two millennia prior to that.

1.3 Outline of the Thesis Organization

This dissertation will begin with a review of literature to arrive at a definition of "pastoralism" as it is contrasted from other modes of food production (Chapter 2). The study will focus on what separates pastoralism from other economic practices. Pastoral mobility strategies and subsistence will be focused upon because they are useful in showing how animals are used as buffering mechanisms against the precariousness of rainfall and resource scarcity. The chapter will conclude with an examination of the similarities and differences between prehistoric modes of pastoralism and those found in the modern and historical ethnographic record. The review will show that the differences between the social and economic organizations of pastoralists exceed the similarities.

Chapter 3 will set the background for the discussion pertaining to the origins and evolution of pastoralism in Africa by reviewing the paleoclimatic proxy data available from the northern and eastern portions of the continent since the Last Glacial Maximum

(LGM). The chapter will also address the role that El Niño and La Niña periodicity plays in determining rainfall and vegetation distribution in Africa. These data will show that the contemporary African landscape reflects the great variability in temperature and rainfall distributions throughout the Holocene.

Chapter 4 will explore the data available for the origins and spread of domesticated animals in northern and eastern Africa. I have adopted the perspective that the hereditary and cultural origin of East African domesticated stock hails from the northern portions of Africa as opposed to the Near East. This contention is supported by genetic and archaeological data indicating that independent domestication of livestock did not occur in eastern Africa but was instead inherited from the north of the continent. However, I will also argue that the introduction of domesticated animals did not accompany a complete cultural package but was instead a moving subsistence response to increasing aridity and unpredictability in the resource base.

Chapter 5 is the background and methodology section of the dissertation and is subdivided into three subsections. The first subsection will describe the modern environment of Tsavo, creation of the park borders and how these two factors relate to the archaeological integrity of the sites discovered and excavated in 2001 and 2004. The second subsection will outline the methodology employed during the survey of 2001 and report all sites found, regardless of their relevance to the central theme of this dissertation. The third subsection will describe the excavation strategies and provide a background for how collection procedures were implemented to optimize time, resources and provide a solid foundation from which the analysis of data could be used to address the central research themes outlined above.

Chapter 6 provides the geoarchaeological interpretations of site habitation and correlates data on El Niño Southern Oscillation (ENSO) periodicity and aridity proxies to site occupations. It will be argued that the Galana was a magnet for habitation during periods when resource availability away from a permanent body of water would have been unpredictable. Environmental proxy data show strong correlations between site habitation and high ENSO periodicity as measured from laminae spectra taken from a high altitude alluvial drainage system in Ecuador (Moy et al. 2002b). Later occupations of the sites show strong correlations to an aridity proxy taken as a continuous $\delta\ ^{18}O$‰ foraminifera sequence from a glacial core on Mount Kilimanjaro (Thompson et al. 2002a; Thompson et al. 2002b). These analyses argue that exploitation of an endoaquatic environment occurred when the surrounding landscape was generally dryer and rainfall more erratic than it is presently.

Chapter 7 analyzes the faunal assemblage from the sites of Kahinju, Kathuva and Mtembea kwa Barafu. MNI counts and a non-randomly selected excavation strategy were limiting factors toward dietary reconstruction of the inhabitants of these sites. However, the data show that unlike PN occupations in the Rift Valley and Central Kenyan Highlands, the PN inhabitants of Tsavo maintained a diverse subsistence base throughout all phases of occupation of the sites. This analysis represents a significant departure from PN occurrences west of Tsavo where later occupations show an increasing reliance through time upon domesticated animals as a meat source. The analysis also indicates that faunal elements that are difficult to transport (such as skulls, vertebrae and sternums) were present in the assemblage in relatively high numbers. This chapter discusses the “schlep effect” (presence of faunal elements at a site is a function of distance from the kill site and portability of different portions of an animal's body) and the indication that the faunal assemblage makes that mobility patterns of the sites' inhabitants were restricted. These findings show that the PN is less a cultural manifestation than temporally and geographically related groups of people who possessed some domesticated animals, but used them differently to exploit a variety of physical environments.

Chapter 8 discusses the lithic tool assemblages from the sites of Kahinju, Kathuva, Mwiitu and Mtembea kwa Barafu. PN sites throughout eastern Africa show great variability in stone tool manufacture and usage. The factor that is the greatest determinant of what types of stone tools are found in an assemblage is the availability of raw material. In Tsavo, the most readily available raw material is quartz, which is undoubtedly the most difficult from which to interpret artifact form and function (Mehlman 1989; Nelson 1973). However, my analysis of the data indicates that there is no discernable change in lithic tool technological production throughout the 4,700-year sequence of PN occupations along the Galana River in Tsavo. Other archaeological investigations of PN stone tool manufacture have shown that the toolkit is designed to exploit a specific resource niche. Therefore, the conclusion of this work generally corroborates the interpretations of other researchers on PN manufacture and usage of stone tools to the extent that there is no detectable change in tool types temporally because the resource base the inhabitants of these sites were exploiting did not change significantly through time.

Chapter 9 makes the case that diagnostic ceramic forms from PN occupations in Tsavo broadly conform to styles recognized from other PN assemblages in East Africa, except for several vessel sherds that liken more to Early Iron Working (EIW) assemblages. The EIW-tradition pottery found in PN contexts in Tsavo raises the question whether there is strong continuity between early pastoralists and later agro-pastoral iron using communities, which are until recently thought to have been distinct from one another. The ceramic assemblages from Tsavo also indicate that the manufacture of large, bulky vessels was common, suggesting a restricted mobility pattern amongst the inhabitants of these sites. These lines of evidence serve to augment arguments presented in other chapters that there is little technological transformation through time, mobility patterns are restricted and there is limited indirect evidence that the later occupations at these sites exist within an intercontinental context of commodities and cross-cultural exchange.

Chapter 10 analyzes data that indicates that Tsavo was part of a precolonial world system of exchange. Three primary lines of evidence are offered to support this claim. The first is a reevaluation of lexico-statistical data (Ehret 1998, 2001) and the recent revision of interpretations regarding PN ceramics found at several coastal sites in Tanzania (Chami and Kweksason 2003). The notion that “Nilotic or Cushitic pastoralists” were genetically and culturally distinct from “Bantu iron using farmers” has now been discredited. The growing body of linguistic and archaeological evidence indicates that close ties between groups living in East Africa have been maintained for several thousand years. This contact not only included exchange of preciosities and language, but also of marriage partners and political alliances. Ethereal relationships such as these are impossible to test archaeologically, but were documented in the historical record by early travelers and missionaries. The second line of evidence is an analysis of EIW and PN pottery motifs recovered from sites throughout East Africa and in Tsavo, respectively. Although pottery decorations are not always the best indicators of cultural contact (Hodder 1977), they show that a continuity of artifact reproduction techniques that extend beyond the function of the artifacts. The final line of evidence is the discovery of a cowry shell *in situ* at the site of Kathuva that dates to 1,500 cal yrs B.P. This artifact predates the florescence of Swahili civilization and signifies that the position of East Africa in the precolonial Indian Ocean exchange network was made possible through economic networks that developed before the monuments of political stratification can be detected archaeologically.

1.4 General Thesis Conclusions

Against this backdrop, the stage will be set for understanding the broader theoretical implications for domestication processes in general. Many scholars have argued that domestication is a process that radically transforms the social fabric and alters the interactions a society maintains with the environment (Bar-Yosef and Meadow 1995; Brovkin et al. 1999; Flannery 1973; Kealhofer 2003; MacNeish 1992; Piperno and Fritz 1994; Wills 2001; Zeder 1994). The data presented in this dissertation instead argue that domestication was an additional tool that was adopted after 4,000 years B.P. used to buffer against environmental uncertainty, but was by not the only means, nor even the most important. The data show that hunting and predation on endoaquatic resources remains an important staple of survival for the PN cultures along the Galana River for 4,700 years.

The data presented in this dissertation also dispute the notion that early forms of pastoralism relied on high mobility. However, this is not the first manuscript to find that early herding societies in East Africa engaged in restricted mobility patterns in order to maximize their potential to exploit a specific resource niche. Hoelzmann et al. (2001) demonstrate that early Lonqam cultures in the eastern Sahara were semi-sedentary cattle-keepers exploiting lacustrine resources. Bartheleme (1985) also interprets the first archaeologically detectable phases of pastoralism from Lake Turkana as occupations of semi-sedentary people who primarily relied on fishing and augmented their diets with domesticated products and byproducts.

Finally, the data show the continuity of cultural ideas and commodities between the oft-separated PN and EIW traditions. This thesis will build upon the arguments presented in Abungu (1994-1995), Horton (1984; 1990; 1996), Wilding (1987; 1980) and Chami and Kweksason (2003) that see material cultural continuity between pre- and post-iron-using communities on the East African coast. Furthermore, we will examine notions of the development of kin-based long-distance exchange networks as it pertains to the links that were maintained between urban merchants living along the coast and their relatives who hunted, herded and traded goods from the interior (Abungu 1989; Abungu and Mutoro 1993; Kusimba 1999b). Evidence for early antecedents of this relationship has been recovered from an archaeological assemblage in Tsavo National Park and will be discussed.

This study represents the first archaeological investigation of PN sites along the Galana River, and, as such, the results presented are designed to assist future researchers in the development of more sophisticated models of subsistence and residency patterns in the region. Recommendations are put forward for further study of the region as the data set in this manuscript are limited. As is the case in any groundbreaking research in a previously unexplored archaeological region, much attention has been devoted to developing rudimentary chronologies and datasets that are limited in their explanatory potential, but necessary for comprising the building blocks for subsequent projects. However, the following pages will test the four hypotheses outlined above and provide a solid springboard for continuing research along the Galana River in Tsavo National Park, Kenya.

Chapter 2. Pastoralism Defined

2.1 Introduction

As an economic strategy, pastoralists share many common characteristics with agriculturalists. This is because pastoralists, like farmers, are involved in the direct *production* of the food they consume to insure a regular supply of it (Dyson-Hudson 1972a). Some researchers argue that production of food creates a radically different social structure centered on private ownership of resources rather than the egalitarian food sharing commonly found among hunter-gatherers (Bonte 1981, 1991; Digard 1979; Goldschmidt 1979; Ingold 1984; Kinahan 1991; Koster and Chang 1994; Smith 1998). Others argue that pastoralism is an adaptation to a set of social and environmental circumstances and does not produce an inherent set of distinct cultural traits that easily distinguishes it from the lifestyle of hunter-gatherers (Gifford-Gonzalez and Kimengich 1984; Gilbert 1983; Higgs 1976). This chapter will argue that the distinctions between "foragers," "agriculturalists/horticulturalists" and "pastoralists" are circumstantial to the environments they inhabit. We will explore a range of pastoral mobility and subsistence strategies used as buffers against localized episodes of aridity or resource scarcity. The chapter will conclude by contrasting historic and prehistoric modes of pastoral production from what is commonly regarded as pastoral production in the modern era.

2.2 What is a Pastoralist?

The hallmark of pastoralists is the keeping and reproduction of domesticated animals. Juliet Clutton-Brock (1987: 21) defines a domestic animal as "one bred in captivity for purposes of economic profit to a human community that maintains mastery over its breeding, organization of territory, and food supply." The general process of animal domestication is undertaken in two primary ways: first, the social structure of human groups is reoriented toward direct interaction with living animals; and second, selective breeding processes change the morphological and physiological properties of the animals being domesticated (Meadow 1989: 81).

As animals enter captivity, their food supply and variety of diet is almost invariably more restricted than in the wild causing malnutrition and developmental deficiencies among captive offspring (Meadow 1989; Reed 1984). Therefore, once an animal enters a state of domestication, it generally becomes smaller in size compared to its wild progenitor (Jewell 1969). In addition, selecting mating pairs, castrating or culling offspring of certain animals that possess undesirable behavioral traits (aggressiveness, stubbornness, etc.) are means that humans will use to manipulate a species' gene pool (Gilbert 1975; Jewell 1969; Reed 1984; Reed 1986). These two factors combine to create an animal that is defenseless in the natural world without the assistance of humans. It will be argued that many humans occupying the semi-arid grasslands of North and East Africa became dependent on a mobile food source for their survival by the middle Holocene, but it should also be remembered that the animals became dependent on humans for their survival as well.

Reed and Perkins (1984) see a continuum between wild and domesticated species. They label the intermediary stage "tamed"—that is an animal accustomed to human activity, but not fully under a human's control (Reed 1984). Reindeer in the Laplands represent an example of a species that is herded, but not fully under the control of the human communities that herd them (Ingold 1984; Paine 1972). Reed (1986) argues that in order for domestication to occur, humans had to overcome their psychological barriers toward interacting symbiotically with animals. In this view, humans evolved as hunters, not tamers and the beginnings of domestication were slow and laborious as humans and animals learned a new means of interacting with one another. The earliest dated interactions between humans and *Bos primagenius* (the wild ancestor of modern African domesticated cattle, *Bos taurus*) in the eastern Sahara indicate that human communities restricted the mobility of the bovids for several thousand years before skeletal morphological changes are noticed in the archaeological record (Banks 1984; Hassan 2000).

2.3 Pastoral Land Utilization Strategies—Causes and Effects

There has been much discussion on the patterns of accumulation and culling of livestock amongst researchers of pastoralism. It has been argued that keeping herd sizes small are necessary to maintain equilibrium between human activity and the natural environment (Clutton-Brock 2000; Reckers 1992). Numerous examples abound in the ethnographic record of pastoralists making conscious choices to destroy, trade or consume their animals in order to stave off an immediate threat overtaxing the environment (Behnke 1980; Gulliver 1955; Sobania 1991). Rigby (1992: 45) argues that herd sizes are naturally limited even without the pastoralists themselves making conscious choices to do so. In this sense, "overproduction" of domesticated stock is impossible because if environmental conditions desiccate to the point where livestock habitation becomes impossible, the pastoralists will either move their camps or be forced to watch their herds reduce in size to a level that the environment can sustain them.

Traditionally, pastoralists have been perceived as parasitic—exploiting an environment until it is no longer capable of sustaining them and then moving into an adjacent territory (Anderson 1974; Herskovits 1926; Netting 1977). Often this movement is associated with violence as indigenous groups attempt to resist the encroachment into their territory (Galaty 1991; Galaty 1993; Spear 1981). In precolonial Africa, this scenario played out many times as early explorers chronicle in detail (Krapf 1968 [1860]; New 1971 [1873]; Thompson 1968 [1885]). However, when these events were being recorded was an abnormally difficult period of time for East African pastoralists. A particularly devastating epidemic of rinderpest disease wiped out nearly all of East African cattle in the mid and end of the nineteenth century (Lindblom 1969: 478; Sobania 1993). The argument that pastoralists are inherently "warlike" and expansionist does not bear out in the ethnographic record (Stenning 1963; Winter 1978).

In addition, the warming trends associated with the end of the so-called "Little Ice Age" (ca. A.D. 1300-1800) severely constrained access to good pasture (Verschuren et al. 2000). East African pastoralist populations had benefited from the wetter-than-present conditions of the Little Ice Age. While the South African landscape desiccated from severe drought, foraminifera $\delta\ ^{18}O$ signatures as well as pollen analysis from cores taken from East African lakes indicate that rainfall for most of the interior regions of eastern Africa increased dramatically after A.D. 1270 (Tyson et al. 2001). At this time, human populations and herd sizes likewise increased in East Africa (Tyson et al. 2001: 146). However, the end of the event left pastoralists with high populations of people and few options for feeding them other than raiding their agricultural neighbors who were better prepared to weather the changing environment (Galaty 1993). Many nomadic people also adopted a more sedentary existence and took up practicing horticulture, but continue to identify themselves as "pastoralists" (Rigby 1992: 195).

Perhaps the greatest threat to the pastoral way of life is the view held by many environmental preservation Non-Government Organizations (NGOs) that pastoralism is inherently destructive to an ecosystem (Goldschmidt 1979, 1981a). However, research conducted by Reid and Ellis (1995) has shown that pastoralism is not as environmentally deleterious as has been assumed in the past. Their studies of pastoralists from the Lake Turkana region examine soil fertility on the basis of nitrogen, carbon and phosphorus densities as well as the presence of *Acacia tortilis* woodlands as a function of the distance from a pastoral homestead (*boma*). They demonstrate that in areas that have received a high amount of domesticated livestock manure, nitrogen and carbon content in the soils are 3 – 23× higher than in surrounding, non-fertilized areas (Reid and Ellis 1995). Furthermore, seed dispersal of *Acacia tortilis* around pastoral *bomas* is much higher than in areas that do not support pastoralists (Reid and Ellis 1995). Patches of *A. tortilis* have been located on Iron-Age sites in southern Africa suggesting that the positive impacts of pastoral settlements may last for hundreds of years (Blackmore et al. 1990; Scholes 1990; Walker and Noy-Meir 1982). Reid and Ellis (1995) conclude that pastoralism is well suited to semi-arid ecosystems as long as those ecosystems are sparsely populated. In many scholars' opinions pastoralism is not generally the prime catalyst of desertification, but in many cases the absence of domesticated animals on a landscape has encouraged land degradation due to the abrupt removal of a key component of land management that has existed for millennia (Mapinduzi et al. 2003; Oba et al. 2000).

A pastoralist cannot be defined in precise, scientific terms because it is a term by which one identifies him- or herself. Most Maasai and Samburu see themselves as pure pastoralists even though many of them have vegetable and bean gardens and have adopted relatively sedentary lifestyles (Rigby 1981, 1992; Sobania 1991). However, identity is difficult to test archaeologically and a recent critique of domestication offered by Terrell et al. (2003) is particularly poignant in its ability to isolate the *consequences* of resource procurement strategies and the effects these have on altering the landscape. Examining mobility and subsistence patterns in archaeological datasets is a testable means to isolate the land use stratagem. For an archaeologist, what matters in the end is not how a group views their relationship with the land, but how they actually survive using the tools available to them.

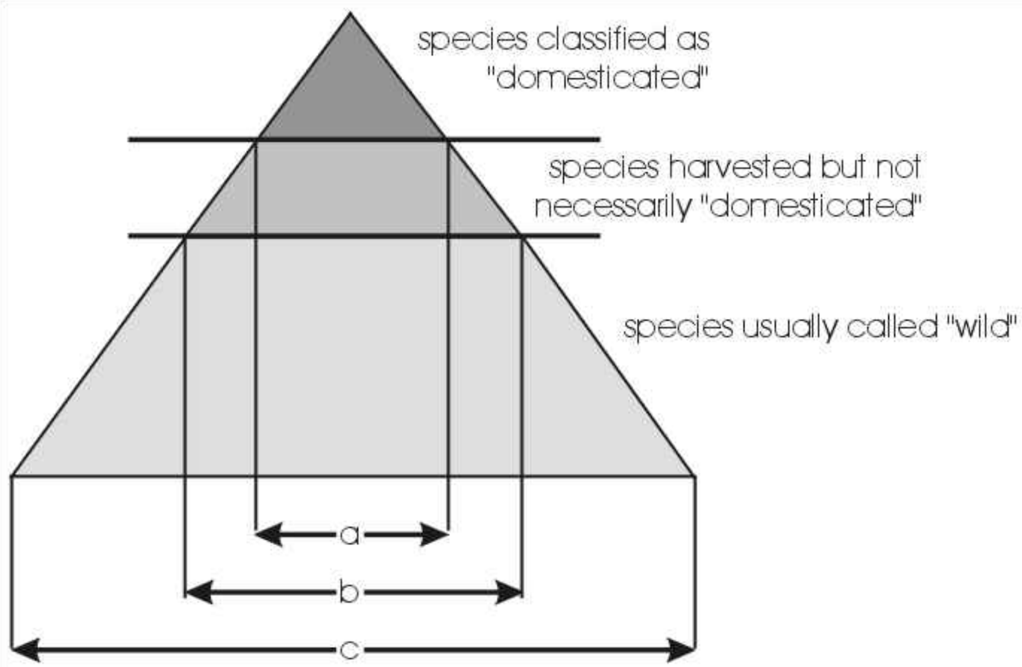
2.4 Modeling Subsistence Strategies

Mobility is recognized as a crucial prehistoric survival mechanism, especially when resources are constricted. Pastoralism has generally been an occupation that necessitated movement of people and beasts in search of fodder and water (Reckers 1992). Therefore, the animals pastoralists tend must be capable of moving long distances. In Africa, such animals normally include caprines (goats and sheep), camels and cattle. When cattle and caprines feed, they select the short, grassy underbrush and generally destroy the roots of the plants as they consume them (Clutton-Brock 1987). After a herd of livestock has moved through an area, pastoralists must wait for the grasses to grow back before they can revisit the location. In many ways, pastoral mobility strategies are similar to those found among foraging groups that follow wild herds of ungulates because the dietary needs of wild and domestic stock is very similar. In the traditional view, the difference between the two subsistence strategies is that in pastoral societies humans control the movements of the herds, while foragers can usually only follow herds and are unable to specifically direct the consumption and use of pasture.

However, the view that foragers are passive instruments in their environments is being criticized within the discipline. Examples abound of foragers deliberately manipulating their environments in order to improve their chances of being able to find food. The most well known example is probably the precolonial Australian Aborigines who kept the continent alight with brush fires (Pyne 1991). A fire-dependent ecosystem evolved in response to these actions and Aborigines were highly successful in exploiting their arid landscape with the aid of their fires.

Another recent critique defines human subsistence behavior as "an interactive matrix of species and harvesting tactics," whereby different species and environments necessitate different degrees of human manipulation in order for humans to be able to inhabit the landscape (Terrell et al. 2003). In Terrell et al.'s (2003) view, domestication is too fluid a concept to be defined precisely because humans have been managing resources within their foraging ranges since the Pleistocene. These acts can include something simple like distributing the fallen seeds of baobab trees (*Adansonia* sp.) in Africa or more complex land management strategies such as burning large tracts of land in Aboriginal Australia (Pyne 1991; Terrell et al. 2003).

Recent genetic analysis of domesticated dogs has shown that they originate from Asia and began slowly speciating from wild forms after 100,000 years B.P. (Vila et al. 1997). The analysis indicates that a "predomestication" process occurred whereby canines sought refuge from harsh high latitude winters and consumed the scraps discarded by Pleistocene cave dwellers (Reed 1984). The human communities benefited by having their garbage removed and the dogs would ward away potentially dangerous predators (Reed 1984). The version of "man's best friend" that we know today came much later, perhaps by 14,000 years B.P. in East Asia (Savolainen et al. 2002). However, the symbiotic relationship between humans and dogs evolved over thousands of years and grew increasingly interactive. In this sense, dogs were a resource on the landscape that became tamed, and therefore "useful" to human communities.

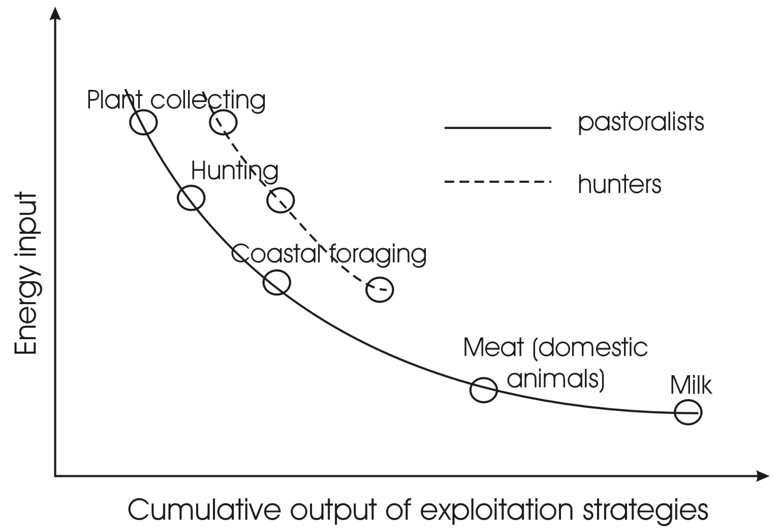


The "Landscape Pyramid" includes (a) the range of species traditionally considered "domesticated," (b) represents the total number of species utilized from a landscape and (c) is the total amount of species that are found on a landscape. This figure is taken from Terrell, et al. (2003: 358).

Figure 1. The "Landscape Pyramid"

Figure 1 illustrates the "Landscape Pyramid" of species utilization and resource manipulation as presented by Terrell et al. (2003). It shows a hierarchy of species of plants and animals that are available to use, harvested in some form by humans, and those classified as "domesticated." The middle tier of the pyramid emphasizes the continuity between wild, tamed and domesticated species.[1] As humans exploit the resources of their environment, humans enter into a biological and evolutionary communion with the products they exploit. That is to say that as much as African savanna grasses currently depend on commensal feeding by wild grazers to spread their seeds across the landscape in order to perpetuate their species (Leuthold and Leuthold 1973), so too do humans and prey enter into a quasi-symbiotic relationship whereby human culling, predation and propagation selects for and sustains the genetic makeup of certain plant and animal species.

[1] I would argue that the lines that separate the species that are "utilized" and "not utilized" on a landscape rendered in this diagram are too definite. Species utilized by a human community during one season, year or even decades are not necessarily *always* considered usable. For example, there are strong *fady* (taboos) amongst certain groups in Madagascar for eating the animal of their totem (Ruud 1960). Some communities claim they would prefer starvation to eating their totem (akin to cannibalism), and this phenomenon has been documented. However, other clans choose to utilize their totem as a starvation food claiming that it is a gift from the ancestors during periods of extreme famine (Ruud 1960). Interpretations of what is permissible to eat and what is unavailable as a food source can change between generations and depending on the circumstances.



Smith, Andrew B., 1992, Pastoralism in Africa: Origins and Development Ecology. London: Hurst and Company, p. 10

Figure 2. Model of energy input/productive yield of subsistence strategies

Pastoral production is less intensive than farming, but generally has more caloric output per hectare than pure foraging (Banks 1984: 212-3; Morris 1980; Smith 1992b). Figure 2 shows the relative energy inputs/caloric outputs of foraging and pastoral subsistence strategies (adapted from Smith 1992b). According to this model, pastoralists will exploit the same resources as foragers, but have the added advantage of being able to rely on domesticated resources in periods when wild resources are unavailable (Dyson-Hudson 1972b; Smith 1992b). However, the classification of distinct subsistence groups following the introduction of food production techniques into an area is misleading.

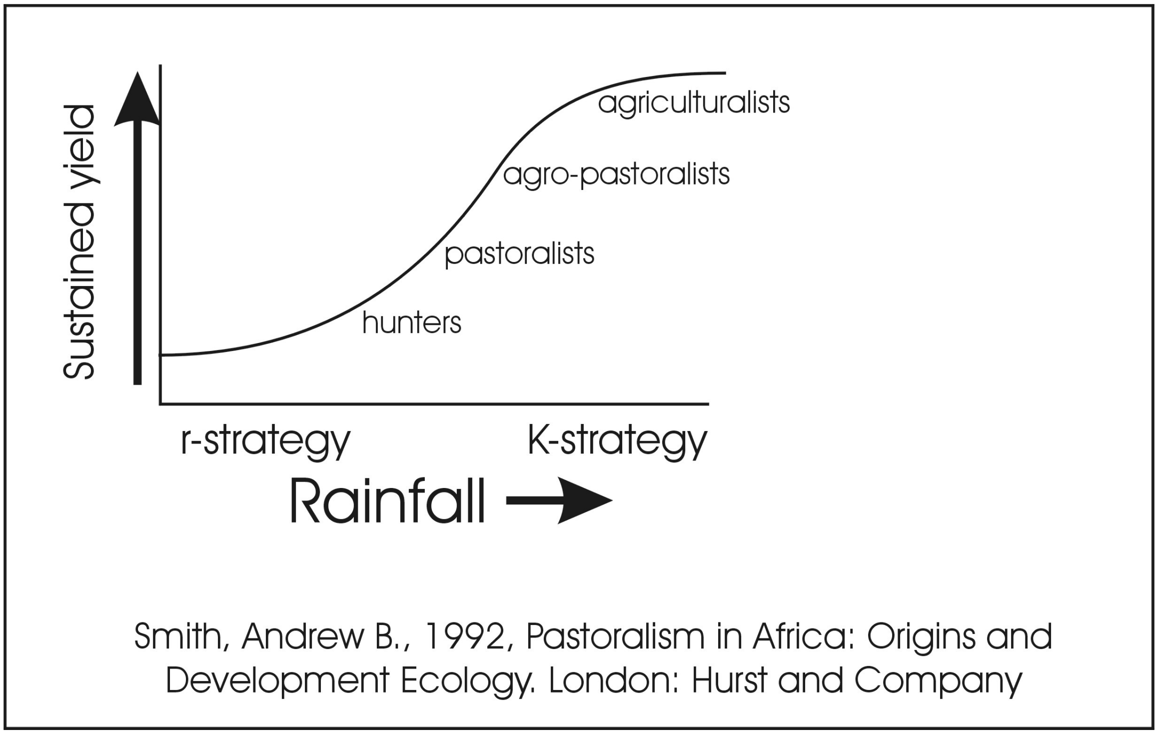


Figure 3. Model demonstrating the relationship between subsistence and settlement strategies

Figure 3 illustrates that the continuum between subsistence categories is a function of group mobility and possesses a fluid dynamic between subsistence options (Smith 1992b). The factor that most greatly affects the adoption of an r-strategy (opportunistic foraging) vs. a K-strategy (food cultivation and storage) depends on the degree to which a group is sedentary or mobile (Smith 1992b). It has been noted ethnographically that individuals or communities shift their reliance on agricultural, pastoral or wild products in different years depending on which endeavor has the potential to provide the best yield (Bates 1972; Kent 1989; Layton et al. 1991; Mace 1993; Stenning 1959). In addition, Phillips (1979) argues that townsfolk during the Pre-Pottery Neolithic, Phase A (PPNA) alternated between urban and herding existences as economic necessity dictated, which explains the lack of large archaeological sites in Israel prior to the PPNB.

2.5 Pastoral Mobility Strategies

Pastoral mobility strategies are highly variable but generally conform to one of two models: peripatetic or transhumant pastoralism. Peripatetic pastoralists occupy large, amorphous ranges in which sporadic or seasonal movement occurs (Bower 1984a). Social groups tend to be very unstable and are subject to frequent fissioning when group sizes become too large (Bower 1984a). This social structure mimics that commonly found among hunter-gatherers, thus it is not surprising that often hunting and wild plant collection comprises a large portion of the economy (Bower 1984a). Today, because so much land is under cultivation no modern pastoral groups could be considered truly peripatetic, only transhumant modes of pastoralism survive.

Transhumant pastoralists generally remain in small, stable territories but migrate between wet and dry season locales in order to maximize caloric intake for their herds (Bower 1984a; Reckers 1992: 25-5). Strong lineage ties define social groups and fissioning is a rare occurrence (Bower 1984a). During the wet season, subsistence primarily revolves around pastoral products and by-products (meat, milk, blood) while dry season subsistence focuses on hunting wild game (Bower 1984a).

2.5.1 Pastoralism of the Zagros Mountains of Iran

Probably the best examples of modern transhumant pastoralists inhabit the Zagros Mountains of Iran. Ethnographic analogies of modern nomadic people are limited in their applicability to prehistory in the sense that the movement of modern people is severely restricted by modern states (Chang and Tourtellotte 1993; Gilbert 1975).

However, domestication of sheep and goats in the Zagros Mountains was a means of coping with resource constriction during climate change because wild caprines are vertical migrators (Hesse 1982: 7). This section will explain how pastoralists living in the Zagros Mountains utilize mobility to exploit seasonally available resources. As we will see, the pastoralists of the Zagros Mountains can be contrasted from agro-pastoral groups discussed in the following section, who have restricted mobility patterns (an increased K-strategy) and depend on a greater range of dietary diversity.

In the present-day Zagros, annual fluctuations in biomass range from 25-30% (Hesse 1982). The aridification of southwestern Asia beginning from the LGM constrained resources along the foothills of the mountain chain and created a situation whereby new resources would have to be located or the groups living in the area would have to emigrate or face starvation (Abdi 2003; Snyder et al. 2001; Zeder 1994). The ability of humans to adapt to the needs of their food source in order to keep it in close proximity represents an important means of cultural adaptation.

The pastoral nomads of the Zagros Mountains depend on the utilization of extensive seasonal pastures (Barth 1964). Most modern pastoral groups engage in some limited form of plant cultivation because the Iranian government has restricted the territory allocated for the migration of their herds (Beck 1991; Digard 1981; Salzman 1967, 1972). However, the pastoral lifestyle is preferred and farming is undertaken only when the loss of livestock leaves no other options (Barth 1961). Other groups such as the traditionally pastoral Yörük of southeastern Turkey frequently shift between mobile and sedentary lifestyles as circumstances permit (Bates 1972). This phenomenon has been recorded throughout the world in areas that until recently were inhabited by purely pastoral people (Aronson 1981; Chatty 1996; Cole and Altorki 1998; El-Arifi 1975; Goldschmidt 1981b; Gulliver 1955; Hopen 1958; Lewis 1961; Rigby 1981; Roscoe 1966; Stenning 1959).

Due to the harsh, rocky terrain, pastoralists such as the Basseri of the Zagros Mountains do not herd many cattle but prefer goats and sheep that are well adapted to the steep conditions (Barth 1964). Barth (1961) documents that the Basseri move 180 days of the year following seasonally available resources. In the warmer months culminating in June – August, Iranian nomads will graze their animals in highland regions ascending >2,000 m in one season from their lowland wintertime pastures (Beck 1991). In accordance to their mobile lifestyle, the Basseri accumulate very few material possessions and carry only the necessities of life with them from campsite to campsite (Digard 1981).

Pasture amongst tribesmen is shared even though the products of their labor generally are not (Barth 1956). However, competition for grazing lands between recognized ethnic groups can be fierce and the establishment of different ecological niches corresponds to ethnically defined territories (Barth 1969). The pastoralists of this region are acutely aware of the Malthusian dynamic to which their animals are subject. Herds can be decimated by lack of water and fodder, which encourages disease, malnutrition and loss of fertility (Barth 1964). Nineteenth century Maasai pastoralists of eastern Africa fought pernicious battles with their neighbors to protect their grazing lands (Berntsen 1979; Galaty 1991; Mutundu 1998; Rigby 1992), but modern industrial governments do not allow open armed conflict to occur within their borders. Thus, diplomatic solutions are more common for resolving territory disputes in the modern era than warfare.

All Basseri share a common general territory, but the groups located in the center of the migration routes are generally not as prosperous as those living on the edges (Digard 1979). Groups positioned around the edges of Basseri territory have a larger buffer zone and less competition for access to grazing land than those who inhabit the heartland (Digard 1979). Barth (1964) and Beck (1991) observe that coercive, hierarchical leadership roles evolve among groups such as the Qashqa'i who live on the western slopes of the Zagros Mountains. Among the Qashqa'i, there is a strong division between wealth and labor (Barth 1964).

However, among the neighboring Kerman people, centralized leadership is absent because the environment is poorer causing the people to disperse and the incentive for leadership is greatly diminished (Barth 1964). Barth (1964) argues further that the more exchange that occurs between communities, the apparatus of leadership becomes more important for managing the movement of goods. Exchange of exogenous items has been documented as a means of social ascendancy for elites in stratified pastoral systems in Africa as well (Bonte 1981; Schneider 1974; Sellnow 1981).

2.5.2 Pure Pastoralism vs. Agropastoralism

Khazanov (1984) presents another model of pastoral mobility strategies. He identifies "pure pastoral" groups as those who do not engage in any form of horticulture, agriculture or wild plant collection. Pure pastoral groups must then be intricately connected to the larger economic community (foragers and agriculturalists) with exchange networks in order to supplement their diet with the vitamins necessary for survival (Bonte and Galaty 1991: 6; Khazanov 1984: 3; Maggs and Whitelaw 1991: 11; Robertshaw and Collett 1983a). Prior to the rinderpest epidemic of the late 19^{th} century, most Maasai are thought to have been purely pastoral (Berntsen 1979). They regarded their foraging and agricultural neighbors as culturally inferior even though they relied on them to supply grain products (Berntsen 1979; Smith 1998: 206).

Attitudes like these are responsible for the creation of what is referred to as a "cattle complex," whereby cattle become not only the dominant mode of subsistence, but also an important cultural-integrative force as well (Herskovits 1926). The Nuer (Evans-Pritchard 1940) and some southern African pastoral groups (Huffman 1982) are also documented as possessing a cattle complex. Among cattle complex cultures, there is a strong attachment between man and beast and cattle are rarely slaughtered for their meat (Netting 1977: 41). Instead, milch pastoralists consume renewable animal by-products in place of meat from their animals. Although cattle in pure pastoral cultures have been interpreted as an expression of dominant cultural values rather than a specific ecological adaptation (Netting 1977: 40), milch pastoralists fulfill an economic niche in the areas they inhabit. They are invariably found in areas that have other subsistence groups with whom they can exchange for food products (Reckers 1992: 24). These networks are beneficial to both pastoralists and agriculturalists to the extent that they can specialize in the production of one or two products and create food surpluses that can be exchanged both in times of plenty and need.

"Semi-nomadic" pastoralists change pastures seasonally and are therefore normally able to practice some form of horticulture (Khazanov 1984). These groups are also referred to as agropastoralists and will emphasize different modes of food production as environmental circumstances necessitate (Layton et al. 1991: 260-1). Caprines often comprise a large portion of agropastoralists' herd because a small flock in a relatively lush environment does not need to move as frequently as cattle (Spooner 1973: 11). Depending on the local environment, small numbers of cattle can normally be maintained near a homestead, but larger herds must be taken to pasture.

Mace (1993) argues that agropastoral households adopt different subsistence strategies based on yearly subsistence needs. When resources are scarce, households will concentrate on the most viable means of subsistence available to them at the time. Because every ecosystem is different, there is no consistent "fallback" that most households will adopt. She argues that chance plays a large role in determining household "wealth," but this chance can be minimized if flexible farming and pastoral strategies are adopted (Mace 1993: 365). In areas that frequently experience rapid climate fluctuations, this can be an important strategy to minimize the risk of complete crop failure or herd decimation.

By definition, all transhumant pastoralists are semi-nomadic but not necessarily all peripatetic groups are purely pastoral. Khazanov (1984) and Bower's (1984a) models are not concordant to the extent that Bower believes that all pastoral groups are engaged in multiple occupations whereas Khazanov sees economic specialization occurring among pure pastoral groups. It is difficult to reconcile whether or not cultivation occurred in the past by pastoral groups because the collection of botanical remains at archaeological sites in East Africa has not been traditionally performed (Ambrose, personal communication, 1998). However, both models present a set of testable hypotheses that can be used to explain cultural variability among pastoral groups.

2.6 Pastoral Subsistence

Pastoralists rarely consume the meat of the animals they raise. Modern African pastoralists tend to exploit the renewable byproducts of their livestock (blood, milk, urine) as opposed to slaughtering and eating the meat (Rigby 1981: 56). There has been much discussion on African pastoralists' affinity for their livestock (Berntsen 1979; Bonte 1991; Bonte and Galaty 1991; Christaller 1933; Conte 1991; Dyson-Hudson 1972a; Evans-Pritchard 1940; Fleisher 2000; Galaty 1991; Galaty 1993; Goldschmidt 1979; Gulliver 1955; Herskovits 1926; Lindblom 1969; Nicolaisen 1963; O'Leary 1984; Reckers 1992; Rigby 1981, 1992; Roscoe 1923; 1966 to list only a few). Cattle are an intricate part of most African pastoralists' lives. Livestock are used as the yardstick of wealth and have metaphysical significance among many pastoral communities (Bonte and Galaty 1991).

No pastoral community can be viable without the acquisition of either wild or domesticated grains, vegetables and fruits. Commonly, these products are obtained by either foraging directly from the landscape or by trading pastoral products and byproducts with neighboring specialized foraging or farming communities. Orma pastoralists and Waata foragers recall that in the recent past, their groups were economically connected by the trade of foodstuffs to buffer against climatic stresses (Hassen 1994: 137; Ville 1995). However, this is a very common phenomenon throughout the world (Behnke 1980; Bollig 1998; Denbow 1984; Goldschmidt 1979; Gulliver 1955; Johnson 1991; Sobania 1991), and only stresses the interconnectivity of human communities since the end of the Pleistocene.

Many modern pastoral groups such as the Samburu of northern Kenya have been forced to plant beans, maize, and other vegetables by their governments as a prerequisite for receiving food aid in times of famine. This is one tool in a growing trend among modern governments to discourage people from practicing pastoralism as a primary means of subsistence (Goldschmidt 1981b). FAO World Aid, the World Bank and NGOs have put increased pressure on developing nation governments to intensify land use (and, to a lesser extent, food production)—a model into which pastoralism does not conform (Goldschmidt 1981a, b; Stiles 1981). Modern pastoralists have thus found themselves in the awkward position of attempting to retain their cultural identity as herders while now tilling the soil as their neighbors do, a practice most pastoralists have looked down upon for as long as anyone can remember.

However, in most parts of Africa agro-pastoralism could be as old as pastoralism itself, and there is solid evidence in the archaeological record to suggest that pastoralism and farming spread into virgin territory contemporaneously (Bower 1991). Most scholars agree that in Africa, the appearance of domesticated animals preceded the arrival of domesticated plants. However, the time gap between the first evidence of domesticated animals and domesticated plants in North Africa (considered the *point de depárture* for both modes of subsistence for the rest of the continent) is less than 2,000 years and may even be less (Zohary and Hopf 2000: 219-220). Modern pastoralists aversions to raising crops is probably a product of more recent environmental and political pressures than a vestige of the conditions that have endured since the Stone Ages as some have suggested (see for example Taylor 1962: 29).

2.7 Differences between Prehistoric Pastoralists and Modern Pastoralists

It is wrong to look at pastoralism as an arcane, static socio-economic category. Like any other human community, pastoralists occupy diverse environments each presenting different land economics. Between groups identifying themselves as pastoral, there is great variability in settlement sizes, mobility patterns, subsistence strategies, etc. However, many prehistoric pastoralists existed in an entirely different environment than what exists today. Access to grazing land was less constraining than what is seen today, especially in East Africa where land proprietorship is sparking numerous conflicts between communities attempting to stake out large swaths of territory to buffer against failing rains.

Modern pastoral economies differ from prehistoric patterns in two ways: they are far more mobile and have a more specialized subsistence regime than their prehistoric precursors. In fertile regions such as the Central Rift Valley of Kenya, agricultural fields and the presence of large, fenced-off ranches restrict the movements of modern nomadic herders. However, in more sparsely populated areas such as northeastern Kenya, northern Saharan Africa and Somalia, high mobility is the best strategy available to ensure survival (Behnke 1980; Gulliver 1955; Lewis 1961; Nicolaisen 1963). Furthermore, agropastoralism is found only in areas where the environment can support cultivated plants. Most of the so-called "pastoral areas" are difficult environments to grow crops and so purely herding people who are highly mobile are more common today than what was found >1,000 years ago (Bower 1997; Gilbert 1975).

Lamphear (1986) argues that the early pastoralists of East Africa were far more sedentary and had a more generalized subsistence than modern pastoralists. The Sirikwa "holes" are late Pastoral Neolithic (PN) occupations (see Chapter 4) that have been interpreted as defensive structures in which livestock and people could be protected from raiders (Sutton 1993b). The modern descendents of the Sirikwa settlements are the Kalenjin people—an amalgam of Nilotic speakers whose economy still largely revolves around tending domesticated animals (Sutton 1987). Excavations at Deloraine, a Sirikwa settlement dating to the Iron Age, have unearthed evidence of agricultural implements and carbonized seed remains of finger millet (*Eleusine coracana*) (Ambrose 1984a). The Sirikwa occupations were not isolated phenomena—examples about of sedentary and semi-sedentary prehistoric pastoralists in Africa. Although mobility is an important component of a pastoralist's grazing strategy, one may maintain a permanent residence even if the animals must be taken to far pastures during certain periods of the year.

2.7.1 Sedentary Prehistoric Pastoralists

In prehistory, exceptions to the model of ephemeral pastoral occupations abound. Some examples from eastern Africa will be illustrated in Chapter 4, but it is worth noting here that numerous complex, stratified pastoral sites are found in the archaeological record throughout the continent. In western Uganda, eleventh to fourteenth century occupations at Ntusi have produced evidence of heavy reliance on cattle and other forms of domesticated livestock (Reid 1990, 1993; Robertshaw and Taylor 2000; Sutton 1993a). Ntusi has been deemed a "town" due to the fact that artifacts have been recovered within a 100-hectare area (Reid 1990, 1993). However, it is not certain whether the entire site was contemporaneously occupied or intrasite relocation or expansion occurred within the radiocarbon dated 300-year timeframe of site occupation (Sutton 1993a). Nevertheless, Reid (1993) argues that local elites would have arisen to manage resources and trade. Although it is believed that agriculture played some role in the subsistence of the inhabitants of Ntusi, long-term intensive grazing is believed to have been one of the key economic features of Ntusi occupation.

Other examples of long-term, semi-sedentary or permanent pastoral occupations can also be found in southern Africa. Great Zimbabwe, its Kutama Phase antecedents and successors (such as Mutupa and Torwa Dynasties) were long-term, pastoral occupations dating from the beginning of the second millennium A.D. until after the arrival of the Portuguese in the early 16th century (Connah 1987; Garlake 1973, 1978; Huffman 1972, 1977; Huffman and Vogel 1991; Pikirayi 1993; Prendergast 1976; Sinclair 1987, 1991; Sinclair et al. 1993). Sinclair (1987) has performed exhaustive site-catchment analyses that conclusively argue that the distribution of *madzimbabwe*, stone enclosure ritual and settlement structures, are best correlated to the presence of good pasture as opposed to other variables such as gold mines, ivory sources or iron ore deposits. The ultimate demise of the Great Zimbabwe is believed to have occurred as a result of the eventual mismanagement of land resources. In the fourteenth century A.D., the ecosystem of the Zimbabwe Plateau was overtaxed through human overpopulation and a lack of accessible pasture on which livestock could graze (Hall 1987).

In addition, the 19th century Nguni Kingdom and the Bahima Kingdoms of Rwanda illustrate that long-term, semi-nomadic or sedentary pastoral settlements of great size occurred until relatively recently (Ballard 1986; Bonte 1991). Hierarchical social structures arose to manage land resources and avoid overexploitation of the territory (Ballard 1986; Bonte 1991). Additionally, flexible subsistence regimes that included horticulture and/or foraging were crucial elements to balancing environmental and population concerns.

2.7.2 Economically Diverse Prehistoric Pastoralists

The timeframe by which the shift to a more mobile, specialized form of pastoralism occurred is still a matter of debate. Some have suggested that the movement of Bantu farmers out of the forests of western Africa onto the savannas of East Africa provided pastoralists with an opportunity to specialize in livestock tenure (Galaty 1991: 175; Spear 1981: 107). According to this theory, early pastoralists were Cushitic- and Nilotic-speaking herders who had marginalized the indigenous click-speaking foragers but still shared an economic interest in trading products and byproducts from their herds in exchange for produce collected from wild plants and animals (Bousman 1998; Lynch and Robbins 1979; Ross 1980). A later migration of Bantu-speaking iron-using farmers swept across eastern Africa originating from West Africa (Chami 1994-1995; Gramly 1978; Guthrie 1963; Hiernaux 1968; Schwartz 1992; Vansina 1984, 1995). According to this model, the Bantus successfully displaced the herders and remaining foragers from the land that was fertile and a symbiotic relationship developed whereby all three communities (agriculturalists, pastoralists and foragers) lived side-by-side exchanging the fruits of their labor for products that they were incapable of or unprepared to obtain themselves.

However, the perspective that the Bantu groups that left western Africa were pure farming communities is changing. Domesticated stock is found in western Africa 6,000 years B.P. (Holl 1998b). Tubers such as yams were domesticated between 6,000 and 4,000 years B.P. in various regions throughout the western peninsula (Phillipson 1993a:

143-149). Ehret (1998: 104) argues that based on linguistic evidence goats and guineafowl were kept by Bantu speakers from "their earliest period." Ehret (2001) further proposes that the theory of rapid colonization and replacement of Cushitic, Nilotic and Khoi speakers by Bantus as originally proposed by Guthrie (1962) is flawed. Instead, the spread of Bantu dialects across the eastern half of the continent was more likely a gradual process that involved blending economic and social traditions including agriculture and livestock tenure (Ehret 1998, 2001), while metallurgy techniques spread independently and tied more closely to paleoenvironmental factors than has been previously considered (Schwartz 1992).

In all of the cases of early sedentary pastoralism provided above, plant cultivation played at least a secondary role in allowing the development of large, stratified settlements. Although evolved Pastoral Neolithic settlements show more evidence of livestock specialization than the early stages of livestock domestication (see Chapter 4), the current sample size of tested evolved PN sites is too small and too focused geographically on the Central Rift Valley to make definitive conclusions about dietary specializations of pastoralists during the Bantu contact period. Marshall (1990c; 1994) argues that the origins of specialized pastoralism occurred after the development of a bimodal rainfall regime (c. 2,600 years B.P.). However, Chapter 3 will demonstrate that predictable interannual precipitation patterns have not existed in East Africa during the Holocene. Instead, highly variable rainfall and resource availability motivated communities to maximize their subsistence opportunities by changing their subsistence strategies to conform to the environments in which they were trying to survive. Thus, desiccation of the landscape may have forced many previously semi-sedentary agropastoralists to become mobile taking their animals with them as a measure of insuring a food source. It may also have forced other groups to seek a more predictable resource base and restrain mobility close to a base camp located in a so-called “green corridor.”

2.8 Conclusion—The Problem of Defining Pastoralism

In the paragraphs above, I have synthesized some of the major theoretical discussions on how pastoralism can be defined. Further, I have augmented theory with examples from ethnography and archaeology to show the nuances of how pastoralism can play out in different ways in the real world. I have shown that pastoralism does not conform to clean, definitive social or economic categories. Pastoralists engage in a variety of complementary subsistence activities to ensure their survival. They also have a broad range of mobility patterns ranging from sedentary settlements to ephemeral campsites. As a socio-economic group, the differences between pastoral communities seem to exceed the similarities.

The next chapter will review changes in climate to the African continent that began at the end of the Pleistocene that were the framework toward the domestication of animals and the spread of pastoralism throughout Africa. Chapter 4 will review the archaeological evidence pertaining to the introduction of domesticated animals into eastern Africa—the geographic region on which the remainder of this dissertation will focus. Throughout this discussion, it is important to bear in mind that pastoralists share many common attributes, but exhibit many differences as well.

Chapter 3. Paleoenvironmental Background

3.1 Introduction

Archaeologists have long sought to understand the relationship between the physical environment and the development of human culture (e.g. Buckland 1976; Butzer 1971, 1982; Cohen 1977; Colecutt 1979; Dimbleby 1978; Edwards 1979; Evans 1972; Flannery 1973; Harding 1982; Masters and Flemming 1983; Shackley 1982). For over 99% of the species' history, foraging was the only subsistence activity practiced by *Homo sapiens* (Dickson 1988). It is not until after 12,000 years B.P. that husbandry of plants and animals can be detected archaeologically (Bar-Yosef and Meadow 1995; Benz 2001; Hassan and Gross 1987; Reed 1984; Smith 1997; Wendorf and Schild 2001a; Zohary and Hopf 2000). Climate is the greatest single external limiting factor to the success or failure of these endeavors (Bar-Yosef 1966; Binford 1991; Butzer 1971; Flannery 1973; Hassan 1988; Keeley 1995; Onyango-Abuje and Wandibba 1979; Watson 1995; Winterhalder 1981). Thus, a quantitative understanding of the physical environment and biological resources of a prehistoric human community will provide insights on the potential motivations and means that drove human commuities to alter their subsistence strategies from foraging to direct production of food.

The purpose of this chapter is to focus on changes in the climate of Africa since the Last Glacial Maximum (~18,000 ^{14}C years B.P.). In particular, this review will focus on inferred oscillations in the temperature and precipitation from a variety of proxies in the eastern Sahara since domestication of cattle and goats can be identified in the archaeological record (~12,000 – 10,000 cal. years B.P.). This review includes proxy records to expand its focus to the Upper Nile region and East Africa for the middle

Holocene (6,000 – 3,000 ^{14}C years B.P.), where early pastoralists expanded southward and eastward in response to drought in their homelands.

Knowledge of prehistoric climate change has increased dramatically in the last decade. The use of multiple proxies of environmental data has allowed researchers to gain clearer insight into the causes and effects of global climate phenomena (Mann 2002). This review will take advantage of the research being conducted in the Quaternary sciences in Africa and adjacent oceans to gain a clearer perspective on the environmental and climatic variability that affected the sustainability of prehistoric cultures. However, aside from explicit references to documented historical climatic events framed within a broad social context, cultural changes that occurred in this time period will be saved for the subsequent chapter.

3.2 Saharan North Africa

The eastern Sahara was ~7–10 ºC cooler at the Last Glacial Maximum (LGM) than it is today (Kitoh et al. 2001). Sea surface temperatures (SSTs) in the tropical regions also fell by several degrees C as demonstrated by offshore coral records (Beck et al. 1997) and alkenone paleothermometry (Bard et al. 1997; Schneider et al. 1995) taken from numerous tropical locations around the world. Lower SSTs decreased evaporation rates in the tropics, which in turn reduced precipitation throughout most of Africa (Ganopolski et al. 1998b). Summer monsoons over Africa were greatly diminished, which had the effect of desiccating fluvial and lacustrine systems throughout the continent (Gasse and Van Campo 1994).

The southern headwaters of the Nile between 20,000 – 12,500 years B.P. had ceased to deliver surface runoff (Maley 2000) reflecting the disappearance of Lake

Victoria (Johnson et al. 1996; Talbot and Livingstone 1989) and water levels that were 46 m lower than present at Lake Albert (Beuning et al. 1997b). Reduced precipitation in the Ethiopian Highlands constricted but did not altogether halt the flow of the Blue Nile during the LGM dry phase (Said 1993). However, the Saharan dunes extended ~500 km south of their present position and dammed up the flow of water from the Nile north of Khartoum (Grove 1993).

KEY to vegetation reconstruction

Tropical

1. Tropical rainforest of humid tropics
2. Monsoon or dry deciduous forest of warm climates
3. Tropical deciduous woodland with open tree canopy
4. Thorn scrub and scrub woodland
5. Tropical semi-desert (sparse scrub or grassland in a warm climate)
6. Closed tropical grassland devoid of trees and shrubs
7. Tropical extreme desert
8. Savanna (grassland with scattered trees and bushes)

High Latitude and Montane

9. Warm temperate broad-leaved forest
10. Montane evergreen forest adapted to cool temperatures

11a. Mediterranean sclerophyll forest/woodland
11b. Mediterranean sclerophyll scrubland
12. Semiarid temperate scrublands
13. Temperate desert (sparsely vegetated with cool winters)
14. Temperate semidesert (open scrub/grasslands)
15. Temperate and montane steppe with dense grasslands and sward

Other

16. Lakes/open water

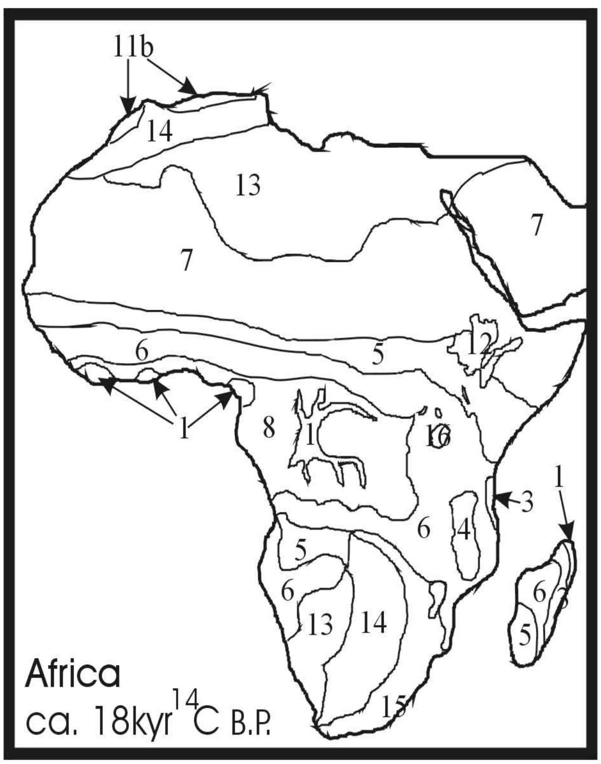


Figure 4. Africa's reconstructed vegetation ca. 18,000 ^{14}C years B.P. (Adams and Faure 1997)

Major hydrological changes occurred in northern Africa after 13,000 years B.P. when massive flooding is recorded along the Nile and Niger Rivers and other minor catchments across Africa (Damnati 2000; Gasse 2000, 2001; Gasse and Van Campo 1994; Giresse and Maley 1998). A rapid shift toward humid conditions is recorded in terrigenous sediments off Cap Blanc, Mauritania after 14,800 cal. years B.P. (deMenocal et al. 2000). The $\delta\ ^{18}O$ signatures in freshwater gastropod shells deposited at ~11,500 years B.P. that have been recently collected from the lower White Nile region indicate that summer monsoons have strengthened significantly (Williams et al. 2000).

The rise in lake levels in North Africa post-LGM is briefly interrupted during the Younger Dryas (YD) period (12,000 – 11,000 ^{14}C years B.P.) when colder and dryer conditions prevailed (Alley and Clark 1999; Alley et al. 1997a; Damnati 2000; deMenocal et al. 2000; Gasse 2000, 2002; Haynes 2001). The YD has been detected by the Greenland Ice Core Project (GRIP) and the Greenland Ice Sheet Project II (GISP2) in the $\delta\ ^{18}O$ and methane (CH_4) records taken from cores of glaciers in central Greenland (Alley et al. 1993; Alley et al. 1997b; Alley and Woods 1996; Cuffey et al. 1995; Fawcett et al. 1997; Gow et al. 1997; Kapsner et al. 1995; Mayewski et al. 1993; Severinghaus et al. 1998; Taylor et al. 1997a; Taylor et al. 1997b). At the LGM, temperatures were an estimated 21 ºC colder than present on the Greenland Ice Sheet (Cuffey et al. 1995). Until ~11,500 years B.P., warming occurred in central Greenland in the magnitude of 15 ± 3 ºC (Alley 2000; Cuffey et al. 1995). However, during the YD, temperatures dropped once again to ~15 ºC below present values (Severinghaus et al. 1998). The effects of this event can be detected globally, although to varying degrees and not always parsimoniously (e.g. Alley et al. 2002; Haynes 2001; Morgan et al. 2002; Schulz et al. 1998).

Active dunes swept across the eastern Sahara at 11,000 cal. years B.P. in response to the YD (Swezey 2001). On the southern margin of the Sahara Desert in eastern Niger, lake carbonates reflect an abrupt shift to arid conditions following a ~2,000 year pluvial phase experienced prior to the onset of the YD (Gasse et al. 1990). In general, lake levels dropped and rainfall was less abundant in the Sahara and Sahel in response to the YD (Lézine and Casanova 1989). Detection of the YD event in the paleoclimate records of northern Africa is consistent with major changes in ocean and atmospheric dynamics found in the low and high latitudes during Holocene deglaciation (Gasse et al. 1990).

A return to pluvial conditions in the eastern Sahara is reflected in a rapid rise in groundwater levels after 9,300 ^{14}C years B.P. (Pachur and Hoelzmann 2000), which resulted in the development of large, freshwater lakes by 7,000 ^{14}C years B.P. (Damnati 2000; Haynes et al. 1989). Changes in the earth's orbital parameters during the mid-Holocene enhanced the amplitude of the seasonal cycle of insolation and subsequently raised SSTs in the Atlantic and increased precipitation across North Africa by >25% (Kutzbach and Liu 1997; Overpeck et al. 1996). Strong seasonal monsoons that had disappeared during the YD are once again detected in the $\delta^{18}O$ record among gastropods living in the lower White Nile River between 8,500 and 7,000 ^{14}C years B.P. (Ayliffe et al. 1996; Rodrigues et al. 2000; Williams et al. 2000). Sediment cores detecting freshwater input into the Red Sea corroborate that higher rainfall and freshwater runoff occurred in the eastern Sahara between 9,250 and 7,250 years B.P. (Arz et al. 2003). Oxygen and carbon stable isotope ratios taken from freshwater mollusk shells and bulk sedimentary carbonate deposits indicate that the summer monsoons extended at least 800 km north of their present range beginning slightly before 9,000 ^{14}C years B.P. (Abell and Hoelzmann 2000). The existence of a large paleolake in western Nubia covering between 1,100 and 7,000 km^2 was established after 8,300 ^{14}C years B.P. that lasted 1,600 ^{14}C years (Hoelzmann et al. 2001; Hoelzmann et al. 2000). Remote sensing conducted from the space shuttle Endeavor has detected the presence of numerous paleolakes across a 15,000 to 45,000 km^2 portion of the eastern Sahara that existed between 8,800 and 4,500 ^{14}C years B.P. (Pachur and Hoelzmann 1991; Pachur and Rottinger 1997). Hoelzmann et al. (2000) estimate that the amount of rainfall needed to generate lakes of this magnitude would be between 500 and 900 mm rainfall / yr. Currently, the same region of western Nubia receives less than 15 mm / yr (Hoelzmann et al. 2000).

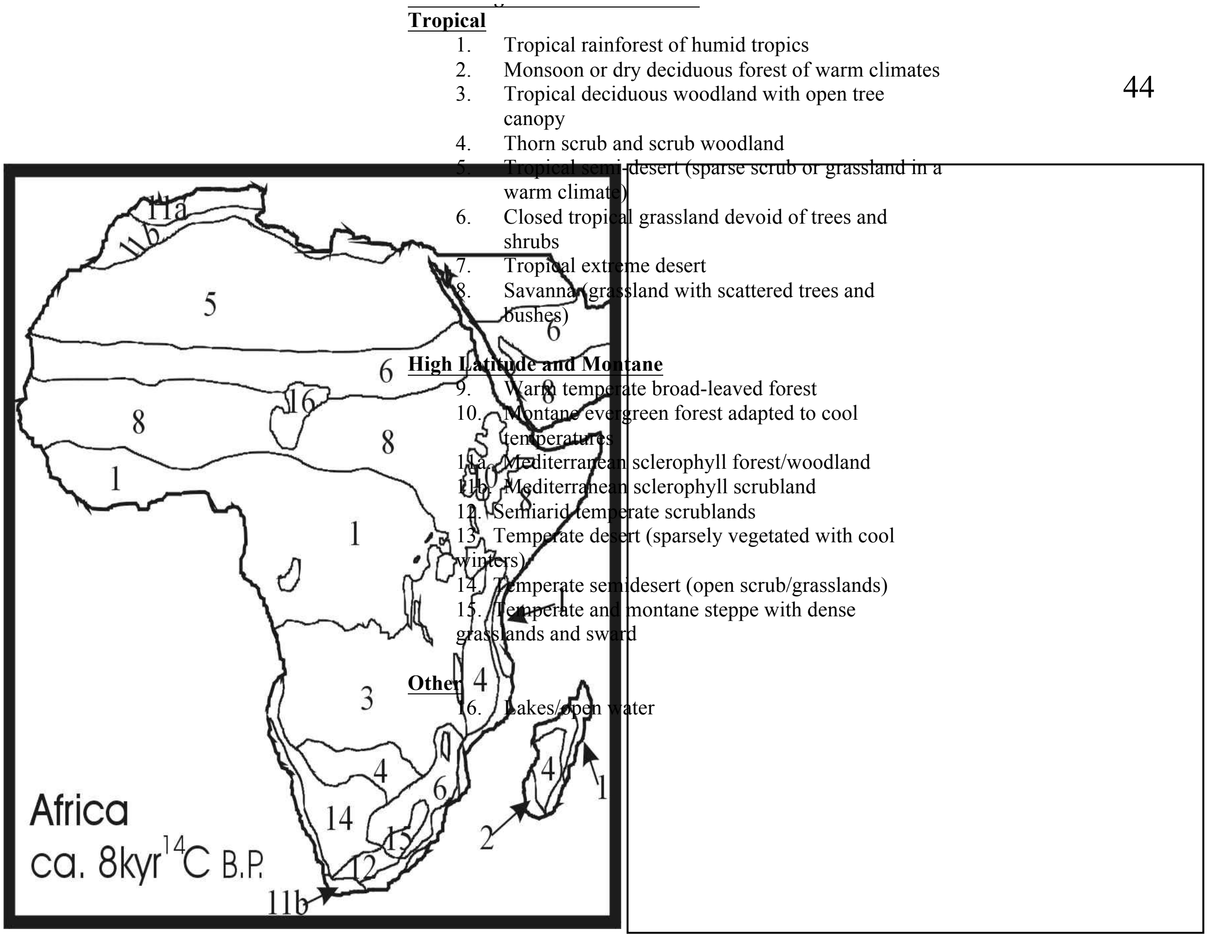


Figure 5. Africa's reconstructed vegetation ca. 8,000 ^{14}C years B.P. (Adams and Faure 1997)

Strengthened monsoonal rainfall from the Indian Ocean constricted arid regions and extended the range of herbaceous vegetation into territory that it is not found in today (Nicoll 2004). The environments between 9,300 and 4,000 ^{14}C years B.P. at 18 ºN were similar to those found at 13 ºN today (Pachur and Hoelzmann 1991; Ritchie and Haynes 1987). It is estimated that at ~6,000 ^{14}C years B.P. desert conditions prevailed north of 23 ºN in the eastern Sahara and 19 ºN in coastal West Africa (Jolly et al. 1998). There was a gradient of diminishing precipitation in the Libyan Desert between 26 ºN and 22 ºN (Pachur and Röper 1984). Today, the Sahara begins at ~15 ºN on both sides of the continent.

However, closed plant cover was not uniformly spread across entire regions but was likely discontiguously concentrated in wadis receiving runoff from adjacent landforms (Pachur and Röper 1984). Local ecotones reflect vegetation regimes as disparate as steppes to open and wooded savannas during the Mid-Holocene Climatic Optimum (MHCO) (Jahns 1995). The tertiary drainages of the eastern Sahara attracted Neolithic settlers as far back as 9,000 ^{14}C years B.P. because they were the best suited areas in the region for sustaining foragers and transhumant pastoralists (McHugh et al. 1989). Riparian vegetation was probably the key to the success of early pastoralists of this region. Although the Saharan climate during the MHCO was more benevolent than it is today, environments far from a permanent source of water were still inhospitable for human colonization (Hoelzmann et al. 2001). Full-coverage archaeological surveys of large tracts of the Sahara have shown that few Neolithic human habitation sites are located more than one or two kilometers from a source of water (Hoelzmann et al. 2001; Mandel and Simmons 2001; McHugh et al. 1989; Pachur and Röper 1984; Wendorf et al. 1984).

Although the mid-Holocene pluvial phase began rapidly after 9,000 ^{14}C years B.P., the event took several centuries to fully terminate in northern Africa (Pachur and Hoelzmann 1998). Radiocarbon ages taken from across the eastern Sahara show that carbonate accretion in paleolakes ended asymmetrically between 5,000 and 4,000 years B.P. depending on a location's ability to retain groundwater in the absence of precipitation to recharge the aquifer (Pachur and Hoelzmann 2000). Some lake carbonates in the southeastern Sahara reflect a weak aridification event beginning after 7,000 years B.P. (Pachur and Hoelzmann 1991), but the present level of aridity was not achieved across the entire region until after 4,000 years B.P. (Haynes et al. 1989; Ritchie et al. 1985; Vernet 2002). The surface water was gone from Selima Oasis by 4,000 ^{14}C years B.P., which was as deep as 20 m between 8,000 and 7,000 ^{14}C years B.P. (Haynes et al. 1989). Strontium isotope ratios from bedload sediments provenienced to the Blue Nile that date to 4,200 ^{14}C years B.P. taken from the Lower Nile River Delta also confirm that a major hydrological shift occurred during this time period as a result of massive erosion stemmed from vegetation desiccation (Stanley et al. 2003). The response of nomadic herding communities to the greening of the Sahara and its subsequent desertification will be discussed in great detail in chapter 4.

Historical analysis of Egyptian texts from the era as well as a plethora of archaeological finds from ^{14}C 4,000 years B.P. confirm that a major environmental perturbation occurred around this time. The collapse of the 6th Dynasty in 2280 B.C. (4,000 ^{14}C years B.P.) and the emergence of First Intermediate Period of Egyptian civilization until 2060 B.C. (3,800 ^{14}C years B.P.) was marked by a lack of centralized authority in the Nile Valley (Bakr 1990). Although it was uncommon for the ancient Egyptian nobility to record their hardships to posterity, fragments of documents and inscriptions from nomarchs (rulers of nomes or districts) who lived at the end of the Old Kingdom reveal widespread famine along the entire extent of the Nile River Valley (Vandier 1934). By the end of the 5th Dynasty, a relief from the pyramid of Unas depicts a group of emaciated people dying of hunger (Smith 1965). Later documents tell of heroic nomarchs who aided their ill-fortuned neighbors through a period of "ṯzw" (term taken to mean famine induced by periods of low waters in the Nile) (Bell 1971). Bell (1970; 1971; 1975) argues that the famine was brought on by a slow but steady reduction in rainfall that charges the Nile River coupled by a failure of the government to cope with the problem.

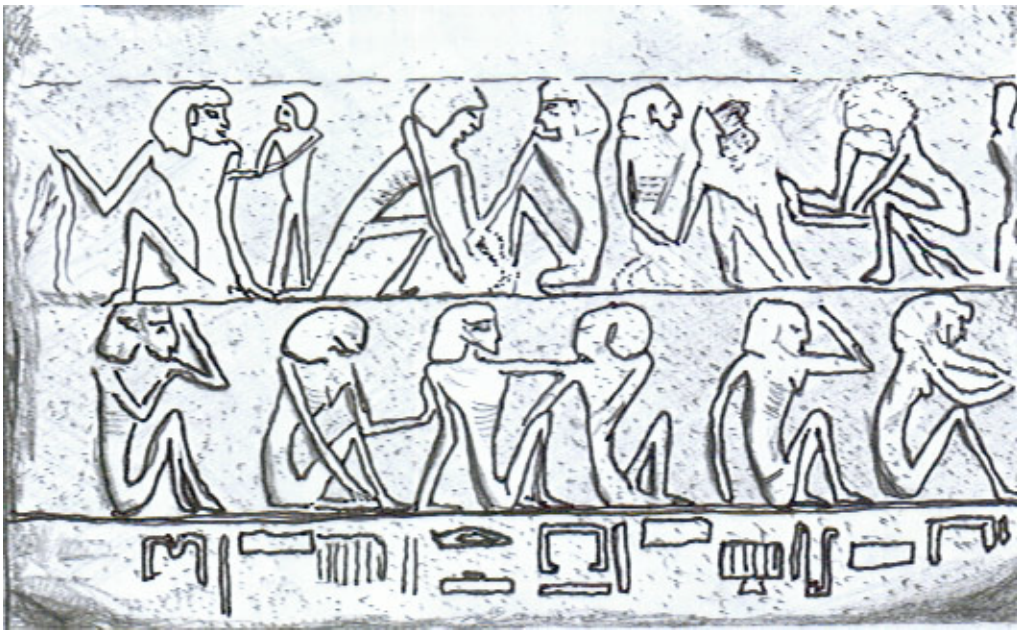


Figure 6. Famine scene from Causeway of Unas, Saqqara, Egypt

Centralized control of the Nile Valley is restored during the Middle Kingdom (2060 – 1785 B.C.) but pharaonic control of the Lower and Upper Nile Valley is initially weak (Bakr 1990). An influx of the Hyksos from southwest Asia is documented after 1729 B.C. (3,300 ^{14}C years B.P.) who challenge pharaonic hegemony until 1580 B.C. (3,200 ^{14}C years B.P.), when Ahmose of Thebes expelled them (Bakr 1990). After 3,100 ^{14}C years B.P., historical sources (Bell 1975) and carbonate δ ^{18}O records (Schilman et al. 2001) indicate that the rains gradually returned to the headwaters of the Nile providing ample flooding to accommodate agricultural needs. However, Bell (1975) believes that based on written texts, the Nile River never returned to the levels it achieved during the mid-Holocene. She concludes that the reestablishment of strong centralized control during the Middle Kingdom did not occur because seasonal flooding on the Nile returned full-force, but happened after Egyptian civilization adjusted to the diminished rainfall levels that set in after 4,300 cal. years B.P. (Bell 1975).

3.3 East Africa

The eastern and northern African paleoclimatic records since the LGM are fairly consistent (Flenley 1998; Gasse 2000; Jolly et al. 1998; Olago 2001; Thomas and Thorp 1995). A cooler and drier climate was found throughout the region and is reflected in the lowering of snowlines by ~1,000 m below present on equatorial mountain glaciers (Grove 1993), a lowering of Lake Turkana water level by ~300 m (Gasse 2000) and the complete desiccation of shallow water bodies such as Lake Victoria which arose from a dry landscape after 14,600 years B.P. (Johnson et al. 2000). Pollen analysis of sites throughout East Africa show that C_4 grasslands expanded by thousands of km^2 at the expense of forests between 22,000 to 14,000 years B.P. (Bonnefille and Chalié 2000; Olago 2001; Street-Perrott et al. 2004) and the estimated average temperatures for the region are 4 – 5 ºC cooler than at present (Jolly et al. 1998).

The vegetation in East Africa after 11,000 years B.P. shifted to a temperate microphyllous shrubland at higher elevations with tropical or dry forests in the lowlands (Jolly et al. 1998). On Mount Kenya, C_4 grasses and sedges around Sacred Lake are replaced by C_3 moist rainforest vegetation indicating a shift to warmer and wetter conditions (Huang et al. 1999; Street-Perrott et al. 2004) and are coeval with a rise in the global level of CO_2 (Wooller and Agnew 2002). There is a sudden change from herbaceous grass pollens adapted to arid climates to deciduous forest vegetation such as *Olea* sp., *Macaranga* sp., *Celtis* sp., *Acalypha* sp. and *Alchornea* sp. surrounding Lake Albert between 12,500 and 11,000 years B.P. (Beuning et al. 1997b). Pollen analyses conducted on cores taken from Lake Magadi, Kenya (a high altitude lake) also show a change in flora from arid to humid species occurred between 12,000 and 11,000 ^{14}C years B.P. (Vincens et al. 1991). Reduced ^{13}C values from 12,300 to 10,600 years B.P. are interpreted as reflecting the establishment of an arboreal forest in the catchment of Lake Tanganyika marking an increase in temperatures and humidity (Gasse et al. 1989).

The early Holocene pluvial phase in East Africa is interrupted by the YD event at about the same time that it occurs in the Sahara. Perhaps the most complete records for the YD in East Africa come from Lake Magadi in southwest Kenya (Roberts et al. 1993). Diatom assemblages, geochemistry and magnetic mineralogy of ^{14}C and U/Th dated laminae show that the climate grew considerably more arid between 11,000 and 10,000 ^{14}C years B.P. (Roberts et al. 1993). Lake levels fell at ~11,100 ^{14}C years B.P. and at ~10,800 ^{14}C years B.P. they achieved their lowest levels for the Holocene (Roberts et al. 1993). After the YD, the lake level rose to peak values by ~10,200 ^{14}C years B.P. breaching a sill at +35 m sill—a similar level to that reached at ~12,000 ^{14}C years B.P. (Roberts et al. 1993). Progressive and general weakening of the monsoon rainfall throughout East Africa during the YD is believed to have been responsible for the arid conditions (Williamson et al. 1993).

East Africa as a whole began to grow warmer and wetter after the YD approaching the MHCO (Bonnefille and Chalié 2000; Gasse 2000; Jolly et al. 1998; Olago 2001; Peyron et al. 2000). Beuning (1997b) finds a reduction in the arid flora pollen in the lake cores of Lake Albert throughout the Mid-Holocene as compared to during the YD. Additionally, Lake Turkana rises to >100 m above present levels from 10,000 to 4,500 years B.P. (Bonnefille and Chalié 2000), but began to steadily decline in levels after 7,500 years B.P. (Butzer et al. 1972; Owen et al. 1982). Modeled analysis of the ratio of potential evapotranspiration indicates that conditions at 6,000 years B.P. were equal to or wetter than today (Peyron et al. 2000). During this period, precipitation anomalies exceeded +50mm/yr. north of 3 ºS in East Africa while they registered ≤+50mm/yr. south of 3 ºS (Peyron et al. 2000).

Thompson et al. (2002b) find that F^- and Na^+ concentrations are generally low after 11,700 ^{14}C years B.P. on Mount Kilimanjaro, permeated by sporadic positive shifts until present levels are achieved at 4,000 ^{14}C years B.P. Positive F^- and Na^+ shifts are indicative of aridification in spite of the general pluvial trend in East Africa during the mid-Holocene (Thompson et al. 2002b). Additionally, the ice core record at Kilimanjaro shows an abrupt reduction in $\delta\ ^{18}O$ values between 6,500 and 5,000 ^{14}C years B.P., denoting more humid and warm conditions than exist today, but less pronounced than during the MHCO (Thompson et al. 2002a; Thompson et al. 2002b). Thompson et al. (2002b) conclude that the fluctuations detected in the Kilimanjaro cores correlate with reductions in methane (CH_4) and ^{18}O found in Greenland ice cores by the GRIP and GISP2 projects.

Thompson et al. (2002b) also report that a sharp reduction in ice on the summit of Mount Kilimanjaro after ~4,000 ^{14}C years B.P. is concurrent with the "First Dark Age" that has been blamed as a catalyst for the collapse of the Akkadian Empire, Indus civilization in southwest and south-central Asia, the end of the first Greek Bronze Age, the demise of Neolithic cultures in the central plains of China as well as the Old Kingdom of Egypt as referenced above (see also Dalfes et al. 1997; deMenocal 2001; Wenxiang and Tungsheng 2004). A major regression is recorded among numerous African lakes during this period (Beuning et al. 1997a; Damnati 2000; Gasse 2000, 2002; Gasse and Van Campo 1994). Analysis of a $\delta^{18}O$ profile of inorganic calcites cored from Lake Turkana show an abrupt and major shift to arid conditions at 4,000 years B.P. (Ricketts and Johnson 1996). Diatom analysis of a central Tanzanian crater lake confirms the presence of arid taxa (*Aulacoseira* spp.) surrounding the lake from 4,100 to 1,700 years B.P.

The contention that the East African climate was much wetter and warmer than present prior to 5,600 years B.P. is further evidenced by the spread of equatorial forests into the low altitudes (Ambrose and DeNiro 1989). Deciduous forest cover surrounded Lake Victoria from 12,000 to 10,000 years B.P., giving way to a coniferous forest after 7,000 years B.P. (Hamilton 1982; Van Zinderen Bakker 1976). The pollen records of Lake Naivasha also reflect high rainfall patterns and warmer temperatures between 9,200 and 5,700 years B.P. turning dry until about 3,000 years B.P. when rainfall increases slightly to its present levels (Butzer et al. 1972; Marean 1992; Van Zinderen Bakker 1976). By 3,000 years B.P., Lake Naivasha completely dried up (Butzer et al. 1972; Marean 1992). Human population densities are the highest between 5,700 and 4,400 years B.P. and the lowest at the peak of the dry phase (3,400 to 2,500 years B.P.) (Ambrose and DeNiro 1989). Grazing by domesticated animals keeps grasses short and maintains grasslands (Marean 1992). The decline in forest cover between 3,000 and 2,000 years B.P. could have resulted as a result of the actions of man or a naturally drier climate (Butzer et al. 1972). Hamilton (1982) believes that humans had little impact on the environment before 2,000 years B.P. based on his interpretation of the pollen records.

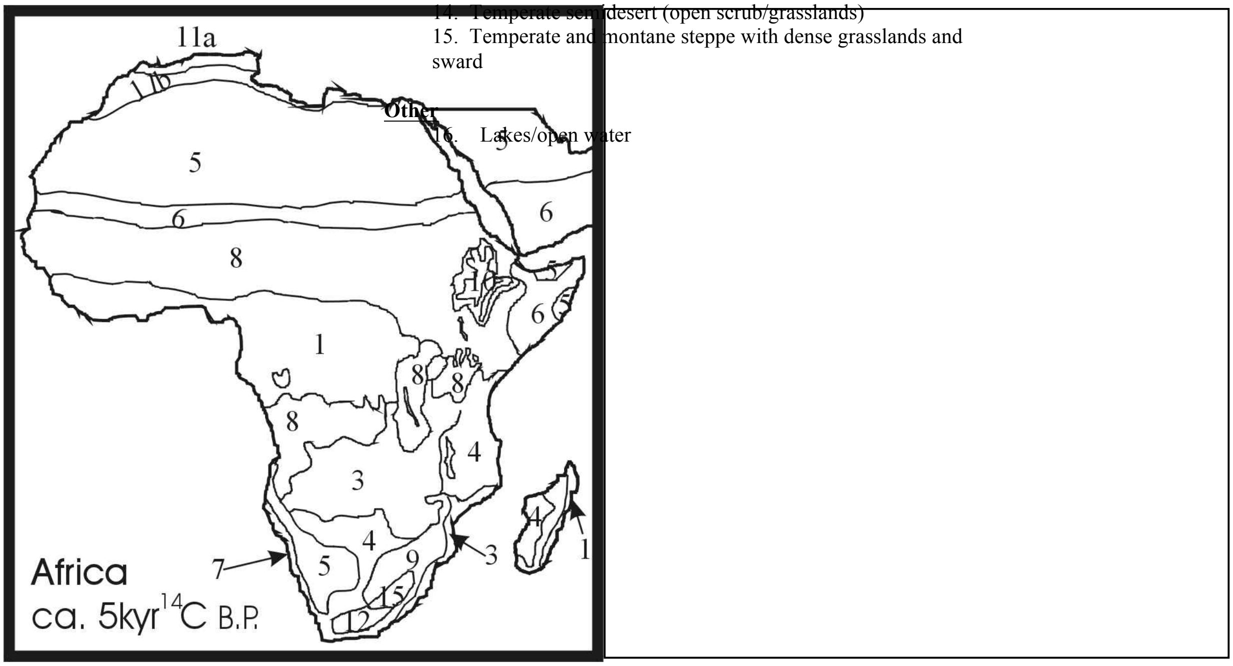


Figure 7. Africa's reconstructed vegetation ca. 5,000 ^{14}C years B.P. (Adams and Faure 1997)

Major regressions in the Ituri Forest cover are likewise recorded between 4,200 and 3,000 years B.P. in Central Africa (Elenga et al. 2001; Runge 2002; Vincens et al. 1998; Vincens et al. 1999). The once vast tropical rainforest Ituri spanned hundreds of thousands of square kilometers abutting the eastern and western coasts of Africa during the MHCO (Corlett 1995). After 4,000 years B.P., the breakup and desiccation of the equatorial forests ensues within centuries (Vincens et al. 1999). The last vestige of this pan-continental forest remains in western Kenya as the Kakamega Forest where hunter-gatherer communities lived into modern times (Obura 2001). The recession of the forests has left large tracts of open savanna grasslands from the Rift Valley to the Indian Ocean coastal plains (Lewis and Barry 1988).

A prominent reduction in pollen concentration possibly reflecting a reduction in evapotranspiration is found in Lake Victoria after 3,500 years B.P. (Stager and Johnson 2000b) although other cores in the same water body show seasonal climates prevailing from 7,200 to 2,200 years B.P. changing to an arid climate after 2,200 years B.P. (Stager et al. 1997b). On the other hand, Talbot and Lærdal (2000) argue that climate fluctuations around Lake Victoria from 13,500 to 2,000 years B.P. were not significant enough to affect the isotopic or elemental composition of cores they analyzed.

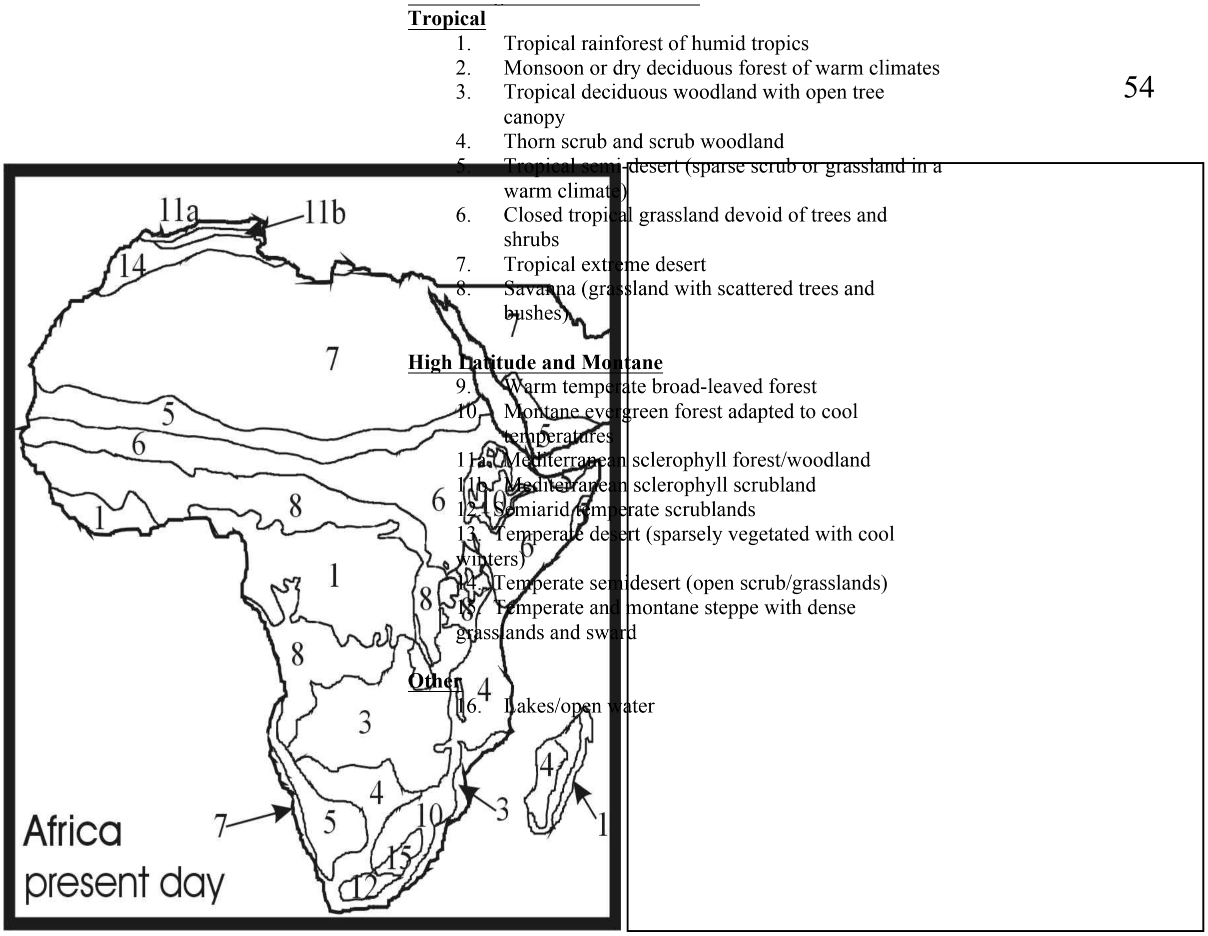


Figure 8. Africa's present day vegetation landcover (Adams and Faure 1997)

An abrupt shift to arid conditions is registered in the geomorphology of fluvial systems throughout the seasonally humid regions of Africa in what are now the semi arid ecosystems (Thomas and Thorp 1995). Jolly et al. (1998) report that the desiccation of vegetation in East Africa beginning after 6,000 years B.P. resulted in the creation of a continuous desert corridor from Somalia to Kenya. However, this assertion does not account for the existence of "green corridors" present along major fluvial systems such as the Tana and Galana-Sabaki. Thompson et al. (2002b) demonstrate that seasonal movements of Mount Kilimanjaro glaciers have occurred throughout the Holocene. All East African highland glaciers have retreated since 4,000 ^{14}C years B.P. (Karlen et al. 1999; Rietti-Shati et al. 2000; Thompson et al. 2002b), resulting in increasing river discharge especially in the Galana catchment (Wijngaarden and Engelen 1985). Furthermore, the replacement of deciduous arboreal cover with herbaceous grasses had the effect of increasing overland flow and decreasing groundwater infiltration of precipitation (Vernet 2002: 49). Thus, the effect of the desiccation of vegetation from the landscape during the mid-Holocene would have resulted in the creation of green corridors concentrated along fluvial systems as the surrounding landscape grew increasingly drier.

3.4 Shift in Seasonality in East Africa

In the sections above, we discussed the chronological connections between the events of the last deglaciation of the northern hemisphere after 18,000 ^{14}C years B.P. and how they were correlated with climate changes across northern and eastern Africa. However, it would be inaccurate to assume that climate processes are driven from a single region (such as the northern latitudes). Instead, the interplay of forcing mechanisms such as seasonal orbital insolation (Bonfils et al. 2001; Braconnot et al. 1999; Broecker et al. 1998; Bush 2001; Cole et al. 2000b; deMenocal and Rind 1993; Hagelberg et al. 1994; Joussaume et al. 1999; Kutzbach and Liu 1997; Partridge et al. 1997; Petit-Maire and Guo 1997), vegetation feedbacks (Braconnot et al. 1999; Brostrom et al. 1998; Carrington et al. 2001; Clark et al. 1999; Claussen 1997; de Noblet-Ducoure et al. 2000; Delire et al. 2001; deMenocal et al. 2000; Doherty et al. 2000; Douville 2002; Foley et al. 1994; Hutjes et al. 1998; Wasson and Claussen 2002), changes in the thermohaline circulation (Alley 2000; Alley et al. 2001; Alley and Clark 1999; Alley et al. 1997a; Bond et al. 1997; Clark et al. 1996; Clark et al. 1999; Clark et al. 2002; deMenocal et al. 2000; Ganopolski et al. 1998a; Ganopolski et al. 2001; Ganopolski et al. 1998b; Morgan et al. 2002; Petoukhov et al. 2000; Rind et al. 2001) and more recent anthropogenic inputs to the system (Alley 1990, 1991; Alley and Clark 1999; Alley and Whillans 1991; Elenga et al. 1994; Ganopolski et al. 2001; Kapsner et al. 1995; Petit-Maire 1999; Petit-Maire and Guo 1997; Rind et al. 2001) synergistically affect weather and climate patterns globally (Alley et al. 2002; Broecker et al. 1998; Elenga et al. 2000; Gow et al. 1997; Morgan et al. 2002; Partridge et al. 1997; Prentice and Jolly 2000; Severinghaus et al. 1998). Large-scale global climate phenomena such as El-Niño Southern Oscillation (ENSO) have had drastic repercussions on human societies over the millennia—empires have risen and fallen in response to the success that they have in managing their environment (Claussen et al. 1999; Fagan 1999). Much of the remainder of this dissertation will focus on climate variability and how a human community can respond to tremendous environmental and climatic variability. It is my hypothesis that ENSO variability coupled with the general trend toward aridification of the northern and eastern African landscapes during the Late Holocene largely fueled the movement of pastoralism into East Africa and beyond.

Known as the "Christ Child" for centuries to the inhabitants of coastal Peru because it usually arrives in December, El Niño is marked when warm surface waters in the eastern Pacific Ocean disrupt the flow of the cool Humboldt Current (Glantz 1996). The phenomenon is marked by catastrophic losses to the anchoveta population as well as extremely high amounts of rainfall along the coastal deserts west of the Andes (Blanco et al. 2002; Coelho et al. 2002; Sanchez et al. 2000; Suplee 1999). La Niñas usually follow El Niños and have the opposite effect on the region, bringing colder waters and rainfall well below the average annual mean (Blanco et al. 2002; Kane 1999).

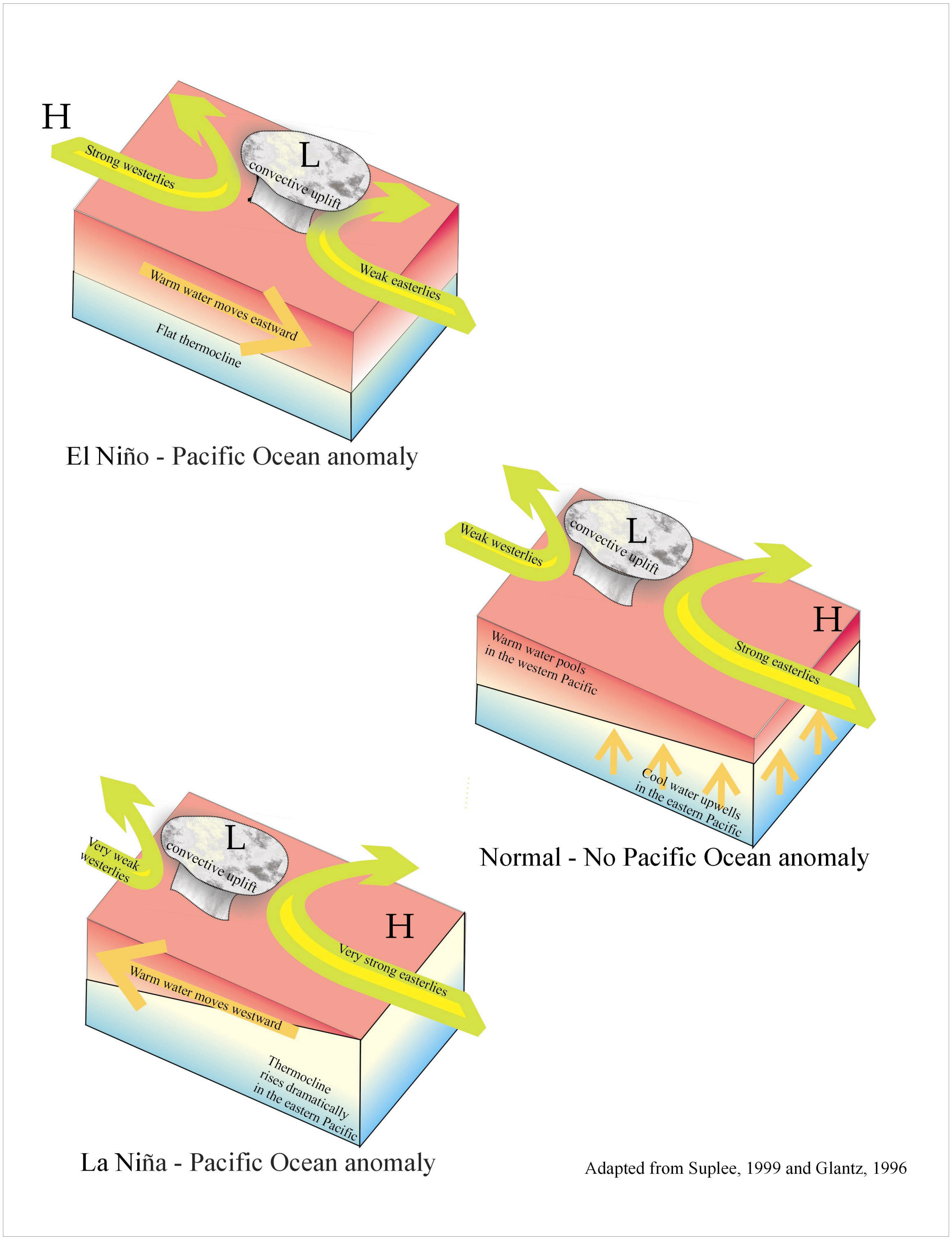


Figure 9. Model of El Niño / La Niña cycles

However, ENSO is more than just a regional weather aberration that affects South America. For over a century, weather stations on Darwin, Australia and Papeete, Tahiti have been measuring the oscillation of barometric pressure systems over the Pacific basin (Glantz 1996). El Niño years are marked when a high surface pressure ridge develops over Darwin and a corresponding low-pressure system is found over Tahiti, and vice-versa for La Niñas (Latif et al. 2001). Strong oscillations in the pressure gradients interrupt the Walker circulation—a continental-scale convective system that operates at low latitudes (Figure 9) (Alexander et al. 2002; Deser and Wallace 1990). There is a warm pool of water in the Indonesian Pacific during non-El Niño years that generates convection and keeps the tropical eastern Pacific wet while the corresponding cold waters that flow along coastal Peru keep the western South American coast hyperarid (Glantz 1996: 46). During an El Niño episode, the high pressure gradient that builds up in the western Pacific and resulting low pressure ridge that occurs off the shores of Peru weakens the easterly surface trade winds across the Pacific basin allowing the warm tropical waters to disperse from Indonesian seas and aggregate thousands of kilometers east (Chiang and Sobel 2002; Lee et al. 2002; Wajsowicz and Schneider 2001). The redistribution of warm and cold water and the associated displacement of zones of regional convective uplift alters weather systems globally in ~4 to 7 year cycles (Chen and Houze 1997; Chiang and Sobel 2002; Deser and Wallace 1990; Kawamura et al. 2001; Pfeiffer et al. 2004; Pinker and Laszlo 1992; Su and Neelin 2002).

The effect of El Niño in eastern and northern Africa has been generally associated with increased rainfall due to a strengthening of the winter monsoons from elevated SSTs in the western Indian Ocean (Anyamba et al. 2002; Barnston et al. 1996; Camberlin et al.

2001; Jury et al. 2002; Nicholson 1997; Nicholson and Kim 1997; Su et al. 2001). Recent studies have shown that a strong east/west dipole develops over eastern Africa during periods of strong Southern Oscillations (SO) (Black et al. 2003; Clark et al. 2003; Indeje et al. 2000). The western Rift Valley and northern Tanzania have anomalously low precipitation during positive (El Niño) phases, while the Indian Ocean littoral and Lake Victoria basin record anomalously high rainfall levels (Indeje et al. 2000). Warmer than normal SSTs (~1 – 2 ºC) at the East African coast are responsible for heavy rainfall associated with El Niños, but also have the effect of weakening the circulation in the lower troposphere, thereby diminishing rainfall over the western portions of the region (Sun et al. 1999a). Heavy precipitation over Lake Victoria has been attributed to the convergence of warm westerlies generated from the Atlantic and warm, but weakened easterlies from the Indian Ocean (Sun et al. 1999b). At the same time, monsoonal flow and its associated precipitation over the northern and southern regions of the continent are sharply weakened during a positive ENSO event (Xue 2001). Variability in precipitation exhibited during El Niños depends on the intensity of the pressure oscillations in the tropical Pacific Ocean (Charles et al. 1997; King'uyu et al. 2000; Ogallo 1988). In sum, oscillations in the Southern Index result in highly variable and unpredictable rainfall patterns for most of eastern Africa.

However, the early Holocene record of ENSO shows that the events occurred at diminished frequencies compared to present episodes (Clement et al. 2000; Cole 2001; Corrège et al. 2000; Gagan et al. 1998; Liu et al. 2000; Moy et al. 2002b; Sandweiss et al. 2001; Sandweiss et al. 1996; Shulmeister and Lees 1995; Tudhope et al. 2001). In a 7-m core taken from an alluvial drainage taken from Laguna Pallcacocha, Peru, a 12,000-year record shows that prior to 7,000 cal. years B.P., the laminae spectra do not reflect an ENSO signature. After 7,000 years B.P., there is a gradual increase in ENSO periodicities that achieve maximum frequency at 1,200 years B.P. and decrease until the present day (Moy et al. 2002b). Analysis of mollusk species present at archaeological sites in coastal Peru (Rollins et al. 1986; Sandweiss et al. 2001), isotope ratios in *Porites* sp. corals from the southwest tropical Pacific (Corrège et al. 2000), the Great Barrier reef (Gagan et al. 1998) and New Guinea (Tudhope et al. 2001), terrestrial pollen cores from northern tropical Australia (Shulmeister and Lees 1995) and modeled responses to orbitally induced changes in solar forcing (Clement et al. 2000; Liu et al. 2000) independently corroborate that the southern oscillation during the Holocene begins in century scale frequency after 7,000 years B.P. and achieves subdecadal variability between 2,000 and 1,000 years B.P. (see also Cole 2001).

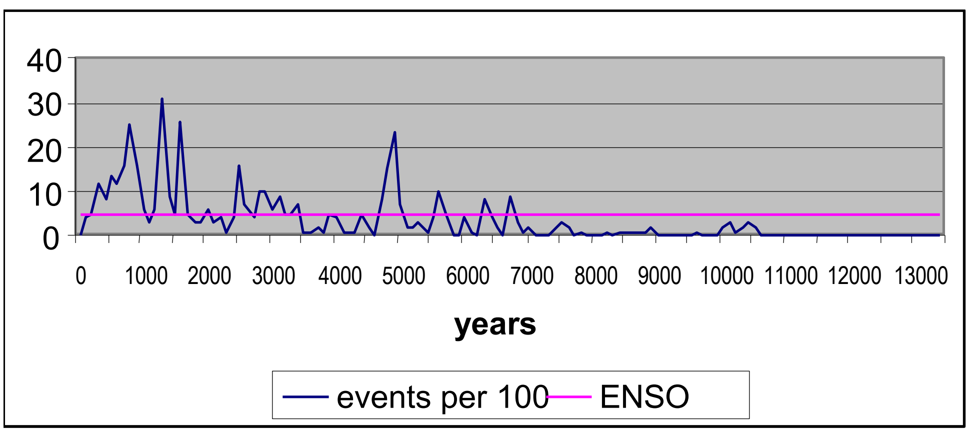


Figure 10. ENSO variability reflected in laminae spectra from Laguna Pallcocha, Ecuadorian Andes (Moy et al. 2002a, b)

These data indicate that El Niño related precipitation perturbations were significantly less frequent until after the MHCO was giving way to a generally more arid environment throughout most of the African continent. The effects of maximum SO on African climates between ~3,500 to 2,400 years B.P. and 1,800 years B.P. until modern times have been profound. Using a multivariate regression model, Jury et al. (2002) account for 40% of the precipitation variance at zero-lag from three distinct regions of the African continent through changes in zonal winds driven by ENSO-related adjustments in the global SSTs. Saji et al. (1999) find that ENSO is responsible for 12% of the SST variability in the Indian Ocean. Other studies have found that the interplay between ENSO and the North Atlantic Oscillation (NAO) account for 25-50% of the rainfall variance (Ward 1998), hence 75% of the interannual vegetation variability in the Sahara region (Oba et al. 2001). ENSO has even been strongly correlated to infestations of locusts in southern Africa—a reflection of the increased precipitation incurred during La Niña episodes (Todd et al. 2002). However, no studies have been performed to date in Africa that show the effects of ENSO during its maximum variability (but see Damnati (1993) for a laminae spectra analysis from Lake Magadi, Kenya that reports cyclicites of varying frequencies related to the global climatic cycle, but not exclusively attributable to ENSO).

3.5 Conclusion—Climate Variability and Change from a Cultural Perspective

Acceleration of the frequency and magnitude of ENSO events during the mid Holocene caused climates to be less predictable thus necessitating a cultural response by human communities that were most affected by anomalous weather (Fagan 1999). The general desiccation of the northern and eastern African landscape after the MHCO coupled with increasingly erratic monsoon-driven precipitation has not only been detected in the paleoclimatological record, but is alluded to in the texts of the ancient Egyptian civilization. Cultures that were largely dependant on mobile food sources would have faced greater challenges feeding themselves than the sedentary agriculturalists along the Nile River delta during the mid-Holocene (Park 1992).

The next chapter will examine the domestication of animals and subsequent spread of pastoralism from Saharan to sub-Saharan Africa. Our understanding on the stimuli that catalyzed the migration of some pastoralists from the Saharan region southward into the rest of the continent is greatly enriched by our knowledge of the Quaternary landscape. The ability to rapidly adapt to failing rains was not as important to the pastoralists living during the MHCO as it was to those occupying the desiccating landscapes at ~4,000 years B.P. We will see that different responses were evoked to shifting precipitation and vegetation regimes during the Holocene. These responses are crucial for defining the cultural parameters that accommodated the movement of pastoralism throughout Africa and timeframe that this movement took. From this knowledge, we are gaining a clearer insight into the environmental and social conditions from which pastoralism initially evolved and building a foundation upon which modern pastoralism can be understood. If the pastoral lifestyle is to survive past the 21st century, we must use our knowledge of past environmental and cultural pressures to develop strategies of sustainability that account for past and future needs of pastoral people (Goldschmidt 1981a; Stiles 1981).

Chapter 4. Origins of Food Production in Africa

4.1 Introduction

This chapter will discuss the theoretical and archaeological dimensions of the introduction of food production in Africa. First, general models that explain the transition from a foraging lifestyle to one that revolves around the dependence on domesticated food products will be reviewed. As discussed in the introduction, the transition from a foraging-based economy to one that is engaged in direct production of food is one of the most important and contentious topics with which archaeologists are concerned. The signatures that mark the transition are not always very clear. Some archaeologists believe that rapid climate change and population pressure are the two primary catalysts for the adoption of domesticates. Others believe that the transition is much more gradual and therefore difficult to discern. Another school of thought contends that the adoption of domesticated plants and animals was prompted by the need of elites to solidify their prestige and engage in competitive feasting, which in turn necessitates creating food surpluses made possible only through direct food production. Each model argues for a different level of commitment and consciousness to the process of domestication on the part of the participants.

The second part of this chapter will be devoted to reviewing the archaeological evidence for the movement of domesticated animals from northern into eastern Africa. Data will be presented from archaeological sites that bear evidence of incipient adoption of domesticates and critically analyzed against the paradigms presented in the first part of the chapter. Whether domesticated animals actually “spread” into eastern Africa from the north remains disputed, most archaeologists and geneticists agree that independent domestication of cattle in East Africa probably did not occur (Ambrose 1998; Bower 1996; Gifford-Gonzalez 1998a, 2000; Loftus and Cunningham 2000; Loftus et al. 1999; Loftus et al. 1994; Marshall 1990c, 2000; Phillipson 1993a; Robertshaw 1990b). Therefore, we will examine domestication of animals (specifically cattle) from the earliest archaeological traces in northern Africa and track their movement through time and space into eastern Africa. This discussion will provide a useful background to the chapters that follow not only in the timeframe and origins of domesticated animals in East Africa, but also of the contemporary understandings of changes in material culture in the late Holocene that occurred simultaneously as dependence on domesticated animals increased. Subsequent chapters will augment the understandings presented in this review by offering an alternative perspective on the Pastoral Neolithic in East Africa based on excavations and analyses resulting from a field season described in Chapter 5.

4.2 The Models

4.2.1 Gradual Adoption of Food Production

Some archaeologists believe that the process of domesticating plants and animals was slow and primarily unconscious (Harlan et al. 1973; Rindos 1984). Rindos (1984) contends that domestication is a "coevolutionary" process, whereby certain plants and animals are brought into symbiotic relationships with humans. The earliest forms of pastoralism are most commonly found in areas that once had numerous exploitable wild animals, but a new set of environmental or demographic constraints made hunting a more difficult occupation towards meeting a group's subsistence needs. Given that, people occupying these regions were forced to provide themselves with alternative sources of protein and fat. In many areas of the world, domesticating animals was a solution to increased resource constriction.

Wendorf and Schild (1998) argue that gradual, but consistently more arid changes to the ecosystem of the northeastern Sahara after ~10,000 cal years B.P. drew humans and proto-domesticates into ever closer spheres of interaction (see also Hassan 2000; McDonald 1998). In ecosystems that are unpredictable or are otherwise predictably arid, interdependence between humans and wild species through range and breeding management was commonly practiced in prehistoric Africa to ensure the perpetuation of a dependable food source, even if it wasn't necessarily a permanent arrangement (DiLernia and Cremaschi 1996). In Bökönyi's (1989: 22) definition of domestication, there is, by necessity, a mutually beneficial relationship established between humans and the animals they capture and domesticate. However, the benefits of entering into this relationship might not have been immediately apparent to both species initially. Modern attempts to domesticate animals such as the goose (*Anser* sp.) (Bottema 1989), elk (*Alces alces*) (Zeuner 1963) and eland (*Taurotragus oryx*) (Clutton-Brock 1987) have shown that successful domestication processes can take many generations to complete and are taxing on both the animals and humans participating in the process.

Once they had been fully domesticated, the secondary benefits of cattle and caprines were discovered and exploited. The milk and blood of these animals is extremely nutritious, providing an excellent source of calcium, protein, iron, and calories (Clutton-Brock 1987). These are renewable resources that can be taken advantage of when herd densities are low and little else is available to eat. Wool and other textiles can be made from goats and sheep without killing the animal as is necessary in producing hides from wild ungulates and carnivores. Large animals (camels, horses, cattle, llamas, alpacas, donkeys) are used as beasts of burden in many areas of the world as well.

4.2.2 Rapid Adoption of Food Production in Response to Environmental Crises

Cohen (1977) proposes a model of domestication that argues the transitions to food production can be rapid in the face of serious environmental and demographic pressures. Foraging groups have little incentive to adopt food production techniques in ecosystems that are in a state of equilibrium (Bar-Yosef and Belfer-Cohen 1991). Only in a food shortage crisis do foragers have an incentive to alter their subsistence strategies in order to meet the demands of a dwindling food supply (Binford 1968; MacNeish 1992).

Cohen (1977) and Rindos' (1984) view of domestication has been interpreted as antithetical to each other (Watson 1995). However, Bender (1978) contends that the difference between general food production and agriculture (under which I will also add pastoralism for the purpose of this argument) is the level of *commitment* a human society makes toward producing their food. In this context, the lines between calculated foraging and proto-domestication become very blurred. Hunter-gatherer groups have always maximized their potential yield from the land by using calculated mobility cycles to procure the most amount of food while minimizing their energy expended (Binford 1968; Winterhalder 1981). Movement between foraging areas is followed in predictable annual patterns where foragers know that certain resources will become available at certain times of the year.

Throughout the Pleistocene, foraging groups were undoubtedly aware of their ability to alter the environment to their benefit. As mentioned in Chapter 2, precolonial

Australian Aborigines continuously burned large tracts of land with the direct understanding that the perpetuation of their ecosystem, within which they were extremely well adapted, depended on frequent fires (Pyne 1991). Aborigines are documented as having carried torches with them everywhere they went, continuously lighting fires so that the first Europeans to visit the island continent believed that they had arrived in an earthly version of hell (Pyne 1991). Flannery (1968: 68) argues that every forager knows that if a seed is placed in the ground, a plant will grow. However, even Terrell et al.'s (2003: 359) continuum of landscape domestication and manipulation recognizes a difference between Australian Aboriginal foraging strategies and "what sharecroppers have done in Arkansas, or wheat farmers do in Kansas." Thus, it still seems a viable endeavor to understand when and how humans stopped exclusively taking the bounty of the land and began producing from it.

Rindos' (1984) model of domestication takes a gradualist view of the evolution of food production, but Cohen (1977) does not explicitly rule this out. All models of plant and animal domestication that center on fluctuations in the environment acknowledge that transitions to large-scale food production do not occur in the absence of some form of resource strain. Rindos (1984) sees numerous independent events that eventually culminate in the evolution of the agricultural (and presumably pastoral) lifestyle. Cohen (1977) believes that the late-Pleistocene climate changes and population explosions rapidly and radically impacted foraging communities in Southwest Asia and the transition occurred relatively rapidly. However, most modern scholars have come to a consensus that there were genetic and social precursors to the domestication of plants and animals, but that the post-glacial desiccation of the ecosystem in the Mediterranean region was the primary catalyst toward dependence on food production techniques (Zohary and Hopf 2000).

In Chapter 3, I showed that the paleoclimatological record from the Sahara indicates warming of between 7–10 ºC since the LGM with a mid-Holocene pluvial event and subsequent aridification. However, the effects of these events were not felt uniformly across the region, nor were they rapid enough to be felt within one generation (with the possible exception of the 4,000 year B.P. pan-northern hemispheric drought). The archaeological record is not clear on how rapidly the transition occurred from an existence that relied solely on food collection to one that was based on food production since there is no continuous record at any number of sites to demonstrate the timeframe of the domestication process itself.

The clearest record of the effects that climate change had on the subsistence strategies of Saharan communities is best reflected in the archaeological record of the West Nubian Paleolake presently located 100 km southeast of the Libyan-Chad-Sudanese border convergence. Archaeological sites identified as occupied between 6,300 – 3,500 ^{14}C years B.P. show a marked transition from sedentary or semi-sedentary foraging settlements that focused on exploitation of lacustrine resources to ephemerally occupied pastoral campsites as aridification increasingly intensified in the Sahara (Hoelzmann et al. 2001; Pachur and Hoelzmann 1991). During the pluvial period, intensive occupations characterized by dense accumulations of Laqiya and "Dotted Wavy-Line" ceramics reflect an environment rich in natural resources which allowed flexibility in foraging strategies for the sites' inhabitants (Hoelzmann et al. 2001; Pachur and Hoelzmann 1998, 2000). Later occupations of sites bearing Leiterband and Halbmond-Leiterband ceramics show that land utilization strategies were more restricted during the time period when the Sahara was becoming extremely arid. Mobile people herding domesticated animals inhabited the later sites, which have very few material culture remains and are interpreted as temporary campsites (Hoelzmann et al. 2001; Pachur and Hoelzmann 1998, 2000). From this evidence, a rapid transition from foraging to a reliance on domesticated animals occurs relatively rapidly between 5,400 – 5,100 ^{14}C years B.P. but does not represent an area from which domesticated animals were brought under human control (Edwards et al. 2004; Loftus and Cunningham 2000; Loftus et al. 1999; Loftus et al. 1994).

The hypothesis of "landscape domestication" presented by Terrell et al. (2003) proposes that human manipulation of the environment is a natural consequence of human occupation within an ecosystem. As pluviation and aridification events occur, humans are forced to adapt to their circumstances and at the same time compel the environment to sustain them (Meadows 2001). Whether by burning a stretch of brush in order to remove the tsetse flies and mosquitoes prior to occupying an area or by introducing domesticated plants and animals to it, human agency in changing the environment is equally as important as how humans respond to non-anthropogenically induced climate change.

4.2.3 Social Models for the Transition to Food Production

Not all archaeologists agree that population pressure and deterioration of the late-Pleistocene environment were causative factors in the adoption of agricultural and pastoral lifestyles. Hayden (1990) argues that agriculture was begun among prehistoric tribes whose leaders (big men) sponsored competitive feasting events between social groups to enhance their prestige. In Hayden's (1990) model, agriculture would first develop in areas that were rich in natural resources at the end of the Pleistocene and where there is no evidence of environmental desiccation. However, Keeley (1995) has shown that although Hayden's (1990) hypothesis is interesting theoretically, when it is tested against the archaeological record, there is little evidence to support it. As we will see in the following pages, incipient agricultural and pastoral communities are found almost exclusively in areas that are under considerable resource stress.

Bender (1978) argues that internal social demands exerted by elites that have extensive, long-distance exchange networks facilitated the creation of a class of craft specialists who were fed from agricultural surpluses. In this scenario, sedentism predates the origins of agriculture because it preconditions the accumulation of material objects and the construction of permanent storage facilities (Bender 1978). In the Levant, sedentary PPNA foraging communities were the precursors to Neolithic farmers and herders (Adams 1966; Bar-Yosef and Meadow 1995: 41; Phillips 1979). Subsistence in these villages revolved around exploiting wild cereal grasses such as wild emmer wheat (*Triticum dicoccoides*), barley (*Hordeum spontaneum*), field peas (*Pisum elatius, P. orientalis*), lentils (*Lens orientalis*) to name a few (Flannery 1973; Hillman 1996; Olszewski 1993). As the climate began to change and collection of wild grains became more difficult to undertake, Bender (1978) argues that the social demands of the elite class necessitated the perpetuation of cereal collection so that their positions of status did not wane. The model predicts that faced with these pressures, the focus of food management was to shift from collection to production of food products.

However, in Mesoamerica the archaeological record indicates that sedentary agricultural communities did not develop for several hundred years until after the advent of subsistence farming (Adams 1966; Flannery 1973, 1986b; Kabo 1985). Hard and Merrill (1992) demonstrate that early agricultural communities in northern Mexico were seasonally mobile, migrating between summer and winter fields following benevolent growing seasons. Incipient domestication at Guilá Naquitz of teosinte (*Zea mays*) has been traced to 5,400 ^{14}C years B.P. (Benz 2001; Piperno and Flannery 2001) and squash (*Cucurbita pepo*) has been detected to between 7,000 and 9,000 ^{14}C years B.P. (Smith 1997). Flannery (1986a) argues that early horticultural practices in the Valley of Oaxaca revolved around seasonal residential mobility and cultivation of grains and gourds until at least 4,000 years B.P. when sedentary village life can be detected archaeologically. Thus, an important center of early agriculture exhibits low population densities and no evidence for social stratification, which strongly calls into question the validity of Bender (1978) and Hayden's (1990) models arguing that storage and competitive feasting are crucial mechanisms behind early domestication processes.

This thesis will focus on the environmental and demographic preconditions of the development of pastoralism. Although there is undoubtedly a large social component to the development of food production techniques, it has not borne out in the archaeological record to this point. This dissertation will argue that pastoralism in Africa spread from the northeast region of the continent southward to the subcontinent. However, I also recognize that there are cultural dimensions of the movement of domesticated animals that cannot be tested archaeologically. Instead of speculating on social conditions that could have affected the transition from a purely foraging lifestyle to one that includes the use of domesticated plants and animals, this chapter will concentrate on data available from the archaeological record.

4.3 Archaeological Signatures of Pastoralism

When compared to agricultural societies, pastoralists leave few traces of their presence on a landscape in the archaeological record (Gifford 1978; Shanack-Gross et al. 2003). Furthermore, the nature of the evidence left can be very confusing if only a single method of investigation is followed (such as faunal analysis or size and shape of settlement structures) (Chang and Tourtellotte 1993; Hole 1978). Therefore, it is best if archaeologists employ a research strategy that uses multiple lines of evidence to reconstruct a reasonable scenario for pastoral occupation of a site (Chang and Tourtellotte 1993; Hole 1978). Meadow (1989) argues that analyzing the demographic, zoogeographic and morphological evidence for the domestication of animals at a site or in a region provides important insight into the coevolutionary aspects of interactions between humans and animals. Single lines of evidence limit the interpretative merit of the data and confine the discussion of domestication to narrow foci that have little didactic value.

This section will briefly examine the archaeological characteristics of prehistoric pastoral occupations. All areas of the world that pastoralists occupy reflect numerous mobility and subsistence strategies catering to the specific needs associated with the keeping of different types of domesticated animals. Pastoralists worldwide keep a variety of animals that have different subsistence needs. It then becomes difficult to precisely define what all archaeologists look for when they are identifying pastoral campsites. Much of this work is area specific and is based on strong intuition combined with knowledge of the nuances of the archaeological record of the area. An ethnoarchaeological approach can augment understandings of site formation processes, artifact distribution and preservation conditions (Binford 1991; Blumenschine and Marean 1993; Bunn 1993; Chang and Tourtellotte 1993; Cribb 1991; Gifford 1978; Hudson 1993; Lupo and Schmitt 2002; Mutundu 1998; Nicholas 1998; Shanack-Gross et al. 2003; Stiner 1993). Organized into a set of testable hypotheses designed to test and explain site function through time, the archaeologist has many tools available to reconstruct prehistoric subsistence and land utilization strategies.

Pastoralists must alter the environments they inhabit in order to successfully herd their stock. Burning large tracks of land serves two primary functions for African pastoral groups. The first is to eliminate wooded areas that are the home to tsetse flies, which are vectors for the disease *trypanosomiasis* (or "African sleeping sickness"). *Trypanosomiasis* is fatal to cattle that have bitten by the fly, but have little effect on wild ungulates (Pennington 1997: 46). Areas that possess tsetse have been presumed uninhabitable for pastoralists who risk losing entire herds (Gifford-Gonzalez 2000). The second benefit is that the removal of trees opens up of grasslands conducive for grazing domesticated animals (Talbot 1964: 93). Such activities reduce the biodiversity of the range, eliminating predators that threaten herds of domesticated animals and competition for grazing land is also reduced (Kjekshus 1996; Mloszewski 1983: 21).

Onyango-Abuje and Wandibba (1979) argue that as technology became more advanced, the impact of human activity on the environment became more profound and intrusive. They do not argue that human activity of the early Holocene *caused* environmental desiccation, but conclude, "Man himself played an important role in altering [environmental ecotones] for his survival and destruction as well (Onyango-Abuje and Wandibba 1979: 38)." In the archaeological record, levels of carbonized plant remains will reflect burning episodes if they are found over large, sequenced stretches of land. However, testing whether a landscape was deliberately or naturally altered by means of fire or overgrazing is very difficult to do.

Pastoral settlements often leave very distinct (albeit ephemeral) traces in the archaeological record. The first recognizable feature of a pastoral settlement is the structure of the village itself. Pastoralists must constantly guard their animals against predators and theft. At night the animals are most vulnerable to these threats and so pastoral villages are often designed as "kraals." Kraals are usually circular in shape with the boundaries of the village defined by piles of sticks or thorn bushes. Dung huts are constructed around the inside perimeter of the fence while the center of the village is where livestock are kept at night. The building materials of the village are organic, and decompose rapidly in tropical environments but leave distinct vegetative traces in the archaeological record. Dung deposits are often burnt as fuel, which often fossilizes and can be found on or near the surface of a site (Burchard 1993: 131). Furthermore, the organic composition of soils in former pastoral campsites in Somalia and Kenya are rich in nitrogen, phosphorous and potassium allowing plant species such as *Cynodon dactylon*, *Cleome tenella* and *Gisekia pharnaceoides* to grow (Barker et al. 1990; Reid and Ellis 1995; Stelfox 1986). If one can identify clusters of these species of plants on a landscape, he or she is very likely to find a former pastoral campsite underneath. It is also important to note that pastoral settlements will be situated to meet the needs of only one or two animals whereas foragers will be trying to settle in areas that are suitable to an eclectic group of animals (Hole 1978: 123).

The faunal composition of the midden deposits of pastoralists will, by definition, invariably contain some quantities of domesticated animals. Many archaeologists have devoted their careers and written many books on the subject of using bones to identify wild and domesticated animals (Clutton-Brock and Grigson 1984; Davis 1987; Hudson 1993; Reitz and Wing 1999). In many cases, the preservation of faunal material in the archaeological record is too poor to make these distinctions. The longer a bone has been in the ground, the more decomposition is a factor in identifying the type of animal from which the bone came. The denser the bone matter is, the longer it preserves in the archaeological record, which is why identifying bird and fish species in a faunal assemblage is so difficult to do. In addition, the bones of *Bos* species (*indicus, taurus*, *taurus* cf. *africanus* and *primagenius* in an early stage of domestication) are often too similar to tell apart (Grigson 2000: 54-5; Marshall 2000). The same problem exists in identifying between species of caprines (Stein 1989: 91). In many cases, genus distinction is the best a faunal analyst can expect to make. However, wild and domesticated species can usually be differentiated on the criteria that domesticated species tend to be smaller than wild species of an animal (Clutton-Brock 1987: 22). In arid areas where preservation of bone matter is good, faunal analysis can answer crucial questions regarding the subsistence and mobility strategies of prehistoric people.

The archaeological record of pure pastoral groups that are utilizing animal byproducts (milch pastoralists) will reflect high proportions of older domestic cattle. Bulls will be preferentially slaughtered over cows if animals of childbearing age are to be taken. Cows are also valuable as a source of milk. Animals that are being used for their milk and blood generally live to mature ages, which can be determined by looking at the fusion of the limb epiphyses and general health of the bone matter recovered. Among pure pastoral groups, herd accumulation is normally sought even when it may not be ecologically sound (Reckers 1992). In many cases, no or few bones will be recovered in a stratified midden deposit because many of the animals will die of disease or natural causes as opposed to being slaughtered for their meat. The ephemeral nature of specialized nomadic pastoral settlements is difficult to track in the archaeological record (Gilbert 1983). Therefore, a milch pastoral group might have very few domestic animal bones present in their faunal assemblage or be virtually unrecognizable archaeologically thereby potentially masking the true function of the site.

Pastoralists who raise livestock for their meat will generally slaughter juveniles whose meat is more succulent and easier to digest than the meat of older animals. Bones will generally deposited in a midden pile where other domestic refuse is tossed. Pastoralists must be careful not to deposit bones in an area that could attract predators that would threaten their livestock (Blumenschine and Marean 1993) and so middens tend to be centrally located within the confines of the protected kraal (Huffman 1982). The problem, of course, with the bones of juvenile animals is that they are far less dense than the bones of adults and so they tend to decompose more rapidly once they are in the ground.

Agropastoral groups can be identified in the archaeological record by their association with agricultural implements (such as hoes, sickles and grindstones) along with the presence of domestic fauna. If Mace's (1993) assertions are correct, then densities of domestic animal bones will vary annually reflecting conformity to changing environmental circumstances. In years when reliance on meat is particularly necessary, high densities of juveniles and females will be found in the faunal assemblage. Conversely, years where plants are the primary means of subsistence will have fewer domestic animals being consumed. Animal herds grow larger in these years so that in times of crisis when cultivation is difficult or impossible, their meat can be utilized as a primary food source. All pastoral groups must be mindful of the fact that too many domestic animals can overtax an ecosystem, rendering it unproductive for agricultural and pastoral pursuits (El-Arifi 1975: 98).

4.4 Applying Models of Pastoralism to African Prehistory

4.4.1 Pastoralism in the Eastern Sahara and Lower Nile Valley

There remains some question whether *Bos* species were domesticated first in North Africa or in the Mesopotamian Valley (Loftus et al. 1999). However, most believe that cattle (*Bos taurus*) and donkeys (*Equus asinus*) were indigenous domesticates in North Africa independent of the Middle East (Holl 1998; Stokstad 2002). *Bos taurus* was first domesticated around 10,500 years B.P. from wild *Bos primagenius* species (aurochs), donkeys were domesticated at approximately 7,000 years B.P. (Banks 1984: 220; Holl 1998a: 81, 85; Wendorf et al. 1987; Wendorf and Schild 1994). Zebu cattle (*Bos indicus*), a particularly ruddy species well suited for arid environments, were domesticated separately in India and then later made their way to Africa (Clutton-Brock 1987: 69; Loftus et al. 1999; Loftus et al. 1994; Marshall 1989). Goats (*Capra* sp.) and sheep (*Ovis* sp.) were likely first domesticated in small numbers in the Zagros Mountains area of Anatolia and western Iran around 12,000 years B.P. and later moved into the Levant and North Africa (Hole 1989: 97).

In the previous chapter, we discussed the occurrence of abrupt pluvial events interspersed with arid phases beginning after 9,800 years B.P. in the Sahara and Sahel (Damnati 2000; Gasse 2000, 2002; Hassan 1986; Haynes 2001; Said 1993). At this time, populations in certain areas of the eastern Sahara and Lower Nile Valley had begun to become more sedentary (Barich 2002). The early Holocene wet phase between 9,800 and 8,500 years B.P. in the Sahara had encouraged the construction of many fishing and small-scale foraging settlements along the lakes that increased rainfall produced (Hassan 2000: 68). In this environment, humans and wild bovids came into increasing contact with one another and it was during this period that the groundwork for full-scale domestication of cattle was undoubtedly laid (Banks 1984; Gautier 2002; Hassan 2000). In Southwest Asia and North Africa, regional population levels and the presence of numerous small sedentary villages had left little land into which hunter-gatherers could peacefully migrate if the environment deteriorated (Clark 1976; Close 1996; Muzzolini 1993).

The pluvial event that began after 9,800 years B.P. transformed the eastern Sahara from a lifeless eolian desert present during the Terminal Pleistocene and Younger Dryas to a semi-arid savanna ecosystem attractive to wild fauna and Neolithic pastoralists (Haynes 2001). In this critical period of early domestication of specifically *Bos primagenius*, archaeological sites in the Sahara and Sahel have ambiguous faunal assemblages and discerning between wild and domesticated animals in this period is difficult for even the most seasoned faunal analyst (Clutton-Brock 1987: 27; Gautier 2002; Hassan 1976; Marshall 1994). By the middle Holocene, skeletal morphologies of domesticated and wild animals are identifiable and genus or species-specific taxonomic differentiation of archaeological faunal assemblages is possible (Clutton-Brock 1981). However, Wendorf and Schild (1994; 2001b) are convinced that the identification and provenience of three separate M3 (3rd molar) finds from an early Neolithic (9,500 – 8,000 years B.P.) context (Gautier 2001) is secure, although this assertion has been strongly disputed (Clutton-Brock 1989; Grigson 2000; Muzzolini 1993; Smith 1992a).

Before 8,000 years B.P., evidence of limited numbers of domesticated animals can be found in the Nabta Playa and Bir Kisebia region of the eastern Sahara, but it is not until after 6,000 years B.P. that they become a significant source of food in the Nile Valley (Close 1990; Harlan 1982; Hassan 2000; Wendorf and Schild 1998). The faunal record of early Holocene sites located in northern Africa and Mesopotamia demonstrates that humans came to rely on the predictability of wild grazers' proximity to their homesteads (Gautier 2001). However, in the unpredictable early Holocene environment of the Sahara, Sahel and Mesopotamian regions, foragers saw the need to restrict the mobility of certain types of bovids in order to ensure that they would remain exploitable resources (Wendorf and Schild 1994). Therefore, early domesticated animals were buffers against the failure of the summer monsoons despite the fact that the climate was generally favorable to foraging.

After 6,000 years B.P., desertification started to become too intense in the northeastern Sahara to sustain existing population levels (Banks 1984: 56; Claussen and Gayler 1997; Hassan 2000). At this time, herding populations were first moving from the hinterlands of the eastern Sahara toward the Nile River and small-scale wheat and barley farming were introduced from the Levant (Alexander 1984; Banks 1984; Malville et al. 1998; Zohary and Hopf 2000). This forced the Nile Valley indigenous foragers to either adopt some food production techniques or leave the area (Banks 1984; McDonald 1998). Domesticated resources became important staples to ensure the long-term survival of the groups inhabiting North Africa in the middle Holocene. This marks a significant change from the early Holocene period when domestication appears to have been experimental and possibly short-term.

In the Fayum region, close to the Nile River Delta, agro-pastoralism was adopted by 5,500 years B.P. (Camps 1974). In the central Sahara in the Tassili-n-Ajjer and Tadrat Acacus regions, agropastoralism can be detected archaeologically at Safar and Jabbaren by 5,000 years B.P., and 5,950 years B.P. at Ouan Muhuggias (Camps 1974). At the "Fayum A" (5,900 years B.P.) occupational levels, domesticated cattle comprise an estimated 25% of the faunal assemblage, suggesting that cattle certainly has become an important part of the overall subsistence strategy along the Lower Nile River, but is not their sole source of food (Brewer 1989). In addition to some agricultural products, aquatic resources and ungulates that are attracted to fluvial systems also continued to be very important staples to the diet of the Neolithic inhabitants of the Lower Nile River Valley and the long-term sustainability of the groups were easily maintained based on this exploitation strategy (Banks 1984; Hassan 1975; Muzzolini 1993). Settlement patterns show that the people of Fayum preferentially occupied aquatic habitats, which allowed them to diversify their subsistence base in response to different environmental stresses (Brewer 1989; Wenke 1991). Fishing provided a seasonally stable resource upon which the residents of Fayum could normally depend as a dietary supplement.

At Nabta Playa, similar patterns of foraging combined with small-scale plant and animal domestication are found as early as 9,200 years B.P., but heavy reliance on domesticated resources is not intensified until after 6,500 years B.P. (Banks 1984; Wendorf and Schild 1998). It is believed that cattle in this area are primarily utilized for their milk and blood, which explains the near absence of young cattle found in the faunal assemblages (Wendorf and Schild 1998). Meat is a non-renewable resource that destroys the by-products. As wild animal populations dwindled in the Sahara during the late Pleistocene/early Holocene in response to aridification and elevated population levels (Haynes 2001), the importance of maintaining renewable resources would have been very apparent to the first herders. These subsistence modifications induced a period of population growth, increasing sedentism, and a general cultural uniformity between different sites in the eastern Sahara (Banks 1984: 166).

Some early Holocene groups such as those found at the Siwa Oasis in the north-central Sahara were able to successfully continue a pure hunting and gathering lifestyle by relying on high-mobility strategies in marginal areas (Hassan and Gross 1987). Based on the distribution of water sources and the ability of groups to easily access them, Hassan and Gross (1987) estimate that the home range of the occupants of Siwa was over 7,000 km^2, giving them a high degree of flexibility in their food procurement strategies. However, unlike the region near the Nile River, population densities in the Siwa Oasis remained low (.05 people per square kilometer) allowing the status quo to continue until the increasing intensity of aridity within the Sahara forced them to abandon the region. Even though the residents of the Siwa Oasis were likely aware that domesticated animals were being exploited by their neighbors to the east, there was no cultural or environmental impetus to push them into that lifestyle. Hunting and gathering is an extremely successful cultural adaptation in areas with low population densities and abundant natural resources (Ames 1994; Kusimba 2003; Lupo and Schmitt 2002; Mannino and Thomas 2002; Marean 1997; Mercader 2002; Stephens and Charnov 1982; Winterhalder 1981).

As discussed in preceding sections, it is during stressful periods that one would expect to see the first indication of food specialization. Localized ecological strains would have likely caused the exhaustion of one or more subsistence complexes forcing some previously multi-occupational groups to specialize in herding. If Rindos' (1984) scenario is correct, it would have taken some time before wild animals would become fully dependent on humans for their survival. However, as both humans and grazing animals were forced to occupy the small pockets of habitable terrain in the eastern Sahara, symbiotic relationships would likely have gradually developed.

As humans gained mastery over their stock, they grew dependent on maintaining a mobile food source nearby because if foraging strategies in the area they inhabited failed, they could no longer move to a surrounding area. Humans would not have wanted to overexploit one of their most dependable food sources, and the cattle had few other places to run. By the time humans were forced to occupy more arid regions and areas that were prone to severe climate shifts in a short period of time, they had gained control over the reproduction of certain animal species and thus had the capacity to occupy regions that did not support large amounts of wild animals.

4.4.2 Pastoralism in the Upper Nile Valley

The environment of the Sahara started to become drier after 6,000 years B.P., and after 4,000 years B.P., aridity reached present levels (see previous chapter). This condition was coupled with a period of irregular flooding that overtook the Nile River valley making settlement and subsistence in general a very difficult endeavor (Barich 2002; Bell 1970, 1971; Hassan 1988; Wetterstrom 1993). Areas that were not in the immediate proximity of a permanent source of water, once suitable for herding, agriculture, hunting or fishing now became virtually uninhabitable (Barich 2002: 215). This created a resource crisis forcing many people to leave the region and find suitable environments elsewhere (Banks 1984: 57, 241; McDonald 1998: 137). As the northeastern Sahara grew increasingly arid, archaeological sites in the southeastern Sahara witnesses the introduction of domesticated animals (e.g. Hassan 1986: 98-9; Hoelzmann et al. 2001; Krzyzaniak 1980; Smith 1984: 91-2). Domesticates were are means for communities to buffer their resource base during periods of general resource scarcity, but the hyperaridity that set in after 6,000 years B.P. in the northeastern Sahara was too severe to sustain even seasonal occupations.

When precipitation in the Sahara fell to its lowest levels since the Younger Dryas at 4,000 ^{14}C years B.P., pastoral subsistence in the Nile Valley became an even more arduous enterprise than it had previously been (Banks 1984: 57). Although precise population levels are impossible to estimate accurately, the development of social stratification and large settlement sites in the Khartoum region undoubtedly reflects the presence of larger groups of people than had been previously witnessed in the Pleistocene (Krzyzaniak 1991). Near the confluence of the Blue and White Niles, cattle appear at the site of Kadero at around 4,000 years B.P. (Marks et al. 1985) and around 6,000 years B.P. at Esh Shaheinab (Krzyzaniak 1978). Leiterband and Halbmond-Leiterband ceramic-using herders can be found from the same time period near the West Nubian Paleolake in the modern day Wadi Hawar region (Hoelzmann et al. 2001). These sites show different strategies toward the exploitation of domestic animals.

As discussed briefly above, Leiterband and Halbmond-Leiterband ceramic using occupations represent a clear shift in technology from earlier Laqiya and Dotted Wavy-Line ceramic using foragers. The earlier foraging populations settled on the margins of the West Nubian Paleolake (5,330 km^2 estimated maximum coverage) and exploited lacustrine resources (Hoelzmann et al. 2001). The foragers were semi-sedentary as evidenced by bulky, non-portable items such as large, globular ceramic pots and heavy grinding stones.

When desiccation of the West Nubian lake occurred, purely foraging populations are no longer found in the region and Leiterband and Halbmond-Leiterband mobile cattle herding people begin to inhabit the margins of the shrinking lake (Hoelzmann et al. 2001). Technology is much more portable and although some aquatic fauna are being consumed, the primary meat staple in the diet is domesticated cattle. Site sizes of Leiterband and Halbmond-Leiterband occupations reflect a more nomadic lifestyle and Hoelzmann et al. (2001) posit that this is a function of the need to adapt to an increasingly arid climate. The early periods of Leiterband ceramic sequences begin 500-1000 years earlier than the Khartoum Shaheinab pastoral traditions (Caneva 1988) suggesting that the pastoral occupations of the West Nubian Paleolake may be ancestral to the Upper Nile River pastoral economies.

At Esh Shaheinab, hunting, fishing and collecting wild plants was the primary occupation with small numbers of domestic animals found in the faunal assemblage (Krzyzaniak 1978: 160). Kadero’s faunal assemblage contains 88% domesticated animals shortly after their arrival at the site (Gautier 1984; Krzyzaniak 1978/: 164). Krzyzaniak (1978: 165) believes that the tool kits found at Kadero represents a specialized adaptation to pastoralism because very few hunting implements are present in the assemblage. These two strategies represent different ways of conceptualizing the function of domestic animals as a subsistence tool. At Esh Shaheinab, domesticated animals were dietary supplements that were consumed when wild meat was not available.

Kadero represents a culture that relies heavily on the consumption of cattle, with bovines representing 75% of the domestic animals found in the faunal assemblage. However, this culling pattern reflects a different subsistence strategy than what would be expected from a "pure pastoral" culture. Because modern pure pastoralists primarily utilize animal by-products, lower counts of cattle would be expected in the faunal assemblage if Kadero represented a cattle complex culture. This, however, may demonstrate the gap between cases of pastoral subsistence documented in the ethnographic record and those found in the archaeological record. In any case, the occupants of Kadero certainly relied heavily on cattle for meat and likely traded pastoral products with the residents of Esh Shaheinab for agricultural and wild animal products (Krzyzaniak 1978).

With the encroachment of the driest regions of the Sahara into the Upper Nile Valley, pastoralists were once again forced to disperse into new, more humid zones (Håland 1987). It is likely, though, that the southern migration of pastoralists never completely ceased at any point in time. Pastoral peoples who herd bovines (which is most African pastoralists) cannot be more than one half day's journey from a water source at any point and time because, as was mentioned above, cattle must drink at least once a day (Reckers 1992; Western and Finch 1986). Although the movement of the desert waxed and waned periodically after the end of the Mid-Holocene Climatic Optimum (MHCO) (ca. 6,000 years B.P.), it generally grew in a southward direction for about one thousand years (Hamilton 1982, and refer to the previous chapter).

As was mentioned above, pastoral adaptations generally occur in areas where semi-arid, savanna conditions prevail. The earliest pastoralists in North Africa and Southwest Asia inhabited the grassy margins of the deserts not only because such areas are best suited for grazing domestic bovids and caprines, but also because encounters with wild, huntable game tends to be seasonal and unpredictable (Talbot 1964; Talbot and Stewart 1964). It would have been very difficult for any other human economic group to survive in this environment without a mobile, but reliable food source nearby. However, except in the rare cases of pure camel herding, pastoralists cannot sustain their herds in hyperarid, desert-like conditions (Reckers 1992). Given this, as the Sahara gradually crept further south, pastoralists were forced to follow the semi-arid margins of the desert that were suitable for keeping livestock.

The pattern for pastoral settlement in the Sahara begins at the onset of the Holocene pluvial period (~9,800 years B.P.) when humans and wild animals came into more frequent contact with each other. This occurred at the margins of lakes that had settled human foraging communities. Paleoclimatological data shows that the pluvial event was punctuated with arid spells (Gasse 2002), which would have caused humans and animals to enter into a symbiotic relationship to ensure their mutual survival. After desiccation of the Sahara began (~6,000 years B.P.), human settlements in the hinterlands of the Sahara grew fewer as the environment proved too unpredictable to sustain them.

During this time, humans moved to different permanent water sources and spread southward down the Nile River (the area's largest watershed). Unlike the foragers of the Pleistocene, the people of the mid-Holocene were able to take their food source with them. This marked an important transition for humans and their animals alike because it signaled the first time in which humans became dependent on maintaining close contact with animals. In the section that follows, we will examine how pastoralism spread further south into East Africa and the how the adaptation of the pastoral lifestyle occurred in a remarkably different series of ecosystems.

4.4.3 The Pastoral Neolithic and Iron Age of East Africa

The term Pastoral Neolithic (PN) describes:

> cultures of eastern Africa, which (1) relied substantially on domesticated stock for their livelihood, (2) used pottery, and (3) employed typical Later Stone Age technologies for the manufacture of edged tools (Bower and Nelson 1978: 562).

The PN includes all herding communities that inhabited the Lake Turkana Basin, Central Highlands, Rift Valley, Serengeti ranges and the Indian Ocean coastal plains from approximately 4,500 until 1,300 years B.P. Starting around 2,300 years B.P., linguistic evidence suggests that a new range of food products, including sorghum, millet and yams, were introduced to the region providing a new pallet of subsistence options (Ehret 1998; Nurse and Spear 1985). As farming grew to be an increasingly important component in the East African subsistence economy, some believe that pastoralism in East Africa likewise became increasingly specialized (Smith 1992a: 134). Because they could consistently trade for (or steal) plant goods from farmers, PN people were able to focus their energies more succinctly into maintaining their herds (Smith 1992).

It is being argued here that pastoralism is a unique adaptation to a set of environmental constraints. While the social structure was fundamentally changed in many ways after a group adopted a pastoral lifestyle, these changes were slow to develop and were far from unified. Thus, the Pastoral Neolithic was not a rapid invasion of people who were escaping environmental desiccation in the north and overcame the hunter-gatherers of East Africa, but was a series of smaller migrations of cattle herders that sparked an idea that was gradually adopted by many indigenous groups. Figure 11 is a model demonstrating the complex interactions and fluid categorization of so-called cultural entities in East African prehistory.

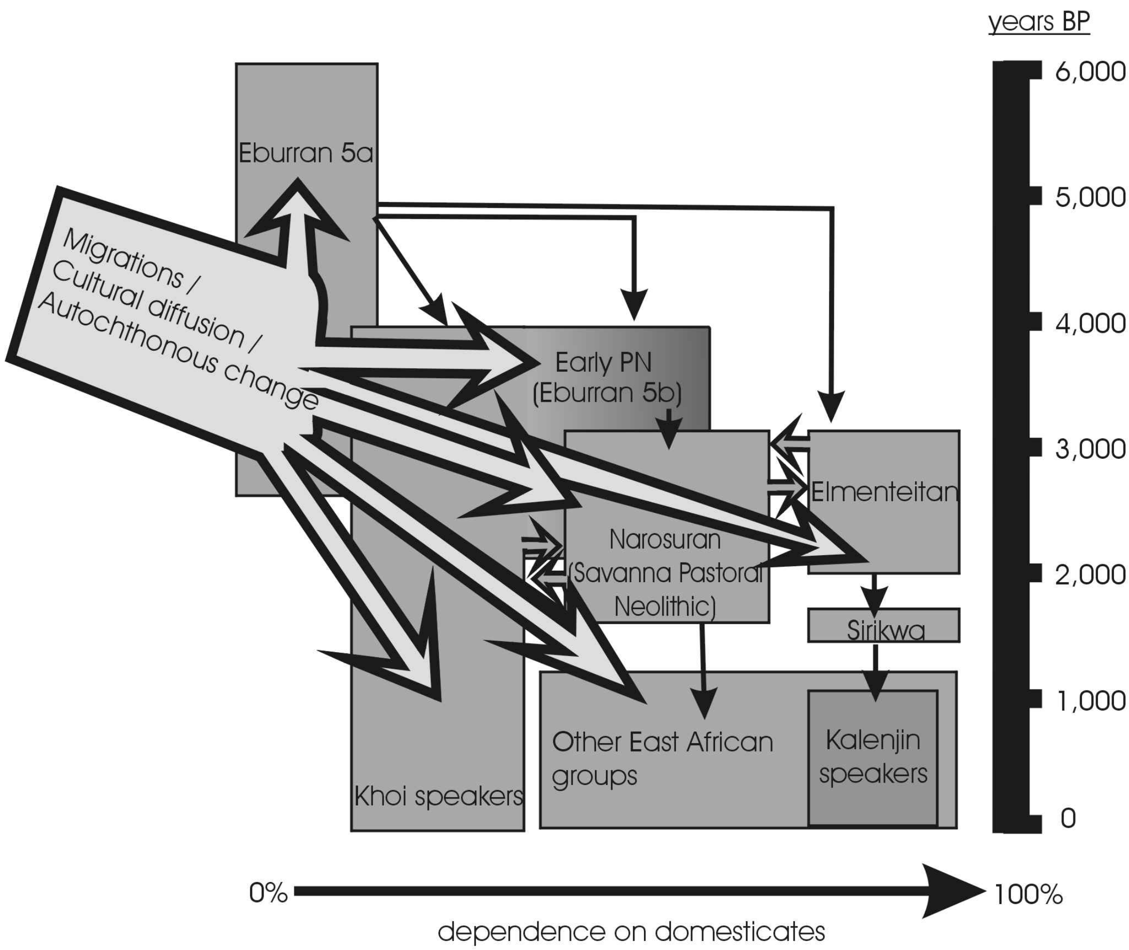


Figure 11. Culture development model for East African societies, ca. 6,000 years B.P. to present

In the following pages, the three phases of the PN will be described in some detail. In accordance with Bower's (1991) classificatory system, the earliest phase will be referred to as "Early Pastoral Neolithic" while subsequent phases will be called "Narosura" and "Elmenteitan." However, all three phases conform to the definition provided above and therefore are all considered different stages of the larger cultural classification deemed the Pastoral Neolithic. Information that has been published on Iron Age occupations in East Africa will also be presented and discussed in the context of the continuity between PN and the advent of iron working in the region.

4.4.3.a Early Pastoral Neolithic

The onset of aridity in the Lake Turkana Basin occurred at about 6,600 years B.P. (Johnson 1996). The result of this was the gradual recession of the montane forest in favor of vast grasslands ideal for pastoral occupation (Butzer et al. 1972; Hamilton 1982; Owen et al. 1982). Presently, the earliest known pastoral site in Kenya is Dongodien located on the banks of Lake Turkana. Domesticated animals are securely dated to around 4,500 years B.P., but could also have arrived as much as 1,000 years earlier if ceramic sequences are indicative of contact between Lake Turkana and cattle herding people known to be living in the Upper Nile River Valley at this time (Barthelme 1985; Marshall et al. 1984).

Similar to many of the pastoralists who inhabited the Blue and White Nile confluence region near Khartoum, the pastoral-phase inhabitants of Dongodien were not pure pastoralists. They relied heavily on aquatic and wild terrestrial resources (Barthelme 1985; Marshall et al. 1984; Robertshaw and Collett 1983a: 298). This lends some credence to the notion that pastoralism might have been an indigenous response to changing environmental circumstances rather than an imported economy from the north. Pastoralism was an idea that was well suited to the environmental circumstances and social climate present at Dongodien, so was it necessarily an economy brought from the north by pastoral colonizers?

Wendorf and Schild (1998) believe that the earliest archaeological markers for domesticated cattle originate from Nabta Playa in what is now the Egyptian Sahara. Mitochondrial DNA (mtDNA) markers among modern African cattle populations indicate that at least two separate domestications of cattle occurred—one of taurine breeds in southwest Asia around 10,000 years B.P. and another of indicus breeds in southern Asia at around 7,000 years B.P. (Bradley et al. 1996; Loftus et al. 1994; MacHugh et al. 1997), with a possible additional independent domestication of eastern Asian breeds (Mannen et al. 2004). Epstein (1971) contends that indicus breeds were introduced to Africa via the Horn of Africa from Saudi Arabia and the genetic evidence bears this theory out (Loftus and Cunningham 2000; Troy et al. 2001).

Hanotte et al. (2002) offer a compromise between those who argue for complete domestication in northeastern Africa and those who claim that livestock domestication (specifically cattle) originated form the Middle East. Their position is that protodomestication of *Bos primagenius* (wild aurochs) occurred in northeastern Africa, but the genetic evidence indicates that some admixture between Indian and Middle Eastern species occurred along the way as well (Hanotte et al. 2002). The current data suggests that cattle spread from the locus of northeastern Africa to the rest of the Eurasian continent (Bailey et al. 1996; Bradley et al. 1996), as well as down the eastern spine and into the western regions of the African subcontinent (Hanotte et al. 2002). The independence of genetic haplotypes among mtDNA of modern and ancient cattle specimens tested suggests that there is potential for many independent loci of domestication on each continent with minimal intercontinental influences (Edwards et al. 2004).

Barthelme (1985: 335) is convinced based on ceramic and lithic sequences that the first inhabitants of Dongodien originated from Khartoum and probably diffused into northern Kenya in limited numbers as a result of the climatic deteriorations of the Sahara and Sahel savanna zones. Similarities between what is now referred to as Leiterband and Halbmond-Leiterband (Hoelzmann et al. 2001) and Kadero (Krzyzaniak 1984) ceramic traditions from the southern Sahara and Nderit tradition ceramics[2] (Barthelme 1985; Bower and Nelson 1978; Bower et al. 1977) found around Lake Turkana and later around Lake Victoria are too numerous to relegate to mere coincidence (Chapman 1967; Marshall et al. 1984; Phillipson 1982, 1984). However, Bower (1991) questions whether ceramic traditions associated with domesticated animals diffused into or out of the Lake Turkana region. Kansyore tradition ceramics found in Neolithic contexts Sudan postdate early finds of the pottery at Gogo Falls by 1,000 years (Bower 1991). Therefore, Bower (1991) sees a bidirectional movement of people and ideas, including ceramics and livestock, "trickling" into and out of East Africa as opposed to a unidirectional exodus of herders fleeing the increasingly arid Sahara into the Lake Turkana basin.

After the introduction of domesticated livestock at Dongodien, aquatic resources remained important elements of the subsistence strategy, but hunting of terrestrial mammals decreased precipitously as the society was reorganized toward the maintenance of large herds of domesticated animals (Barthelme 1985). As the climate in the Turkana region turned increasingly arid after 4,000 years B.P. (Ricketts and Johnson 1996), domesticated animals became a more significant source of food as wild resources became

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[2] In most of the literature on the East African PN, the term "ware" is used to describe what would be referred to as a "ceramic tradition" in most other regions of the world. Entrenched in the literature of PN East Africa, this term is difficult to avoid using even though its common usage is incorrect. I have chosen to employ the globally accepted terminology in this chapter, and will save a critique of the PN ceramic nomenclature until Chapter 9.

scarcer. Later PN cultures in the Central Highlands exhibit the same general trends in their subsistence strategies—as time progresses, food production becomes a more important component of the economy until it virtually replaces foraging altogether (Ambrose 1984b: 376; Gifford-Gonzalez 1998a: 175; Marshall 1990c).

With the advent of food production, there was an increasing emphasis on bulky storage items (such as ceramics), which limited the mobility of the first pastoralists (Bower 1984a: 255). The earliest ceramics at Dongodien are dated to ~7,000 years B.P., but were not extensively produced or utilized (Barthelme 1985). Nderit tradition ceramics first associated with domesticated animals by 4,000 years B.P., and are later identified with cultures in the Lake Nakuru region over one thousand years after they are introduced at Lake Turkana (Barthelme 1985; Collett and Robertshaw 1983; Gifford-Gonzalez 1998a). The tool kits created and used by PN people was functionally specific and included such shaped tools as backed microliths, *outils écaillés*, and scrapers (Ambrose 1984c; Barthelme 1985; Bower 1984b). As would be expected, there is a lack of stylistic uniformity between disparate PN sites (especially between those in the northern lowlands and the Central Rift) (Gifford-Gonzalez 1998b). The occupation of different natural environments necessitated the creation of tool kits designed to efficiently maximize exploitation of the available resources.

Pastoralism was slow to spread from the northern lowlands into the Central Rift Valley of Kenya. Ambrose (1980b; 1984c; 1985; 1998) hypothesizes that the hyperarid phase that gripped North and Central Africa between 5,500 and 3,000 years B.P. lowered water levels in much of southern Kenya and Tanzania so substantially that pastoralists would not have access to enough water to maintain their herds. His claim is supported by paleolimnological data conducted on Lake Naivasha, Lake Nakuru and Lake Elmenteita south of the Lake Turkana region as well as on the equatorial mountains of East Africa that shows the complete desiccation of the Rift Valley lakes by 3,000 years B.P. (Beuning et al. 1997b; Bonnefille and Chalié 2000; Butzer et al. 1972; Richardson 1966, 1972; Stoyer and Johnson 2000). Water levels at Lake Turkana dropped significantly during this time period, but did completely dry up as did other East African lakes (Johnson 1996; Owen et al. 1982). Thus, it appears that the Lake Turkana region was an oasis in the midst of a severe continental environmental desiccation event.

Gifford-Gonzalez (1998a; 2000) argues that cattle diseases such as rinderpest, *trypanosomiasis*, Rift Valley Fever, East Coast Fever, foot and mouth disease and malignant catarrhal fever precluded the spread of domesticated livestock southward until the forests that colonized the central and southern Rift Valley during the MHCO had receded. Forest habitats are breeding grounds for ticks, tsetse flies and mosquitoes, which are the primary vectors for cattle diseases in East Africa (Gifford-Gonzalez 1998a, 2000; Pennington 1997). In his travels along the eastern coast of Africa, Richard Burton (1859, in Kjekshus 1996) reports that cattle are virtually absent and is told that tsetse flies are the primary reason that people did not keep many domesticated animals in this region. However, there is no solid archaeological evidence that the presence of such diseases hindered the movements of pastoralists in prehistory and so the theory remains hypothetical and ultimately untestable with presently available technology.

In either case, by 3,000 years B.P. pastoralism entered the Central Rift Valley in full force (Bower 1991, 1996). The environment improved for pastoral occupations and vast grasslands opened up—similar to those found in the region today, although conditions were somewhat drier (Ambrose 1984c; Van Zinderen Bakker 1976). Bower (1991) proposes that prior to 3,000 years B.P., pastoralism "trickled" into the economies of the indigenous foragers of eastern Africa. Domesticated animals are found in limited numbers before or ca. 4,000 years B.P. at Ele Bor in Ethiopia (Phillipson 1984), Dongodien, Ileret, GaJi2 (Barthelme 1985), Enkapune ya Muto (Ambrose 1998), Gogo Falls (Karega-Munene 1987; Robertshaw 1991) and are now recognized in Tsavo National Park, Kenya. Bower (1991) contends that aridification after 4,500 years B.P. prompted small numbers of pastoralists to leave their home ranges in the southern Sahara in search of greener pastures. Indigenous foragers living in the regions into which the small migrations of pastoral peoples were occurring gradually acquired domesticated animals either by raiding or trading for them (Bower 1991). Bower argues that pastoralism "splashed" into East Africa after 3,000 years B.P. as most archaeological sites found after this date include remains of domesticated livestock.

The stall of Neolithic pastoralists provides significant insight into the perceived relationship between the environment and pastoralism. For approximately 1,500 years, the southward-rolling frontier of pastoralism was halted. Prior to that, domesticated livestock had been rapidly and successfully entering new environments or the material and social culture spread from herding communities to indigenous hunter-gatherers for 2,000 years with only limited interruptions. By understanding the needs of their livestock and striving to maximize pasture and minimize risk, Neolithic pastoralists chose to remain in the stressed, but not desiccated ecosystem around Lake Turkana rather than risk entering a virtual desert that might not have fertile ground on the other side. We see here that minimizing risk can mean to take chances in some circumstances (such as undertaking the movement of animals across the rugged Ethiopian Plateau from Kadero into East Africa) while avoiding jeopardy if the potential peril outweighs the potential reward.

Eventually, Early Pastoral Neolithic peoples moved into the savannas on the east side of the Rift Valley and adjoining lands as well as the Serengeti National Park, Tanzania (Ambrose 1980b, 1984b, c; Bower 1984a). Ambrose (1984c) recognizes two different PN settlement types: traditional PN settlements originating from the northern lowlands and Eburran 5 hunter-gatherers who gradually acquired domestic stock. Most traditional PN sites in the highlands occur between 3,300 and 1,300 years B.P. and are restricted to savanna lands above 1,500 meters above sea level (Ambrose 1984c). Eburran 5A and 5B evolved sites occur between 2,900 and 1,900 years B.P. and are located in the Lake Nakuru-Naivasha Basin and Rift Valley floor and margins (Ambrose 1984c). Eburran 5 people were likely forced by social circumstances to adopt the pastoral lifestyle (Marean 1997).

4.4.3.b Narosura (also referred to as Savanna Pastoral Neolithic)

Although the domestication of cattle and caprines represented a major shift in the way East Africans conceptualized their subsistence options, during the early phase of the PN hunting and gathering was still the primary means of acquiring food except in times of extreme climatic stress (Barthelme 1985; Bower 1991). However, in many ways food production can be considered an addiction. As cattle and caprines strip the ecosystem of primary biomass, introduce new diseases that can be transmitted to wild ungulates and human populations expand in response to a consistent food source, fewer wild animals migrate into areas where human settlements are (Bergström and Skarpe 1999; Duncan

2000; Ego et al. 2003; Kay 1997; Kjekshus 1996; Laliberte and Ripple 2004; Ocaido et al. 2004; Salvatori et al. 2001). Thus, it is not surprising that PN site functions become more oriented toward the exploitation of domesticated cattle and less toward hunting as time progresses. Bower (1991) contends that after 3,000 years B.P., settlement and subsistence strategies in the East African Neolithic began to change.

The Narosura is one of two identifiable evolved stages of the PN. It has an enormous geographical range, spanning from Lake Naivasha in the north to Lake Eyasi in the south, and the western Mara River to 50 kilometers east of Nairobi (Bower 1991: 68). Depending on the age and location of the site, there is a gradient of cultural similarities between early PN and Narosura people. Generally speaking, the closer in time and physical proximity to the early-phase PN area a Narosura site is, more cross-cultural similarities can be found (Bower 1991). There is some chronological overlap between the early PN and Narosura, which explains some of the material culture similarities found in the early phases of Narosura (Bower 1991: 67). However, later Narosura tradition pottery and lithic assemblages bear little resemblance to its antecedents (Bower 1991), suggesting that as subsistence practices changed, so too did the tools and technology by which people exploited and overcame the natural limitations of their physical environment.

Prolonged Drift (GrJi1) is an open-air site located on a low-lying flood plain of the Nderit River south of Lake Nakuru. Radiocarbon dates obtained from elephant ivory yielded ages of 2,530 ± 160 years B.P. and 2,315 ± 150 years B.P. (Gifford et al. 1980). Although domesticated cattle represent the largest taxonomic category present in the MNI diagnostic faunal assemblage, they are significantly outnumbered by wild, migratory herbivores (Gifford et al. 1980; Gifford-Gonzalez 1984). However, do the limited remains of domesticated animals at sites like Prolonged Drift represent pastoral people who engaged in a limited culling strategy or those of hunter-gatherers who simply raided the herds of their pastoral neighbors?

Gifford-Gonzalez (1984) believes that the evidence at Prolonged Drift indicates that the site was occupied by semi-mobile pastoralists because the deep deposits of domestic stock in the faunal assemblage indicates that this was a location occupied consistently and intensely for a long time. Even if the occupants of Prolonged Drift were true hunter-gatherers and only preying on local pastoral herds, it was a resource that is found in the first levels of occupation and a resource upon which they were able to rely (Gifford et al. 1980). Based on the faunal evidence available, it appears likely that the residents of Prolonged Drift were in possession of domesticated animals when they initially occupied the site (Gifford et al. 1980: 90).

The material culture of the residents of Prolonged Drift further suggests that they were at least in contact with Neolithic groups because of the presence of a stone bowl as well as Narosura pottery (Gifford-Gonzalez 1984). The lack of evidence for large quantities of domesticated animals present Prolonged Drift does not *necessarily* disprove Bower's (1991) "trickle/splash" hypothesis, as the site may not be representative of Narosura cultural development as a whole. With such a limited excavated data set, it is difficult to ascertain whether Prolonged Drift is the exception or the rule. However, at face value, Prolonged Drift appears to conform to the first scenario of Ambrose's (1984c) model of PN culture settling in the Central Rift Valley after leaving the Lake Turkana region in response to environmental crises.

4.4.3.c Elmenteitan

The third major phase of pastoralism found in the Central Rift Valley was the Elmenteitan. The Elmenteitan is roughly contemporaneous to the Narosura phase occupations with the highest frequency of sites existing around 2,500 years B.P. (Rightmire 1984: 196). Elmenteitan cultures are defined by the presence of domesticated animals in their faunal assemblage, spouted ceramic vessels that are not usually decorated, and the production of long, segmented blades, end scrapers, and small geometric microliths (Robertshaw 1990b: 7). Modern Maasai seasonally transhumant migration patterns between highland montane and lowland savanna pastures leave similar artifactual traces to those found at Elmenteitan sites (Ambrose 1980a).

Elmenteitan settlements are commonly found in rockshelter sites located in the high moorlands and lower bushlands of the western end of the Central Rift Valley, giving them little or no territory overlap with either Eburran hunter-gatherers or other PN people (Ambrose 1980b, 1984c, 1998; Robertshaw 1988). However, nitrogen isotopic evidence indicates that Elmenteitan pastoralists foraged for wild plants and/or engaged in limited forms of agriculture more so than their Narosuran neighbors placing them in direct more competition with early phase Eburran niches (Ambrose and DeNiro 1986). Elmenteitan sites are found exclusively above 1,940 meters above sea level on the fringes of montane forest ecosystems (Ambrose 1985), while Narosuran sites are found in the savanna lowlands.

Generally speaking, the lower in elevation the settlement and the later in time that it existed, the more specialized food production tended to be, but Elmenteitan sites were generally not exclusively oriented toward pastoralism (except, see Ngamuriak below)

(Ambrose 1985; Gifford-Gonzalez 1985). The lowland sites are all single-occupation settlements, giving credence to the notion that these are seasonal pastures. Highland sites have high intensity occupation levels, suggesting that they are more than ephemeral camps. Typological variation within and between Elmenteitan sites is common, just as it is for the early PN and Narosura (Bower 1991; Nelson 1980). Therefore, two Elmenteitan sites (Ngamuriak and Enkapune ya Muto) will be examined in order to evaluate the role that the environment plays in determining cultural similarities and differences in pastoral economies.

Ngamuriak (GuJf6) is an open air Elmenteitan site located approximately 3 kilometers east of Lemek village in the Lemek Valley of the Loita-Mara region of Kenya. It is a single occupation site that has been dated to 2038 ± 134 years B.P. (Robertshaw 1990). Although some backed microliths are found at Ngamuriak, the vast majority of the lithics at the site are scrapers and other obsidian processing tools (Robertshaw 1990). Despite the close proximity of several minor obsidian sources, the inhabitants of Ngamuriak obtained their raw material from the western slopes of the Mau Escarpment, some 30 kilometers northeast of the Lemek Valley (Merrick et al. 1990: 177). The obsidian found at the site is known to have circulated in excess of 250 kilometers from the Mount Eburru source to other sites during the same time period (Merrick and Brown 1984). This suggests that there was an extraordinary amount of intercultural contact between groups in very distant locales. In contrast to earlier LSA populations who seem to have established only a few, limited range exchange networks (Bower et al. 1977), Elmenteitan people relied on each other, at least to some extent, to acquire technology, but it is unclear whether these networks were hegemonic in nature. This is an area of investigation that needs to be explored in future research projects.

The ceramics of Ngamuriak are primarily straight-sided bowls or globular pots (Robertshaw 1990: 185). Robertshaw and Collett (1983) suggest that because pottery traditions are so variable during the Neolithic, it is difficult to discern truly unified cultural traditions based on stylistic criteria alone. Pottery at Ngamuriak closely resembles that found at certain Elmenteitan sites, but also exhibits substantial stylistic differences from other Elmenteitan sites (Robertshaw 1990: 200-1). During the earlier PN and Narosura phases, there was little inter-site continuity between vessel forms or styles; but during the Elmenteitan, standardization of form and function of ceramic vessels gradually became more prevalent (Ambrose 1984b; Bower 1991; Robertshaw 1990). The ceramic sequences of Elmenteitan sites provides one of the strongest lines of evidence for the argument that Elmenteitan people entered the Central Rift Valley as a developed pastoral people rather than being indigenous hunter-gatherers who are gradually assimilated into a pastoral economy. The evolution of standard Elmenteitan forms from highly variable forms suggests that the antecedents to Elmenteitan culture had been present in the Rift Valley for some time. Direct evidence for early PN, Narosura, and Elmenteitan cultural continuity is still lacking at this point because there is so much variability in the material culture of early East African pastoral people. However, regional homogenization of artifact forms occurs at the same time that long distance exchange networks are emerging, providing an extremely plausible mechanism for the slow, internal development of material cultural patterns over a wide geographical area.

The faunal assemblage at Ngamuriak is comprised of 98% domesticated animals (Marshall 1990c: 876). This number is surprisingly high given the high ungulate biomass that can be found in the surrounding area today (Marshall 1990b: 876). Marshall (1989; 1990c) posits that the cattle found at Ngamuriak are *Bos indicus*, an Asian breed of domesticated cattle that is well adapted to hot climates that receive little rainfall. If *Bos indicus* were indeed found in western Kenya at this time, it would likely mean that the pastoralists occupying the Lemek Valley at this time could have been highly specialized herders (Marshall 1989: 237). *Bos indicus* require more maintenance than taurine breeds in that they consume more vegetation and must move more frequently. However, new dates for the proposed genetic distances of Asian and African breeds of cattle (Loftus et al. 1994) as well as reclassification of faunal identification criteria for African cattle (Grigson 1991, 2000) have created strong doubt as to whether *Bos indicus* was truly present at Ngamuriak (Marshall 2000). Regardless, the incredibly high percentage of domesticated animals found in the faunal assemblage indicates that the occupants of this site were very heavily invested in maintaining a pastoral economy (see also Robertshaw and Collett 1983: 296).

The presence of numerous mature specimens in the faunal assemblage suggests that the pastoralists at Ngamuriak were also engaged in dairy farming (Marshall 1990c). Lactose byproducts can only be produced by cattle that occupy areas with bimodal rainfall patterns because peripatetic movement places too much stress on livestock for them to be able to lactate (Marshall 1990c: 887). Earlier paleoclimatological data indicated that a bimodal rainfall regime developed in East Africa after 4,000 years B.P. (Richardson 1972), which has been interpreted as the impetus for the advent for specialized diary pastoralism (Bower 1991, 1996; Marshall 1990c, 1994, 2000). However, more recent data indicate that the high frequency of El Niños in the late Holocene may have made a true bimodal rainfall pattern sporadic at best (Chapter 3). If a bimodal rainfall regime existed when Ngamuriak was inhabited, it was not evenly distributed throughout East Africa. Therefore, I would argue that large groups of people engaged in specialized dairy pastoralism such as what the Maasai practice today may have begun much later than 2,000 years B.P. if a predictable bimodal rainfall regime is necessary for it to occur.

Enkapune ya Muto (designated GtJi12, henceforth EYM) is a multi-occupational site located in a large enclosed rockshelter above the Naivasha Basin on the Mau Escarpment. Radiocarbon dates suggest the Elmenteitan horizon occurred between 2,800 and 2,600 years B.P. (Marean 1992: 73). Prior to the inception of the Elmenteitan, caprines are found in extremely limited numbers as early as 4,000 years B.P. (Marean 1992: 77, 107). Below the Elmenteitan levels are a series of Eburran 5 pastoral and LSA hunter-gatherer occupations (Ambrose 1984b; Marean 1992). The Eburran 5 faunal assemblage at EYM includes an array of domestic caprines and closed habitat ungulates such as bushbuck, reedbuck, and bush duiker (Ambrose 1984b, Marean 1992), while LSA horizons consist primarily of small, wild bovids (Ambrose 1984b). As the climate became progressively more arid around 4,000 years B.P., fewer forest animals are found in the archaeological record and more open range savanna animals are found (Marean 1992). Through time, domesticated animals dominate an increasingly larger proportion of the faunal assemblage until the Elmenteitan occupation of the site, when hunting and gathering is almost completely replaced with the herding of domesticated cattle and caprines (Marean 1992).

Backed flake industries dominate the lithic assemblage of EYM until Elmenteitan levels (Ambrose 1984b: 228). The early forms of such tools would have primarily been used for hunting, although after the appearance of domesticated animals, their function doubtless became more multi-purpose. The introduction of domestic animals without a rapid shift in tool technology has led Ambrose (1984b) to the conclusion that the early use of domesticated animals was an indigenous response to dramatic climate and social pressures. Ambrose (1984b) sees continuity between Narosura and Elmenteitan lithic assemblages. Bower (1991) believes that these similarities are overstated because he believes that later Elmenteitan lithics are radically different typologically than those found in previous occupations. However, because of the chronological overlap between many early and later PN sites, the Elmenteitan occupation of this site can be viewed as likely having displaced Eburran phase occupants either by means of direct or indirect competition. As was the case for the Ngamuriak, EYM Elmenteitan occupational levels cannot be looked at as simply "evolved Eburran"—they represent a separate cultural tradition that developed independent of the indigenous, gradual acquisition of domesticated animals.

4.4.3.d Analysis of Pastoral Neolithic Intersite Variability at Present State of Knowledge

Several types of pottery typify early PN settlements in the highlands: Nderit, Kansyore, Narosura and Elmenteitan (a.k.a. "Remnant" ware) (Ambrose 1984c; Bower et al. 1977). There is also a considerable amount of internal variability in the ceramic traditions of the Elmenteitans (although not as much as with the PN). All of these vessel types are found in different settlement areas and likely represent forms of social differentiation between cultural sub-groups (Bower 1988, 1991), but they may also indicate the presence of sophisticated exchange networks (cf. Hodder 1977). The evidence for such networks can be found in the ever-expanding trade in obsidian prior to the advent of iron technology in the central Rift Valley beginning at around 1,300 years B.P. (Merrick and Brown 1984). The discovery of a cowry shell at ~1,300 years B.P. in a Pastoral Neolithic occupation level at the site of Kathuva in Tsavo, Kenya (to be discussed in Chapter 10) further bolsters the notion that contact between the coast of the Indian Ocean and interior has a long precedent (see also Leakey 1966; Nelson 1993)

Early infiltrations of domesticated livestock into the central and southern Rift Valley are widely interpreted as autochthonous transition to pastoralism based on non-indigenous cattle and caprines (Ambrose 1998; Gifford-Gonzalez 1998a; Marean 1992; Marshall 2000). Given the extent of cultural contact between LSA communities (Bower et al. 1977), adoption of domesticates through exchange as opposed to migration of pastoral people from the north seems the most plausible scenario. During the incipient phases of the adoption of domesticates in East Africa, there is little evidence for a sweeping change in the elements of the material culture (namely ceramics and lithics) that would be indicative of an invasion of allochthonous pastoralism. Instead, small numbers of domesticated animals appear in the assemblages of Eburran 5 foragers until after 3,300 years B.P. when large-scale shifts in settlement strategies occur that are oriented toward the rearing of livestock. It is likely that when pastoral peoples arrived *en masse* ("splashed") into the Rift Valley from the north, they were initially engaged in direct competition with Eburran hunter-gatherers over access to resources (Ambrose 1984b, c; Marean 1997).

Environmental change in East Africa can frequently be swift and harsh (Grove 1977). Household strategies must be flexible in the face of environmental flux. Domesticated stock can be liabilities during severe droughts, and may be culled to increase a group's mobility potential. During periods of less acute climatic stress, social units may acquire domestic stock as an assured food source, while later relying primarily upon wild resources when the environment ameliorates (Mace 1993). It is also logical that ceramic vessel forms and styles along with the stone tools they used to optimally exploit the environment at different times would have been highly variable. Therefore, classifications of cultural entities can be tricky if ceramic or lithic typologies are the only criteria for determining them. Internal cultural heterogeneity between PN people is a reflection of specific social and environmental circumstances, but is generated from a mental template, which reflects the broader adaptive range of a particular group.

Site selection and utilization provide good examples of that the PN was a blend of different pastoral and indigenous hunter-gatherer techno-complexes. Early PN people were attracted to lacustrine and fluvial habitats such as at Lake Turkana and the Galana River. The majority of Elmenteitan sites are located in rockshelters away from permanent bodies of water, however the lithic and ceramic assemblages of Ngamuriak indicate an Elmenteitan occupation despite its exposed location. Ambrose (1984c: 230) suggests that lower elevation Elmenteitan occupations may be indicative of differentiated adaptations to specific ecological zones. As population densities increased, pastoralists would have been forced to spread into environments that were not their primary choice

(Layton et al. 1991). From the present evidence, rockshelters in the high elevation montane regions appear to be the optimal settlement sites for Elmenteitan pastoralists, while earlier PN people prefer lowland savanna ecozones.

There is enough material evidence to conclude that the Elmenteitan and earlier PN were not merely gradients of the same cultural complex, but rather distinct people with different ways of responding to environmental stresses. Thus, there is no unified "PN complex" because the Pastoral Neolithic (even including evolved forms) is different people in different places who developed exchange networks with other economic groups. Essentially, all family units were autonomous entities whose interactions with other communities was undoubtedly very limited given the great geographical distances that separated pastoralists from their neighbors during much of the year (see for example Gulliver 1955).

4.4.3.e Iron Age

Most archaeological investigations on pastoralism in East Africa have been devoted to understanding the early Neolithic origins and spread of cattle. Very little research devoted to actually understanding Iron Age pastoralists has been conducted in the last 15 years. The greatest source of information about pastoralists from this time comes from the Swahili coast, where archaeologists have been studying the rise of Iron Age city-states and have recovered domesticated animal bones dating to the late eighth century (Horton 1996: 384). Chittick (1984) also records the presence of domesticated animal bones in stratified deposits at Manda dating to the mid-ninth century A.D. C. Kusimba (n.d.) has also recovered bones of cattle, camels, goats and sheep at Mtwapa, and formal analysis of this faunal material will be published soon. Research into the spread of the Bantu mixed farming economy into East Africa has also shed light on the role of domestic animals in the development of culture in the African Iron Age.

Most of the work geared toward understanding the Bantu spread into East Africa has focused on using linguistic clues in modern Bantu languages to determine the antiquity of different aspects of their material economy (Ehret 1984, 1998, 2001; Grant 2001; Guthrie 1962, 1963; Holden 2002; Nurse and Hinnebusch 1993; Nurse and Spear 1985; Spear 1981; Vansina 1995). However, early understandings of the spread of Bantu people into East Africa has been convincingly critiqued and revised into a more realistically complex scenario (Ehret 1998, 2001). Further discussion of this topic is therefore reserved until Chapters 9 and 10, where linguistic and archaeological data assembled from various sources in East Africa will be discussed in light of ceramic analyses from archaeological assemblages recovered from Tsavo in 2001.

To date, much of the archaeological evidence of Iron Age pastoralists in the interior of East Africa has focused on discussions around the "Sirikwa holes" that are found throughout the Central Rift Valley and Western Highlands of Kenya and northeastern Tanzania (Soper 1967a; Sutton 1965). Sirikwa holes were first identified and excavated in 1937 by Mary Leakey who undertook a series of excavations at Hyrax Hill in 1937 and 1938 and was able to determine that they were built and used by Iron Age pastoralists (Leakey 1945). Sirikwa holes average between six and 25 meters in diameter, between one and two meters deep and are usually found on the side of hills (Sutton 1966). Based on oral histories and archaeological inference, it is believed that the modern Kalenjin people are the descendents of the builders of the Sirikwa holes (Ambrose 1984a; Chapman 1966; Posnansky 1967; Sutton 1965, 1966, 1987). The

Kalenjin regard the Sirikwa as their ancestors and it is believed that there were Sirikwa settlements into the nineteenth century (Chapman 1966). The Kalenjin speak a Nilotic language, which differentiates them from their Bantu- and Cushitic-speaking neighbors.

Despite having a limited data set because there have been so few excavations of these sites, Sirikwa holes appear to be semi-permanent pastoral homesteads that have an attached small animal enclosure (Posnansky 1967; Sutton 1987). Typically two or three small houses are clustered in a small courtyard. A small entrance to a circular animal pen is constructed at one end of the courtyard near the doorways to the houses. The "holes" that remain visible on the modern surface are the remnants of the animal trampled earth in the animal enclosure left from years of intensive occupation of the site. These are different from modern Maasai settlements that are typically in kraals, which are cattle and small animal enclosures with small daga huts constructed around the inside perimeter of the fence. However, like the modern Maasai the Sirikwa formed very close relationships with their livestock to the extent that domestic animals lived very close to the confines of the family dwelling area.

Figure 12. Sirikwa holes from Hyrax Hill, Nakuru, Kenya (author's photo)

Figure 13. Sirikwa holes from Hyrax Hill, Nakuru, Kenya (author's photo)

Figure 14. Sirikwa holes from Hyrax Hill, Nakuru, Kenya (author's photo)

Several groundstones and one carbonized finger millet (*Eleusine coracana*) seed were recovered *in situ* at Deloraine (Ambrose 1984a) and one groundstone was found at Hyrax Hill (Leakey 1945). Given this evidence, it is unlikely that Sirikwa pastoralists were pure pastoralists. Because they were undoubtedly in contact with Bantu mixed farmers who produced iron hoes and axes and brought domesticated cereal crops from further north and west, Sirikwa had ample exposure to cultivation techniques. No Sirikwa iron artifacts survive in the archaeological record[3] but they are unquestionably using iron, which is indicated by indirect evidence of cut marks left on excavated bones (Sutton 1987). Iron tools make farming a much less laborious endeavor and the site of

[3] This is probably due to preservation factors more than the paucity of iron implements used by the Sirikwa. The soils in the western Kenyan highlands are extremely acidic and break ferrous materials down rapidly (Sutton 1987: 16).

Hyrax Hill is situated in one of the most fertile agricultural regions in the world (Sutton 1987: 15). However, because the Sirikwa were perfectly situated in a highly productive agricultural zone, they may not have perceived a need to grow crops. It is possible that the Sirikwa did not farm, as the modern Maasai do not because they can easily exchange pastoral products and by-products for agricultural produce.

Ambrose (1984a) has convincing data from Deloraine that suggests continuity between Elmenteitan vessel forms and styles to Sirikwa and eventually Okiek and Kalenjin occupations of the site. To Ambrose (1984a), this is compelling evidence to suggest an Iron Age evolution of the Pastoral Neolithic. Posnansky (1967) argues that the inhabitants of Lanet represent an early Iron Age proto-Sirikwa culture who tended *Bos indicus* and opportunistically hunted wild animals to avoid unnecessarily culling their herds. There are also ceramic connections between the Iron Age and modern Kalenjin pastoralists at Lanet (Posnansky 1967).

Horton (1990; 1996) claims that the earliest settlers of the Swahili coast were Pastoral Neolithic Cushites. The primary line of evidence for Horton's (1990) claim lies in the descriptions provided by the *Periplus of the Erythraean Sea*. This document was written in the first century A.D. by for Greek ocean merchants to describe the products and people that sea faring traders could expect to encounter on their voyages (Casson 1989). It describes a port in the Indian Ocean called Rhapta, believed to be located near the modern city of Dar-es-Salaam, Tanzania. Horton (1990) sees many similarities between the social and material culture of the inhabitants of Rhapta and what is found in the archaeological record of Pastoral Neolithic pastoralists. He does not believe that the *Periplus* is describing a "Bantu" settlement (Horton 1990).

Horton (1987) argues that the early settlement pattern of the Swahili sites more closely resembles a Pastoral Neolithic "cattle corral" model than Bantu homesteads. In Horton's model, Cushitic (Elmenteitan) pastoralists moved from the interior to the coast and were the first progenitors of the Swahili culture. Later, Bantus arrived and introduced cultivation techniques and influenced the development of the Swahili language. However, Iron Age pastoralists laid the essential groundwork of Swahili culture and many elements of that socio-cultural worldview survive into the modern era of Swahili culture (particularly language and transoceanic contacts) (Allen 1993; Horton 1990, 1996). Likewise, Abungu (1989; 1994-1995) sees continuity in the ceramic sequence between Neolithic pastoralists and Early Iron Working (EIW) sites on the coast.

However, Chami (1994; 1994-1995; 1998) and Collett (1985) strongly disagree with this claim.[4] Based on their interpretation of ceramic sequences and linguistic data, they believe that the first inhabitants of the Swahili coast that are recorded in the *Periplus* are Bantu agro-pastoralists. Chami (1994, 1994-1995, 1998) and Collett (1985) also see no connection between Pastoral Neolithic ceramic sequences and the development of EIW and later Triangular Incised Wares (TIW). Instead, the evolution of these wares appears to derive from Bantu forms brought from the western parts of the continent (Chami 1994, 1998; Collett 1985: 53-4, 96).

Further arguments against continuity between PN people and early Swahili florescence include the fact that Horton (1996) discovers domesticated cattle remains in the faunal assemblage only after the late eighth century A.D. at Shanga, even though the site is occupied throughout the seventh century. If Pastoral Neolithic people originally

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[4] Chami and Kweksason (2003) have recently revised Chami's earlier position. A thorough examination of the data and interpretations that led to their reconsideration is provided in Chapter 10.

inhabited the site, one would expect to see more cattle in the first occupational stages at the site. However, the transition from a foraging diet to one that revolved around domesticated plants and small amounts of domesticated stock is clear (Horton 1996). This debate will be revisited in Chapters 9 and 10.

4.5 Conclusion

This chapter has evaluated origins of pastoralism as it relates to the need of certain human groups to diversify their subsistence base at the beginning of the Holocene in response to rapid climate changes. However, climate change should not be looked at as the only driving force behind the spread of pastoralism throughout Africa. Pastoralism was an idea that spread in Africa once humans and animals entered into symbiotic relationships. More arid conditions in the Sahara forced humans and wild cattle into closer proximity to each other. Eventually, humans gained mastery over the animals by controlling breeding and feeding cycles. In turn, cattle grew dependent on humans for their own survival. Goats and sheep were later introduced through the Levant corridor. Domesticated animals came to be an insurance policy against the perils of the environment that had kept human population levels low throughout the Pleistocene.

Anywhere pastoralists are successful, it is largely because the people who herd domesticated animals are willing to invest tremendous time and resources to ensure that pasture and water are available. This includes strategies such as burning forests to eliminate disease vectors and predators as well as eliminating competition for grazing land. Mobility is an important strategy for pastoralists who must move in order to guarantee that their animals always have food. Among some pastoral groups, high mobility strategies preclude the cultivation of plants, whereas others move less and are able to practice simple horticulture to further broaden their subsistence base.

Pastoral Neolithic cultures were very diverse in that they successfully employed a number of mobility and subsistence strategies. Interaction with other subsistence groups was an essential feature of survival and this is demonstrated by evidence of exchange in ceramic and tool technologies. Most Pastoral Neolithic people were likely indigenous Eburran hunter-gatherers who received cultural influences from early PN people from the Turkana region. Bower (1991) contends that pastoralism “trickled” into East Africa until it “splashed” after 3,000 years B.P. when pastoralism becomes the dominant mode of subsistence. Pastoralists of the East African Iron Age represent a significantly understudied subject in African prehistory. What is known of their settlement strategies conforms to the risk-minimization model because they protect their livestock carefully and are able to acquire non-pastoral foodstuff by opportunistically hunting wild animals and trading for or growing crops. Because pastoralism in East Africa had such disparate introductions, it appears as an incredibly varied cultural entity in the archaeological record. However, all pastoralists are unified in their attempt to minimize the risks of complete subsistence failure by keeping an accessible, but mobile food source.

Chapter 5. Tsavo Environment, Survey and Excavations

5.1 Environment

5.1.1 Tsavo National Park

Established by the British colonial administration in 1948 to preserve the habitats of endangered wild flora and fauna, Tsavo National Park has had no human occupation for over 50 years. Encompassing 21,000 km^2, Tsavo National Park is the fifth largest national park in the world. For administrative purposes, the park is divided into Tsavo East and Tsavo West, measuring 13,000 km^2 and 8,000 km^2 respectively. Prior to its creation as a wildlife refuge, the colonial government demarcated the region based on the assumption that human populations were sparse in the proposed boundaries (Glover and Sheldrick 1964). Small numbers of Akamba agropastoralists were relocated to a reservation beyond the park boundaries, but no provisions were made for Waata foragers and Orma pastoralists who still occupied and utilized the land within the new park. Most of the Orma chose to move north toward the border of Ethiopia while the Waata assimilated into surrounding Taita communities. The Waata, in particular, were forced to radically change their subsistence economy from hunting to farming. Not surprisingly, the Waata were for a long time the primary poachers in the park, creating conflict between their community and the park administration. Today, poaching is primarily practiced by members of the Akamba tribes who hunt mainly for meat and collect wild honey while well-armed Somali bandits enter the park during the rainy season in search of ivory (Daniel Woodley, personal communication, 2001).

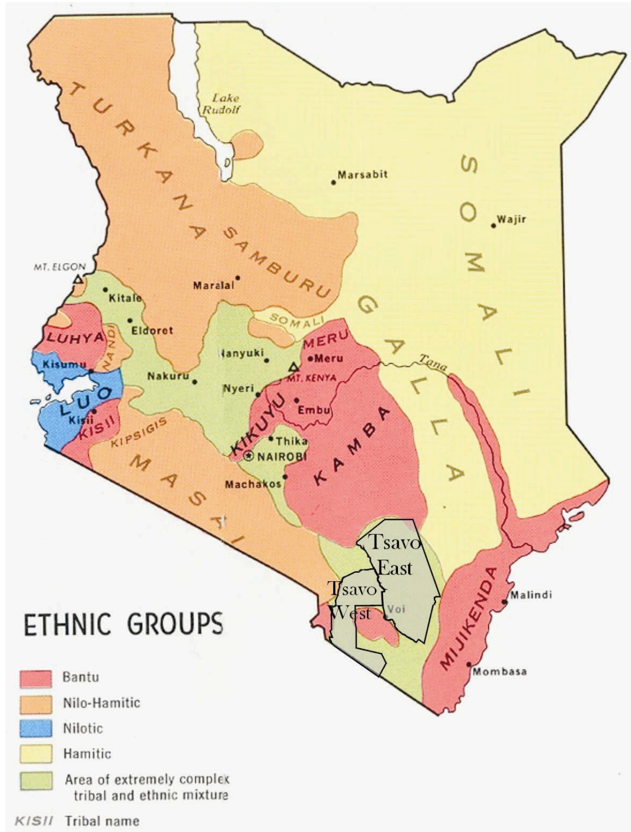

Figure 15. Ethnic groups of Kenya ca. 1974 (Map courtesy of University of Texas Library)

The landscape of Tsavo East generally consists of low relief dissected, erosional and some sedimentary plains. Park elevation rises from 150 meters above sea level in the southeast corner of the park to around 1,000 meters in the northwest (Wijngaarden and Engelen 1985). Tsavo West is marked with topographic irregularities that allowed for the creation of rockshelters and shallow caves. However, Tsavo East is generally devoid of rockshelters, except along the northeast face of the Yatta Plateau that rises and falls over 300 meters in a linear distance of one kilometer. The Yatta Plateau is the world's longest lava flow measuring more than 300 linear kilometers. It extends from Ol Doinyo Sapuk (near Nairobi) and terminates several kilometers northwest of Sobo Rock on the north side of the Galana River. Metamorphic rock formations such as Sobo and Sala Rocks are also found along the fault line between the Basement System geological subsurface and the Taru Grits sedimentary system. Shallow rockshelters are found in these outcroppings and are the only topographic relief for many kilometers. Otherwise, the topography consists of gently rolling hills (1 – 5% slopes) broken by occasional seasonal streams and the only permanent source of water in the park, the Galana River.

Figure 16. Shaded relief map of Kenya with Tsavo East and West and the project area depicted (shaded relief map courtesy of the University of Texas Library)

5.1.2 Rainfall and Hydrology

The diversity of vegetation found within the Park reflects the great internal fluctuation of rainfall—some areas experience intense droughts while other areas that are located within 50 km are flooding (Cassady and Orodho 1973; Wijngaarden and Engelen 1985: 8-11). There is great variability of the geographic distribution of precipitation in the East African plains due to atmospheric forcing of convective cells largely driven by Indian Ocean monsoon winds (Leroux 2001). As a result, rainfall in Tsavo can fluctuate significantly two meteorological stations less than one km from one another despite the fact that they may be topographically homogeneous (Jackson 1981). This phenomenon occurs throughout the continent of Africa, but is particularly acute in East Africa (Lewis and Barry 1988).

Technically, Tsavo is a semi-arid equatorial ecosystem with average rainfall distributions ranging between 200 – 900 mm per year (Wijngaarden and Engelen 1985: 12, Table 1). There are two rainy seasons in Tsavo (March through May; November through December) within which the vast majority of the annual rain falls. However, rainfall is not a predictable occurrence in most of Tsavo. Most of Tsavo East lies within a bioclimatic region that receives less than 50 mm of rainfall during the long rains of dry years (Wijngaarden and Engelen 1985). There are two primary rain-measuring sites in Tsavo at Voi and MacKinnon Road. In a study conducted from 1904 to 1971, annual mean rainfall was measured at 550.4 mm in Voi and 700.5 mm in MacKinnon Road (Cassady and Orodho 1973). However, the standard deviation was calculated to 208.2 mm in Voi and 254.7 in MacKinnon Road with a coefficient of variation of 37.8% and 36.4%, respectively (Cassady and Orodho 1973). In this type of ecosystem, the statistical probability of having a successful rainfed maize harvest is less than 20% (Wijngaarden 1985: 9).

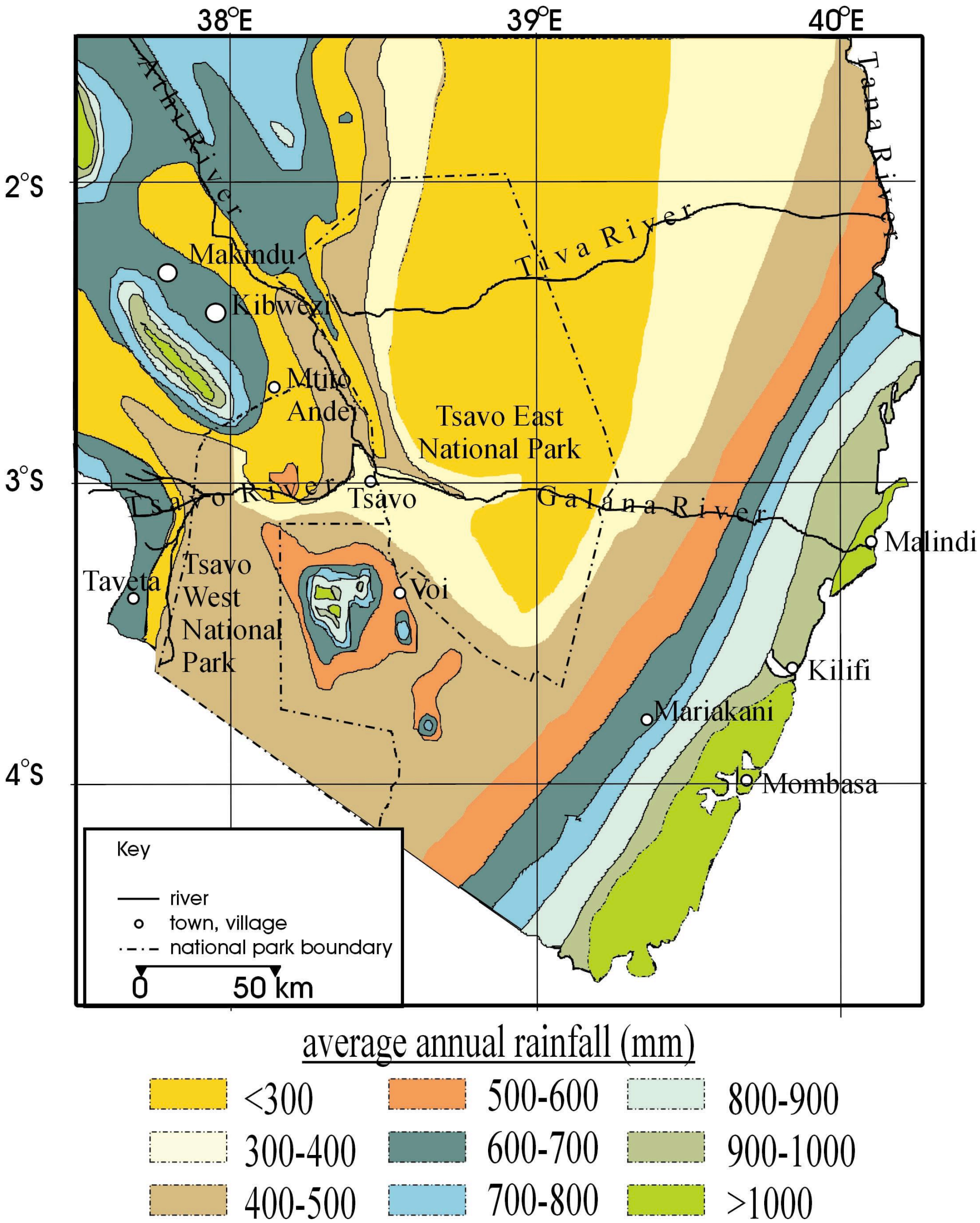

Figure 17. Annual average rainfall distribution in the Tsavo region (Wijngaarden and Engelen 1985)

Tsavo is very sensitive to global weather phenomena such as El Niño and La Niña. No statistical work has been done at these stations since Cassady and Orodho's

(1973) study, but in light of the 1982 and 1998 El Niño events and the subsequent droughts, the coefficient of variation has undoubtedly risen drastically. Eyewitnesses of the 1998 El Niño event recall flooding of a near Biblical proportion as the Galana rapidly overran its banks sweeping away entire tourist camps and vast portions of the Manyani to Malindi Road, stranding wildlife, visitors and park tenants for days at a time. In the following year, rain failed during both of the rainy seasons. Consequently, wildfires decimated the southern portion of Tsavo East, destroying 85% of the vegetation of the area from Aruba Dam to Voi Gate (Robert Muasya, personal communication, 2001). The carcasses of animals that died of thirst or were caught in the fires littered the park. Those who inhabit the park, past and present, can testify that water is its most precarious resource, to say the least.

Permanent rivers and seasonal streams run through the Tsavo region draining the surrounding highland regions into the Indian Ocean (Pritchard 1962: 88). The Galana (Sabaki) River begins after the confluence of the Athi and Tsavo Rivers. The Athi source is Mt. Kenya while the Tsavo drains from Mount Kilimanjaro. This river system flows into the Indian Ocean, located only 90 kilometers from the eastern edge of the park. The floodplain of this river system is almost non-existent in normal years as the Galana has steep scarps that retain most of the overflow within the sandy margins of the banks. The Voi River has a larger flood plain, but is seasonal and due to the unpredictability of rainfall in the region, it is often dry in the rainy seasons. The other seasonal river, Tiva, has a larger floodplain (several hundred meters wide in some portions during good rainfall years), but is also fed by intermittant rainfall (Wijngaarden and Engelen 1985).

The Galana ends its course in the Indian Ocean near the city of Malindi. Given the high seasonal variability of rainfall in Kenya, the Galana River normally floods its banks in the rainy seasons (April, May, October, November) but is reduced to a small stream during the dry months (January – March, July – September) that is crossable by foot in many areas. Despite this, the Galana has only completely dried up twice in the historical period (Wijngaarden 1985). It is the only permanent natural water source within Tsavo East National Park, making it a vital lifeline in the dry season for wildlife inhabiting the park.

Otherwise, numerous smaller seasonal streams close to the Galana River drain Tsavo. These are easily distinguished on the landscape because of the dense bush cover that grows in and around the margin of the streambed. Most streambeds are little more than ten meters wide, although forest cover can grow fifty meters thick in the areas of streambeds that are closest to the Galana. In areas outside a five-kilometer radius of the Galana, the geology changes and drainage is poor (Wijngaarden and Engelen 1985). Waterholes bored open by elephants and ungulates can be found throughout this region. Natural springs along the Yatta plateau provide numerous sources of permanent water, but it is very saline especially close to the dry season (Wijngaarden 1985: 17). Animals can often be seen congregating around these sources of water during the dry season (W. Leuthold and B. Leuthold 1973) as well as subsistence poachers who understand the restricted range of their prey in the lean months.

5.1.3 Geology

The Taita Hill/Galana River basin is broadly included as the youngest part of the north-south extending Neoproterzoic Mozambique Belt that formed between 500 and 600

Ma (Hauzenberger et al. 2000). The region has been divided into three main geological units by Hauzenberger et al. (2000) based on constituent petrology and formation processes. The Sala Region consists of subhorizontal west and east dipping foliation planes (Hauzenberger et al. 2000). The region around Sobo Hill is a shear zone with subvertical foliation planes that run westward for ~30 km in the direction of the Taita Hills (Hauzenberger et al. 2000). The third region is the Taita Hills, which gently dip northwards as a result of thrusting (Hauzenberger et al. 2000).

The bedrock between Sobo Hill and Sala Gate has been more broadly characterized as the Taru Grits subsystem of the Duruma Sandstone series, which is the Kenyan equivalent of the massive Karoo system of Southern and Central Africa (Sanders 1963). Although this is a very simplified view of the geology of the region, it characterizes the region as part of a metasedimentary orthogneissic basement that includes coarse-grained graphite bearing marbles, metapelites high in quartz and ultramafic lenses (Hauzenberger et al. 2000). Metasedimentary rocks are conducive to the formation of silicates such as chert and quartz stones, which are heavily exploited by prehistoric human communities. On pedestrian survey, natural chert outcroppings were not noticed despite the fact that flaked cherts were found at several sites. However, Sanders (1959) records the presence of a cherty limestone outcropping 3.5 miles (6 kilometers) south-southwest of Sala and another 4.5 miles (7.5 kilometers) south-southwest of Kuwetu. In thin section petrographic analysis, the rocks were high in calcium carbonates and contained only 12.29% silicate (Sanders 1959), which is not optimal petrography for the fashioning of stone tools. However, natural chert outcroppings higher in silicates are very likely to exist in places not noticed either on our archaeological surveys or in the Sanders (1959; 1963) or Hauzenberger et al. (2000) geological surveys of the region in the 1950s because well-formed cherts are recovered *in situ* during archaeological testing in the 2001 field season in the form of flakes.

The soils along the Galana River are dissected erosional and sedimentary plains with slopes varying from 1 to 5%. Wijngaarden and Engelen (1985) describe the soils along the Galana River floodplain as mostly comprised of shallow calcic cambisols with a moderate to high-level of soil nutrients.[5] Cambisols are young lateritic soils that show poor soil horizon development and little illuvial accumulation (FAO 1974; Kiome and Muchena 1998). Calcic cambisols in fluvial environments tend to be associated with >1 m thick B_k or B_w horizons comprised of undifferentiated alluvium (Food and Agriculture Organization 2000).

Generally speaking, soils that develop above the Taru Grits formations are a complex of well-drained, stony and gravelly sandy clay loams. Their colors tend to be reddish brown or yellowish brown, indicative of a lower iron content than is found in the very leached soils beyond the Taru Grits formations. The soils along the Galana are relatively rich in phosphorous, potassium, magnesium and calcium in spotty areas (Wijngaarden and Engelen 1985: 149-52; personal analysis). These minerals are conducive to the development of sustainable agriculture and fertile pasturelands (Kiome and Muchena 1998), although the limiting factor to developing sustainable agriculture throughout much of Africa is the lack of nitrogen input in the soils and water (Wild 1993).

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[5] Chapter 6 has a revised soil assessment based on the USDA classification and thorough geomorphic analysis of sediments recovered from archaeological trenches.

Petrographic analysis undertaken at the estuary of the system in Malindi indicate that the sediments entrained in the Galana River are primarily composed of fine- to medium-grained quartz sand and include an average suite of 15% heavy minerals (Abuodha 2003). The main sediment sources for the Galana originate from the weathering of igneous rocks that are found near Nairobi, the metasedimentary Mozambique Belt rocks that are found to the east of Nairobi extending eastward to the coast (Abuodha 1998; Geographical Survey Staff 1959; Hauzenberger et al. 2000). Comparative analysis of nitrate, phosphate and silicate concentrations in the river system during the rainy and dry seasons show that the river is nutrient rich in the rainy season, while low concentrations of nutrients are found in the dry season (Ohowa 1996). Thus, annual soil fertility levels along the Galana River floodplain are a function of general seasonality of the regional precipitation indexes and runoff rates upriver.

Outside the floodplain of the Galana, sandy, ferralsolic and luvisolic soils are most common (Geographical Survey Staff 1959). These have formed mostly on eroded Basement System gneisses, schists, migmatites and crystalline limestones. Wijngaarden and Engelen (1985: 154) maintain that the soils along the Galana River are the most fertile in the Tsavo region. In addition, most areas along the Galana River are adequately suited for irrigated farming techniques (Wijngaarden and Engelen 1985: 238). Outside of this region, sustainable agriculture and intensive pastoral occupations would be difficult to sustain given the lack of water and general inhospitability of the environment to human occupation (Wijngaarden 1985; Wijngaarden and Engelen 1985; see also Thorbahn 1979: 226). However, during rainy seasons, standing pools of water develop on the basement gneisses and migmatites. This would have been a suitable environment for the construction of ephemeral settlements by foragers or pastoralists.

5.1.4 Vegetation

The flora and fauna of Tsavo National Park is extremely varied owing to the diversity of the climate and soil conditions. Most of the vegetation in the park is currently desert grasses and bush, although closer to the park's eastern border, high coastal grasses and bush are more common (Geographical Survey Staff 1959). *Acacia* and *Commiphora* species of trees and shrubs comprise the majority of the canopy cover found in Tsavo south of the Galana River basin (W. Leuthold and B. Leuthold 1973; Wijngaarden and Engelen 1985: 176). Near the Galana, *Commiphora* and *Lannea* species dominate the tree cover. In the western portions of Tsavo East close to Manyani Gate, dense thickets of *Commiphora bosica coriacea* and *Commiphora cordia gharaf* with variants of *Terminalia orbicularsis* preclude traffic of any sort other than on park roads. However, east of this region, the canopy cover thins and *Commiphora caesalpinia trothae* and *Commiphora schmidtia bulbosa* subspecies dominate in the Galana River region, although sporadically, as bushland gives way to grasslands. *Stipaeae* and *Chlorideae* perennial grasses grow in areas that are not completely covered by trees or shrubs (Wijngaarden 1985: 2, 41-2). Prior to the fires of the 1960s, much the area that is now dominated by grasslands was covered with *Acacia* and *Commiphora* trees (Leuthold and Leuthold 1973).

The banks of the Galana River are primarily composed of vertically accreted fine sands and silts, which are deposited during flooding events. Eolian processes also contribute to the sedimentation of the river margins. High winds carry minute amounts of fine silts that are found in episodic thin layers between terrace formations. Furthermore, colluvium eroding from steep scarps that are cut into the terrace faces after flooding events are a major component of the sedimentation of the Galana River. In still other areas of the river margin, exposed Taru Grits bedrock is eroding directly into the river and no soil overlies the system.

Today, the riverbanks of the Galana River are generally lusher than the surrounding plains. The unceasing flow of the Galana has created an oasis of leafy green vegetation in the midst of a very parched landscape. Although hardy, *Commiphora* and *Acacia* species bear few leaves in the dry season forcing much of the browsing wildlife to congregate near the river in search of food (W. Leuthold and B. Leuthold 1973).

The Galana River margins are dotted with doum palms (*Hyphaene coviacea*), *Raphia* sp. and wild date palms (*Phoenix reclinata*) (Wijngaarden 1985). However, the dominant riparian plant species currently found growing along the margins of the river is *Suaeda monoica*, a salty shrub that grows well on saline soils in semi-arid environments (Dale and Greenway 1961: 90). This plant species has hitherto been unidentified in prior landscape studies and may be a relatively recent introduction to the area. Today, the shrub grows in dense groves between ten to three hundred meters from the banks of the river and is ubiquitously found east of Lugard's Falls until Sala Gate. During the dry season when there are few foraging options, many of the park's wildlife are forced along the banks of the river in search of food and water. Elephants and giraffe were frequently observed eating *Suaeda monoica* in the dry months, but as soon as the rains came, the browsers dispersed into other parts of the park to feed on different types of trees. Based on this observation, it seems likely that *Suaeda monoica* is not the favorite fodder of wild browsers, but in the dry season it is a crucial component to surviving the harsh conditions.

Both wild browsers (elephant, giraffe, rhinoceros) and grazers (gazelle, buffalo, zebra) are found throughout the park. There is a strong negative correlation between the number of wild browsers in the park and the density of woody vegetation (Wijngaarden and Engelen 1985). Glover and Sheldrick (1964) record catastrophic overpopulation of elephants in Tsavo National Park, which resulted in the overstripping of browsing fodder. This event nearly resulted in the extinction of the rhinoceros in the park as well as threatened the habitat of elephants themselves. Wijngaarden and Engelen's (1985) study concludes that overgrazing and fires frequently strip localities of their overbrush and the browsers are forced to move to an area that has more forage. Ungulates are flexible and can alternate their ranges depending on availability of fodder and water (Leuthold and Leuthold 1972; Leuthold and Leuthold 1973). These animals have an innate sense of the limitations of their habitat, and will not, under normal circumstances, overtax their environment (Wijngaarden 1985). However, in extreme drought survival instincts take over and the already stressed environment becomes very extensively damaged if too many foraging animals are left to fend for their continued existence.

5.1.5 Summary of Tsavo Environment

Tsavo is a diverse landscape with great topographic and environmental variability. The Galana River is the lifeblood of the ecosystem and is a magnet for the various species of flora and fauna in the region. Naturally, human occupation of Tsavo has also centered around the Galana River as well and focused on exploiting the resources that aggregate around it. In the following section, results of several months' archaeological survey in the eastern portion of Tsavo National Park will be summarized, focusing on the record of prehistoric human communities located in proximity to the Galana River. Throughout this thesis, the discussion of how people utilized the broad array of resources should bear in mind the tremendous range of rainfall, geology and vegetation that the Tsavo region possesses.

5.2 The Survey

During the survey, archaeological sites were recorded based on three main criteria. First, we identified sites based on the position of artifacts on the surface indicating a pattern that clearly demonstrated they were not placed there by erosion. In Tsavo, periodic torrential rains result in the formation of wadis (arroyos), which transport clastic sediments across the landscape. The transport processes frequently fracture the rocks and deposit them in washes, which may remain even if there is a shift in drainage and the wadi is no longer clearly defined. Such "ecofacts" can mirror archaeological sites, so careful analysis of topographic maps for evidence of bioturbation or recent human activity was undertaken after each site was identified (Shea 1999). Furthermore, sites that were identified solely on artifacts included at least two artifacts, which were not of the same type (ceramic, lithic, fauna, worked shell, etc.).

Archaeological sites were also recognized on the basis of surface features that were clearly distinguishable as the product of human activity. Grave cairns were the only features identified without corroborating artifactual evidence. Termite mounds are well distributed throughout Tsavo National Park and can look deceivingly like eroded mud house foundations. The picture is more complicated if one considers the fact that many houses are abandoned in Africa *because* they are infested with termites. Therefore, circular clearings that had no artifacts in the vicinity were not recorded as archaeological sites.

The final means for recording archaeological sites was based on credible witness testimony corroborated by maps or secondary verbal or written verification from other credible sources. Our crew was given vague directions to several abandoned Waata villages, but we were unable to locate them and we did not receive any corroborating information from people who knew the area. Until it is possible to verify the exact locations of the sites, they are not yet classified as archaeological sites.

This section of my dissertation will present the methodology and results of the survey undertaken during the 2001 and 2004 field seasons. Results presented in this chapter do not necessarily pertain to early pastoralism. Seven categories of archaeological sites were identified during the survey and are published here for the consideration of future researchers.

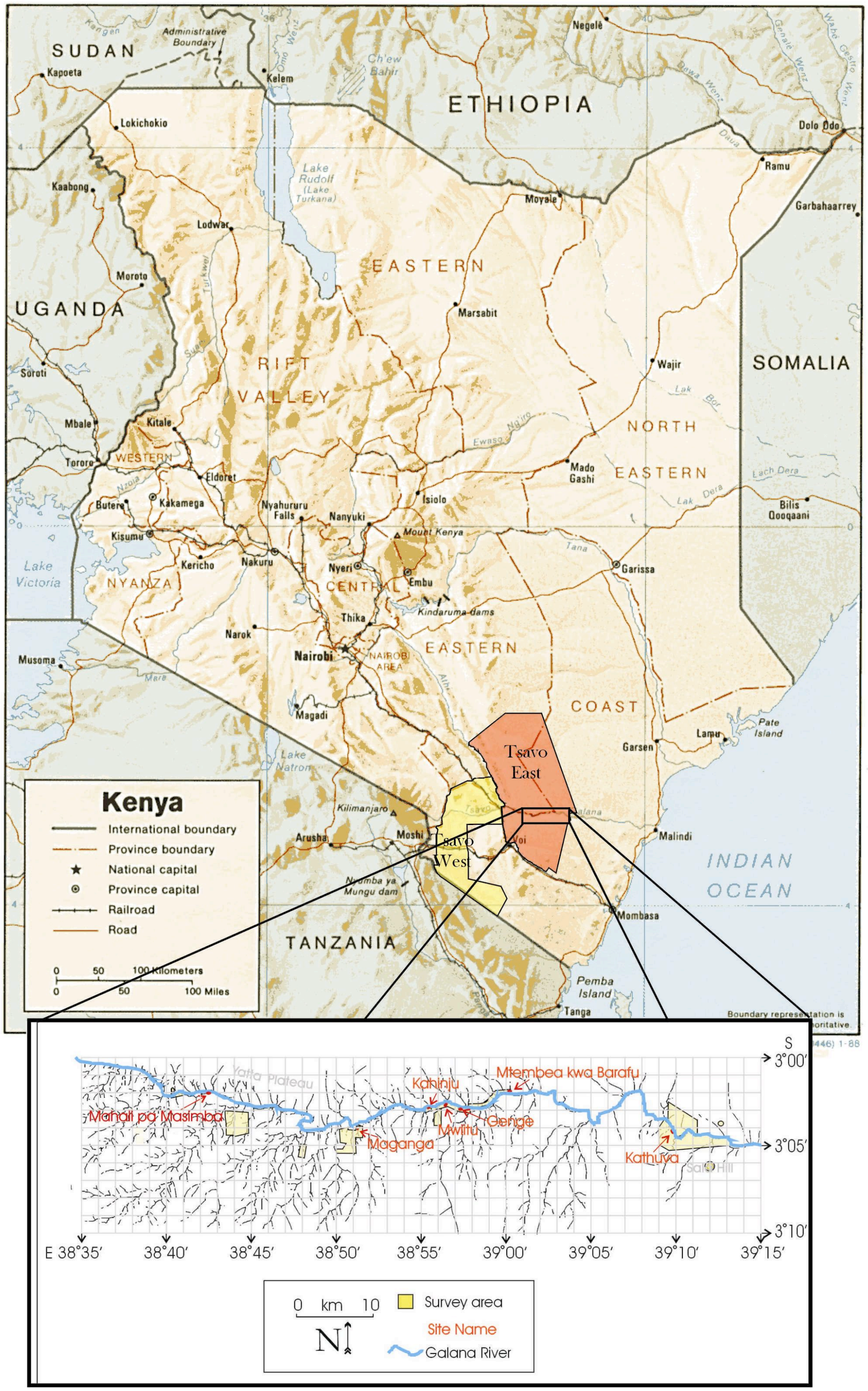

Figure 18. The survey (shaded relief map courtesy of the University of Texas Library)

5.2.1 Survey Methodology

The sampling design of the survey was randomly stratified (Banning 2002). The original intention of the survey was to obtain total coverage and identify sites in three 5-square kilometer zones along the Galana River. These sites were to then be examined in terms of the inhabitants' land utilization strategies and presence of trade goods originating from the Swahili coast. The research design was intended to test the hypothesis that Iron Age sites closer to the Swahili coast would have better access to imported trade goods (glass beads, porcelain, Arabian glazed ceramics, cloth) and coastally produced items (such as cowry and other marine shells, iron, ceramics), and this would be reflected in the archaeological record. If access to trade with the coast were a reflection of distance, densities of artifacts would be highest in those sites that lie in the eastern portion of the survey area. If warlords or independent polities in the deep interior controlled trade, few trade goods would be found outside of the site that controlled the movement of these goods. Thus, a simple linear regression line would show a correlation between the dependent variable (increasing distance from the coast as one moves west along the Galana) and the independent variable (relative density of trade artifacts from the coast in each site). A strong correlation would be used to argue that trade was performed "down-the-line," following methodology used to develop models of prehistoric exchange in the American Bottoms (Brose 1990; Dincauze and Hasenstab 1991; Lafferty III 1994; Little 1987; Peregrine 1992). If no correlation was found in the regression model, trade would have been assumed to have been conducted "point-to-point," whereby specific items were moved in controlled, non-egalitarian directions thereby restricting access to trade for the benefit of a small group of powerful or wealthy individuals.

A randomly stratified survey design (Banning 2002) was chosen because Tsavo has not had human inhabitants since 1948 making it difficult to obtain informant information on the presence of archaeological sites. It was assumed that if there were sites to be found, they would need to be identified without the assistance of informants. In order to obtain an unbiased representation of sites to fit the research design that were not a reflection of the movement of the roads through the park, a full coverage survey was deemed necessary.

However, the survey was hindered by a number of logistical obstacles that precluded the total coverage of the sampling area originally selected. A three-person team led by a Kenya Wildlife Service ranger began pedestrian survey in January 2001. Transects were walked in 10-m intervals where ground visibility was better than 25%. All sites were marked with a portable global positioning system and their proveniences are recorded in the National Museums of Kenya SASES system.

Unfortunately for the research design, the rainy season came late in 2001—heavy evening downpours created large marshes during the daylight hours and the resulting growth of underbrush made surface visibility very low in some areas. Furthermore, the rainfall in Tsavo was very localized during that season, centering on two of the designated survey zones, but rain was absent in areas further south and east of this area. In 2004, the rains began early and also created safety and logistical obstacles for extending the scope of the survey. Heavy rains attract a wide array of dangerous wildlife to the region, and so the survey had to concentrate on areas that were open in order to minimize surprise contact with animals. Because of these reasons, we chose to ignore certain areas slated to have been surveyed, while we concentrated on other areas that were outside the delegated survey zone.

Midway through the survey in 2001, our team was directed to investigate an area along the banks of the Galana River by Mr. Clive Ward of Tropical Ice Safaris, Nairobi. His company conducts upmarket walking and camping safaris along the banks of the Galana River, and he told us that following the El Niño flooding of 1998, he had noticed ceramics and bone eroding from a scarp of the river. Upon investigating, our team recorded the presence of the site of Kahinju, which we later excavated.

Following the discovery of this site, the survey design was retooled to fit the logistical and practical circumstances of the field season and subsequent survey was directed along the immediate banks of the Galana and the hinterlands surrounding the sites. Survey continued throughout the year of 2001, although systematic survey of the three survey zones began in January and ended in late February 2001. A short survey during the 2004 field season also focused on detecting sites along the banks of the Galana River and followed the same methodology that was undertaken in the 2001 field season.

5.2.2 Survey Results

The 2001 and 2004 surveys resulted in the discovery of several types of sites in Tsavo.

1. Early Stone Age type lithic scatter.
2. Middle Stone Age/Late Stone Age type lithic scatters.
3. Conical grave cairns.
4. Rockshelter with paintings.

5. Open-air hunter-gatherer settlement.
6. Open-air pastoral settlement.
7. Settlements concentrated along the banks of the Galana River.

Table I. ARCHAEOLOGICAL SITES DISCOVERED DURING THE 2001/2004 SURVEYS

Number of sites	Site Type	Cultural Material*	Approximate Age
2	ESA scatter	L	>1,300 years
2	MSA/LSA scatter	L, C	>1,300 years
68	grave cairns	PR	50-500 years
1	rock art	O	50-500 years
1	open air foraging	n/a	50-500 years
1	Open air pastoral	L, C, G	50-500 years
6	fluvial settlement	L, C, G, S, B	1,300 - 6,000 years
* L=lithics, C=ceramics, PR=piled rocks, O=ochre, G=grindstones, S=shell, B=bone			

5.2.2.a <u>Early Stone Age Type Lithic Scatter</u>

Only one site fits this description. It is located very close to the Galana River in an open area that is very sparsely vegetated. Seasonal streams that drain the surrounding plains crosscut the area, but this site does not appear to have been affected by erosion or deposition of alien elements. The stone scatter is situated on a vein of natural igneous basalts and feldspars, from which the artifacts appear to have been fashioned. The only artifacts observed were single-strike choppers and expediently created tools. No bone or other diagnostic artifacts were present.

Given the proximity of this site to Kathuva (discussed below in detail), it is possible that this was a mine from which the inhabitants of Kathuva procured the raw material from which they would later fashion finer stone tools. However, it is impossible to say without sophisticated mineralogical analysis of *in situ* lithics from Kathuva and the ESA type-site whether the site is part of the resource base of Kathuva or a part of a separate archaeological tradition. It warrants future investigation.

5.2.2.b <u>Middle Stone Age/Late Stone Age Type Lithic Scatters</u>

Peter Thorbahn (1979) notes several of these sites in his survey of Tsavo East National Park. These sites are distinguished by the presence of between ten and one hundred stone flakes, made of locally available material and some chert imported from surrounding areas. There are no chert outcroppings in close proximity to the sites discovered, and so this raw material must have been imported from very distant locales either by human or fluvial transport. Sanders (1959; 1963) indicates that the nearest possible chert source to the Galana River is located in near Sala Hill (Figure 18).

There does not appear to be any correlation between the presence of MSA/LSA stone scatters and permanent settlements. However, the data set is limited at this point and more survey must be done to be able to say that there is no relatedness between any of the settlements and the stone scatters. We only located two MSA/LSA sites independently and were unable to relocate several of Thorbahn's sites. It is possible that he collected all of the surface material from the sites, although his notes and dissertation make no mention of the methodology of surface collection.

In one of the scatters our team located, a handful of potsherds were recovered (HeJt11), but none of these were diagnostic. Ceramic temper and mineralogy appear very similar to non-diagnostic sherds recovered from Pastoral Neolithic settlements along the banks of the Galana. However, this is a provisional diagnosis and X-Ray defraction (XRD) analysis will be undertaken in subsequent years in order to examine the possibilities that these ceramics represent artifactual remains of people traveling or seeking pasture away from the larger settlements situated along the Galana River.

MSA/LSA lithic scatters appear to be located on or near washes of metamorphic gravel. An obvious reason for this is that the raw material for making tools is readily available. Most of the flakes are made from quartz rocks and basalts, which are in abundance in pockets particularly close to the Yatta Plateau. Both of these stones contain internal striations that allow for reduction, but neither is ideal in the sharpness of the edge created. This could be the reason that chert was imported to the region despite the obvious hardship of undertaking a long journey of that nature.

5.2.2.c Conical Grave Cairns

The presence of grave cairns in the Tsavo region was noted by Thorbahn (1979) and C. Kusimba and S. Kusimba (2000). Thorbahn (1979: 210-1) attributes them to either Oromo (a.k.a. Orma, pejoratively referred to as Galla) pastoralists or Waata (a.k.a. Waryanguru, Walyankuru) foragers who inhabited the region until it was designated a national park in 1948. Somali are also known to practice this form of interment and they provide a useful ethnographic analogy for understanding the function of these graves as territorial markers (Brandt and Gresham 1989; Lewis 1998: 139; Sutton 1973: 48). Holl (1998b: 157) argues that pastoralists often bury their dead in one of their dry season camping areas. He argues that this demonstrates the strong relationships that form between humans and their livestock (Holl 1998b).

Kirubai Mnyambo Konuru, a Waata tribesman who lived in Tsavo before it was designated a national park, claims that the Waata people never buried their dead in the ways of the Oromo people. The Waata were foragers who spoke a southern dialect of the Oromo language, and lived in the area around Ndololo, near the present day town of Voi. The Oromo are documented to have inhabited between central Ethiopia and the Galana River (Hassen 1994; Spear 1981), but their territory fluctuated greatly according to availability of grazing land and their ability to fend off hostile intruders. According to Mnyambo, the Waata had a symbiotic relationship with their pastoral cousins, exchanging honey and dried wild animal skins for cattle meat and milk (see also Karega-Munene 1997: 186; Thorbahn 1979: 177; Ville 1995). Mnyambo states that the Oromo buried their people in the exact location where they died. Bodies were not transported to another locale for burial.

Most of the cairns our team located were made from sedimentary limestone and fossilized coral outcroppings that dot the Tsavo landscape. In areas closer to the Yatta, fine-grained igneous rocks are the primary material from which the cairns are constructed. This is a reflection of the local availability of rock, which varies greatly throughout the survey zone. In several cases, cairns were located up to a kilometer from the nearest source of stone. According to Mnyambo, the taboo against transporting the dead was so strong that it justified carrying stones to the burial site rather than the less labor-intensive option of moving the body to a source of stone.

C. Kusimba and S. Kusimba (2000) place Tsavo grave cairn sites into two categories based on their 1999 – 2000 survey of the park. The first site category is the "single cairn," that is a cairn located in an area without another cairn within 500 meters.

The second category is the “multiple cairn” site. These sites have numerous cairns found within close proximity to one another. A similar pattern of cairn distribution was noticed during the 2001 and 2004 surveys, and has been found in a survey of the Upper Juba River in Somalia as well (Brandt and Gresham 1989).

Thorbahn (1979) hypothesizes that there was a two-tiered settlement scheme for precolonial foragers in Tsavo: 1. small, dispersed settlements centered around procuring seasonally available resources and 2. larger sites near permanent water sources that were occupied in the dry season. Data from the 2001 survey does not refute Thorbahn’s (1979) hypothesis, but very little survey was done away from the river. However, during the 2000 field season, one multiple cairn locale was identified at Konu Maju—located several kilometers from the ephemeral Voi River (C. Kusimba and S. Kusimba, 1998-2002 field notes).

5.2.2.d Rockshelter with Paintings

We accompanied Daniel Woodley, the warden of Tsavo East, north Division, to a rockshelter along the Yatta Plateau said to contain paintings inside the dripline. This site is said to have previously been visited by Mary Leakey and is designated as having a fifteenth century Oromo occupation from which the paintings are dated. Confirmation of this site was found inside the National Museums of Kenya SASES system.

The site is located on the northern slope of the Yatta Plateau and is marked on the 1:250,000 Kibwezi topographic map (series Y503, sheet SA-37-10, edition 3-SK, 1975). It is located in a cluster of rockshelters, all of which have evidence of recent human occupation. The sites are frequently used as hideouts for poachers and are routinely visited by Kenya Wildlife Service rangers as they patrol for poachers in the area. Human disturbance into the archaeological integrity of the site is very pervasive and *in situ* prehistoric occupations will be difficult to discern from recent occupations. Poachers and rangers have been setting fires in the shelter and digging for artifacts.

The paintings were difficult to discern, but mineralogical samples have been collected from the suspected paintings and mass spectrometry should confirm or deny the use of substances such as ochre or charcoal. One figure readily discernable appears to be a shield or another elliptical form with half-stripes across the breast. The pigmentation appears to have been fashioned from ochre. It is, however, very faded.

Other figures were not identifiable by the naked eye. The rockshelters in the Yatta region are comprised of Miocene phonolites and Permo-Triassic micaceous sandstones (Sanders 1963). These rocks are subject to the accumulation of calcium deposits and streaks, which have made numerous "patterns" on the face of the rock. These patterns are deceiving to the casual observer looking for rock paintings. Upon close examination of the total context of the rockshelter, it was clear that humans undoubtedly made some of the designs, while others were natural.

5.2.2.e <u>Open-Air Hunter-Gatherer Settlement</u>

One site recorded in our survey was the remains of a settlement of Waata people. The Waata refer to this site as Ndololo, to which it is still officially designated on road signs and maps created by the Kenya Wildlife Service who currently administer Tsavo National Park. This site was located on the advice of Kirubai Mnyambo Konuru, who is referred to in the section above, and has also been noted by Drs. Chapurukha and Sibel Kusimba during previous archaeological reconnaissance of the region (C. Kusimba and S. Kusimba, field notes 1998-2002).

Unfortunately, few of the people who inhabited the site are still alive and our team experienced difficulties in locating any other Waata to provide more information on the history of the settlement. However, a summary of the interview we conducted with Mr. Mnyambo is available upon request. Little information besides this interview exists on the site, which has never been completely forgotten by the outside world, but has never been well documented either.

5.2.2.f Open-Air Pastoral Settlement

During pedestrian survey, our team located the remnants of one pastoral homestead, which has been designated Maganga (HeJt35). The site was originally identified based on a change from sparsely vegetated shrubland to open grassland. The plant species *Cynodon dactylon* grows in abundance on the site and has been correlated with the existence of pastoral occupations in other parts of East Africa. Barker et al. (1990) and Stelfox (1986) suggest that these plants grow best on deserted cattle bomas where dung creates soils anomalously high in potassium, nitrogen and phosphorus.

Maganga is located only 500 meters from the Galana River, and although badly deteriorated, it is likely not more than 100 – 200 years old. Subsurface testing of the soil horizons shows that erosion is very pervasive at Maganga and surface features would not be visible if the site were any older. Shovel tests indicate that the surface soil consists of a poorly developed B-horizon extending <10cm below ground surface. The soils are a red lateritic silty-sand (⅛ to ¼ mm) and very prone to erosion as there is little deep rooted groundcover to hold the soils in place during the brief, but torrential rains that the area experiences. Below the first five centimeters, the soil is very gravelly parent material (C-horizon). Inside the site boundaries, there are no large stones laying on the surface, despite the fact that the surrounding area has numerous veins of extruding igneous rock formations.

One small piece of pottery, one chert flake, several groundstones and metal sharpening stones were also collected or noted. Surface features were in poor condition, but indicated the presence of houses arranged in a very similar fashion to modern Maasai and Samburu *bomas* (Shanack-Gross et al. 2003). At least two structures were positively identified in the center of an elliptical open area that is partially surrounded by acacia shrubs. Two large fallen trees lie near the center of the site. These are non-indigenous species, being considerably larger than the surrounding acacia shrubs that dominate the landscape. The perimeter of the site is well distinguished by a break in vegetation, shifting from grasses in the center of the site to acacia dominated bushland around the margins.

Maganga is located in the area designated as Sobo (in the Oromo language, *sobo* means "hill"). Drainage around the site is good as numerous seasonal streams that originate many kilometers to the south empty into the river. Visibility of the surrounding plains is very good, and one can imagine this was a good vantage point for choosing the direction in which the pastoralists were going to herd their animals on any given day. At the same time, potential threats to the inhabitants of the site and their livestock would have been easily identifiable given the low precipitation index and sparsely vegetated environs of the site. Annual rainfall is between 300 – 400 mm, most of which falls in the months of April and May (Wijngaarden and Engelen 1985). Even in these months, the landscape is only a greener shade of its usual brown, and is not densely covered in bush like the area from Lugard's Falls to the Manyani Gate (Wijngaarden and Engelen 1985).

5.2.2.g <u>Settlements Concentrated along the Banks of the Galana River</u>

The 2001 survey located four settlements along the banks of the Galana River. The sites had the following characteristics:

1. pottery, bone and/or lithics found in erosional slump close to the scarp created by erosion of the terrace closest to the river (T1).
2. evidence of multiple occupations through time, with the exception of one site.
3. technology or subsurface provenience that suggest that the sites are pre-Iron Age (i.e. 2,000 years and older).

As stated above, the El Niño of 1998 produced historically unprecedented rainfall and flooding throughout most of Kenya. At that time, the Galana River swelled several meters above its levees, beyond the banks and covering much of Tsavo in water. After water levels receded, steep scarps resembling small cliffs had been cut into the fluvial terraces. From these terraces, copious amounts of archaeological artifacts were eroding. It was after this time that Mr. Clive Ward of Tropical Ice Safaris, Nairobi began noticing the presence of pottery along the Galana River in two locations. Mr. Ward informed our survey party of the sites and we eventually visited the sites he described. The erosion of the terraces provided a unique archaeological opportunity to locate archaeological sites *in situ* that would have otherwise remained buried. However, the erosion is also responsible for serious damage to the sites and they are currently threatened by further flood events.

The survey team has recorded six such archaeological sites to this point and anticipates finding more sites after a proper full-coverage survey is able to be undertaken the full length of the river, from the Athi/Tsavo confluence to Malindi.

The six sites are listed below in their order of discovery:

1. **Kahinju** (HeJt9) is a large site extending, minimally, 581 meters along the banks of the Galana River. However, erosion of artifacts from the profile of a fluvially cut escarpment and subsurface testing proves that it extends well beyond where it is visible in the scarp of the river. It could well be over a square kilometer in area, but until full mitigation of the site occurs, it is impossible to realistically estimate at this point. Several hundred pieces of pottery, bone and pieces of quartz lithic fragments were found lying on the surface of the site or eroding out of catenas present within the scarp itself. In addition, ash was noticed in one of the profiles that looked to be from a hearth.

    The first cultural level was measured from the scarp face at 190 centimeters below the modern ground surface. A weakly developed, buried A-horizon (A_b) from which pottery and bone was protruding marked the cultural surface. Artifacts were found to be eroding from the A_b for over 500 meters until elephant trails and bedrock marked the discernable end of the site boundaries. Four other A_b horizons associated with artifacts were also recorded, but were not contiguous owing to the degradation of the terrace formation in which the site is buried. Therefore, it was impossible to estimate the areal extent of the earliest settlements based on the survey data alone.

    Ceramics were abundant on both the ground surface and eroding from the river terrace. Most of the sherds recorded and/or collected during the survey were undecorated and non-diagnostic. Ceramic sherds showed that vessel construction employed “pinching” and most of the body and rimsherds appeared to come from large, globular containers. Narosura tradition ceramics (Chapter 9) were the only decorated sherds that fit into a regionally accepted ceramic typology. These were useful in determining that the site was occupied during the PN. However, the distribution of Narosura tradition ceramics is the most geographically and temporally wide-ranging of PN ceramic traditions and therefore was useful only in determining that the site was probably occupied before 2,000 years B.P.

Numerous land snail shells (particularly *Achatina fulica*) were noticed on the grounds as well as eroding from the terrace face. Many shells were whole, unbroken specimens that appeared to be aggregated in the area just above the cultural horizon. Other shells found on the ground were broken and even burnt. Terrestrial mollusk shells proved useful in isolating distinct occupations because they are so numerous in the archaeological deposits and show up in profile view as clear horizons that demarcate archaeological deposits (Figure 19). During excavations, we determined that many of the mollusks fed on the organic material left by the occupants of the site, which is why the majority of the shells are found above the archaeological deposits.

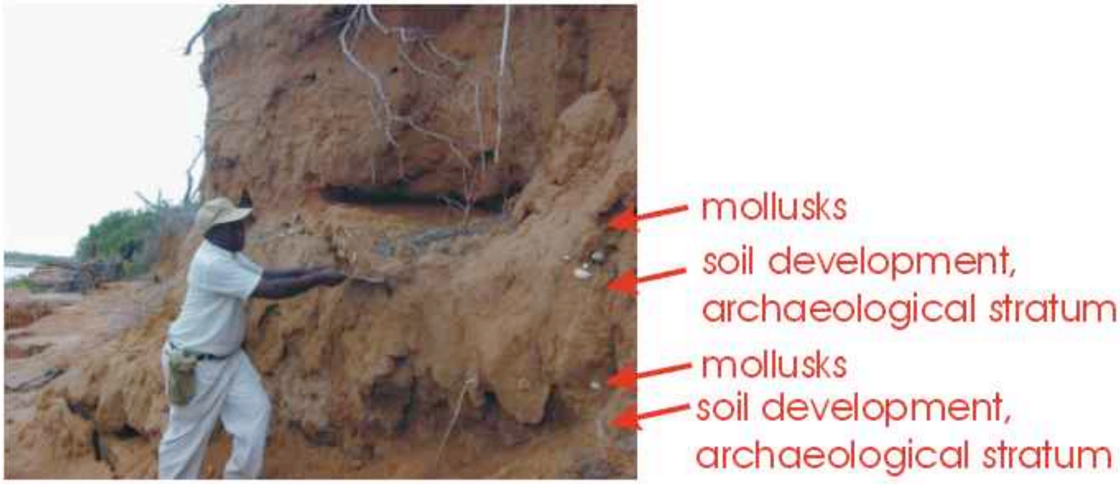

Figure 19. Terrestrial mollusks above *in situ* archaeological deposits at Kahinju

Diagnostic bones were not recovered on survey. The most numerous elements recovered were ribs and most came from size 2 bovids (Appendix A). Most faunal material was burned, severely fragmented and weathered to the point where determining even the genus of the animal was impossible. Based on the recovery of PN ceramics, we hypothesized that many of the size 2 bovid faunal elements were ovicaprid, but this was never positively determined from the sample.

2. **Kathuva** (HeJu5) was located on pedestrian survey without the aid of informants. Fewer than twenty pieces of non-diagnostic pottery were noticed on the ground and none were found *in situ*. Some small fragments of animal bone were noticed as well. Like at Kahinju, most of the surface bone finds were non-diagnostic, although several elements were determined to be from at least one dik dik (*Madoqua* sp.).

Compared to Kahinju, this site was very small. It measured only about 100 linear meters within the zone where artifacts could be noticed. However, it was uncertain whether this was because the site was less damaged by erosion than Kahinju, hence less artifacts have eroded from the terrace.

3. **Mtembea kwa Barafu** (HeJt10) was pointed out to us by Mr. Clive Ward. This site is located on the north side of the Galana River, a very inaccessible area to do survey because there are no bridges or roads that lead to the area directly. However, after crossing the river by foot, the site is only six kilometers downstream from Kahinju. It is situated on the immediate banks of the river with no shoal to buffer the bluff from the river's edge. It is currently on the high-energy side of the meander. Thus, the river is cutting into the site more and more everyday and erosion is occurring rapidly.

   Mtembea kwa Barafu is a very large site and is stratified into at least three separate cultural occupations.

   a. Cultural Level A (CLA) is the closest to the modern ground surface, but is located over three meters below the surface in some areas. The cultural layer is on a thick A-horizon (30 – 50 cm thick throughout the catena) and is underlain with >1 m of sterile alluvium. As was the case at Kahinju, numerous land snail shells are located above the cultural horizon.

      Pottery is very crudely fashioned despite the fact that a very thick clay layer lies just below the horizon. Bone and tooth fragments were recovered from this layer. The bones appear to be ovicaprid, and the tooth might be bovine.

b. Cultural Level B (CLB) appears to have the largest quantity of artifacts coming from it. We collected a very charred piece of pottery from this level that bears strong resemblance to the pottery collected at Kahinju. A rim sherd was collected whose decoration was dissimilar to the decorated pieces recovered at Kahinju, however the temper and firing techniques are very similar.

c. Cultural Level C (CLC) is difficult to interpret. It is located very close to the level of the water during the dry season. The pottery has an orange exterior with a blackish (low-fired) interior. Other types of pottery were recovered as well, but the majority appears to be the orange pottery.

The vertical accretion of sediments on the site is around two or three meters between CLA and CLC. We did not have an opportunity to properly map the site and so proveniences between cultural levels were estimated by pulling a tape measure from level to level, where possible. By this method, it was determined that CLB overlies CLC by less than 75 centimeters. CLA is found nearly 1.5 meters above CLB. A luminescence date run at the Luminescence Dating Research Laboratory at the University of Illinois at Chicago has dated the accretion of the sediments into which the artifacts of CLC are entrained to 4,020 ± 320 years B.P.

4. **Mahali pa Masimba** (HeJs14) was discovered near Lugard's Falls on a ground inspection undertaken after landforms that mirror the geomorphology of the three riverine sites listed above were noticed on aerial reconnaissance. Only two small fragments of pottery were recovered from the ground and several pieces of freshwater mollusk shells. In addition, several thousand pieces of fractured basalt were found on the ground along the banks of the Galana River. It is not clear if these stones are ecofacts or are the product of prehistoric human activity. Other prehistoric sites have been located in the area, including a possible open-air settlement by Drs. C. Kusimba and S. Kusimba. It is not presently known if there is any association between these finds and that site. Future research will attempt to sort this out.

   No artifacts (including basalts) were recovered *in situ* despite close inspection of the terrace face. However, two well-developed A_b horizons were visible in the profile. Landsnail shells were not visible in the profile but were scattered about the surface on the banks of the river. As mentioned above, the other river sites show a strong correlation between the presence of land snails (particularly *Achatina fulica*) and the existence of archaeological sites.

5. **Mwiitu** (HeJt35) was discovered on pedestrian reconnaissance of the margins of the Galana River in 2004 less than 2 km east of Kahinju. The site was defined based on the discovery of multiple catenas of eroding artifacts—specifically bone, quartz tools and ceramics. The site extends a minimum of 90 meters along the banks of the Galana River.

6. **Genge** (HeJt36) was located within 2 km east of Mwiitu and consisted of a single buried catena (AB_b, ~30cm thick) with hundreds of pieces of ceramics, bone and quartz tools eroding from the scarp face. This site minimally extends 500 meters along the banks of the Galana River and appears to include only one occupation level. The occupation facies is buried under >2m of sediment. None of the artifacts recovered were diagnostic, but the general assemblage characteristics conform to a generic Late Eburran-phase or Pastoral Neolithic-phase occupation similar to others that have been located elsewhere along the Galana River.

5.2.3 Summary of Survey Results

Thorbahn (1979) argues that there is a strong correlation between the presence of burial cairns and dense LSA scatters. However, only the site of Maganga demonstrated a positive correlation between the presence of grave cairns and archaeological artifacts. Twenty-five cairns were identified within a 500-m radius of Maganga, suggesting that internment of the dead from Maganga probably was undertaken in these cairns. There is little evidence to suggest a connection between the cairns and river settlements, except maybe at Mtembea kwa Barafu where four cairns were found within 1 km of the site during the survey. Further survey will be necessary of the area surrounding Mtembea kwa Barafu as well as radiometric ages from the site and from *in situ* archaeological deposits in the cairns. Other areas identified as having numerous cairns in the 2001 field season that had no evidence of a settlement may be due to erosion that destroyed surface features.

The great diversity of archaeological sites found during the 2001 survey attests to the archaeological richness of the Tsavo region that is just beginning to be rediscovered.

Archaeological sites dating back to the ESA confirm that the area near the Galana River has been attractive to human settlements for upwards of millions of years. The central argument of this thesis is that the Galana River was a point of attraction to hominids seeking a predictable resource base during periods of otherwise unpredictable resource availability. The data will show that general environmental conditions during pastoral LSA occupations of fluvially deposited terraces along the Galana River were either arid or highly variable due to high periodicity in the ENSO cycle. However, other sites presented above lacking geochronological controls can also be tentatively viewed through this lens unless the null-hypothesis eventually proves otherwise. Fortunately, this research project is merely in its infancy and future investigations will shed more light on the importance of the Galana to sustaining human settlements in Tsavo since the Pleistocene.

5.3 Archaeological Excavations of Fluvial Sites

The 2001 and 2004 field seasons conducted along the Galana River inside Tsavo East National Park were designed to take advantage of erosional exposures in the terraces. Since archaeological horizons were buried under >1 m of sterile alluvium, erosional landform features provided an ideal opportunity to test ancient sediments for their archaeological potential without having to first remove several cubic meters of sterile sediment. Largely, this methodology involved digging geological steps (Van Noten et al. 1987) into the exposed portions of the terrace and obtaining detailed geomorphic profiles (Gasche and Tunca 1983) of the entire deposition sequence of the terrace. Some units were dug as controlled one-meter wide by two-meter long test trenches placed behind the erosional scarp face in order to create a master sequence of deposition and archaeological horizon development in a non-erosive environment. These tests confirmed that artifact entrainment was not a function of erosion upstream and secondary deposition, but represented *in situ* archaeological assemblages from local prehistoric inhabitants. Furthermore, step trenching can provide an efficient means to provenience surface scatters to a datable context (Van Noten et al. 1987).

In Africa, water is generally a scarce resource (Buckle 1996; Leroux 2001), which makes settlement close to a fluvial system an attractive prospect. The identification of multiple occupations on a single river terrace that are separated by thousands, even tens or hundreds of thousands of years, has been made elsewhere in Africa (Huysecom 1996; McIntosh 1995; McIntosh et al. 1992; Oslisly 1993; Salih and Edwards 1992; Van Noten et al. 1987; Willoughby 1992). However, for archaeologists, excavation of riverine settlements can be difficult owing to the complex deposition and erosion patterns created in fluvial environments. Data recovery involves separating archaeological horizons based on landform deposition and proveniencing artifacts in a datable vertical (z) context that corresponds to a horizontal (x, y) understanding of site geomorphology and evolution (e.g. Guccione et al. 1988; Holliday 1987; Huysecom 1996; Jing et al. 1997; Joyce and Mueller 1997; Van Noten et al. 1987; Waters 1988). Because fluvial deposition and erosion patterns are rarely uniform in nature, contemporaneous depositional strata can vary in thickness, vertical positioning and even sediment fractions between short distances (Gladfelter 2001). The importance of ample chronometric dates throughout a fluvial site is therefore crucial for understanding the context of *in situ* sedimentation and artifact entrainment.

5.3.1 Excavation Techniques of the 2001 and 2004 Field Seasons

During the 2001 and 2004 field seasons, three archaeological sites were subsurface tested: Kahinju, Kathuva and Mwiitu. A fourth site, Mtembea kwa Barafu, was examined at close interval pedestrian reconnaissance (<1 m) and sediment samples were collected for luminescence dating. Artifact distributions on the surface of the sites appeared to have similar material characteristics, in terms of decorative ceramic attributes, stone tool raw material selection and tool production techniques in addition to the relatively similar stratigraphic positioning of artifact erosion locales. This stage of the research was designed to maximize potential understandings of these sites in the limited time and financial resources that were available. Because no prior work has been published describing PN occupations in the Tsavo region, there was an unlimited range of questions that needed answering. It was determined that the basic questions of *what* the nature of PN settlements along the Galana River and *when* they occurred were of preeminent importance. Therefore, the excavation strategy was oriented to obtain a geochronology on the basis of being able to reconstruct subsistence patterns independent of dietary preferences, technological capacity, timeframe and intensity of occupations that could be compared with secondary environmental proxy data. To this end, field research employed the following techniques:

1. Exposing profile views of eroded terraces and digging trenches into terrace sediments to recover *in situ* archaeological artifacts.
2. One 1-meter by 2-meter test unit dug behind the river bluff at each site to collect artifacts *in situ*, assist in reconstructing the prehistoric landscape and verify the

vertical provenience of artifacts excavated in geological steps are contemporaneous with artifacts now buried deep below the ground surface.

3. Collection of Optically Stimulated Luminescence (OSL) and AMS radiocarbon (^{14}C) samples for absolute dating of levels.
4. Full collection and provenience of cultural material *in situ* when possible.
5. Sieving through 5-mm screen and full collection of artifacts in all levels where human occupation was suspected or confirmed.
6. Collection of flotation samples in confirmed cultural levels and control samples in non-cultural levels.
7. Detailed site maps using a David White LT8-300 Level-Transit and stadia rod at Kathuva and a total station provided by the British Institute in East Africa produced the maps for Kahinju and Mwiitu.

Excavations at Kahinju commenced July 2, 2001 and ended July 27, 2001. A second round of test units were opened February 22, 2004 and concluded March 4, 2004. A total of nine test units were opened covering 51 m^2 (0.18%) of the total known site area (29,057 m^2).

1. *Unit 1* was located on a scroll plain of the Galana River. It was extended to cover 14 square meters, but digging was limited to surface scrapings to clear loose fluvial sands to expose the depositional horizon that had archaeological material.
2. *Unit 2* was one-meter by four-meter test trench dug into sediments adjacent to and into the face of the scarp that had been exposed by erosion. The erosion had only

partially removed the sediments, leaving an intact portion exposed that had artifacts *in situ*. Excavation extended into a sterile, sandy layer. The profile above the unit was also cleaned for photographing and mapping.

3. *Unit 3* was a one-meter by two-meter test trench placed in an eroded clayey surface around which numerous surface artifacts were recovered.
4. *Unit 4* was a one-meter by two-meter test trench dug behind the erosional scarp face left by downcutting of the Galana River. It was dug to 258 centimeters below the modern ground surface.
5. *Unit 5* was a one-meter by two-meter test trench dug beyond the presumed eastern frontier of the site to test whether the site extended beyond the point where we were no longer recovering artifacts.
6. *Unit 6* was a geologically stepped trench one meter wide by five meters long. It was begun in an area that had numerous artifacts eroding from the surface and then extended into the erosional scarp face.
7. *Unit 7* was a two-meter wide, geologically stepped trench that extended 9.5 meters from the river edge (north) to the bluff (south).
8. *Unit 8* was a one-meter by two-meter test trench dug to one meter in depth on an exposure of a landform previously dated to 5,960 ± 480 years B.P. (UIC1038).
9. *Unit 9* was a one-meter by two-meter test trench dug to between 60 and 100 cm below modern ground surface on an expose of a landform previously dated to ~5,000 years B.P. (UIC1036, UIC1037).

Excavations at Kathuva commenced September 16, 2001 and ended September 26, 2001. A total of three test units were opened covering 15 m^2 (0.29%) of the total known site area (5,220 m^2).

1. *Unit 1* was a geologically stepped trench that covered a total of nine square meters. It was dug into the erosional scarp and extended south in order to recover artifacts coming from an ashy layer that was exposed by digging.
2. *Unit 2* was a one-meter by two-meter test trench dug behind the erosional scarp face left by downcutting of the Galana River. It was dug to 230 centimeters below modern ground surface.
3. *Unit 3* was a four-square meter trench placed on a partially eroded protrusion of the river bluff.

Mwiitu was discovered on February 23, 2004 on pedestrian reconnaissance along the margins of the Galana River. Excavations began on February 26, 2004 concluded March 5, 2004. A total of six test units were dug to sterile alluvium covering 13 m^2 (0.29%) of the total known site area (4,500 m^2).

1. *Unit 1* was a one-meter by two-meter test trench dug in an area with a high density of artifacts on the surface of the landform. It was dug to a depth of 80 cm.
2. *Unit 2* was a one-meter by two-meter test trench dug into a fluvial exposure that had been significantly eroded to expose an early occupation of the site. The trench depth ranged from 115 to 142 cm below ground surface.

3. *Unit 3* was a one-meter by two-meter test trench dug behind the erosional scarp exposed by downcutting of the Galana River. It was dug to a depth of 190 cm below ground surface.
4. *Unit 4* was a one-meter by two-meter test trench dug behind the erosional scarp exposed by downcutting of the Galana River. It was dug to a depth of 190 cm below ground surface.
5. *Unit 5* was a geologically stepped trench measuring one-meter by three-meters. The test unit was placed in sediments that had been exposed by pervasive erosion and had evidence of extensive development of a paleosol.
6. *Unit 6* was a one-meter by two-meter test trench dug into sediments that had been exposed in the terrace following fluvial erosion. A colluvial mantle was removed and a weak paleosol was exposed >70 cm below the modern ground surface.

All levels of all units were screened with five-millimeter sieve except for the first 115 cm of Unit 1 at Kathuva and 100 cm of Units 3 and 4 at Mwiitu. In this case, after closely examining the profile walls of the river bluff, it was determined that there was no possibility of reaching an archaeological horizon until 125 cm below ground surface. Thus, every tenth shovel was screened until 115 cm after which all soil was screened through a 5-mm sieve.

All artifacts recovered in the sieve were tentatively separated into categories and handed to the field laboratory technician. The technician cleaned and sorted all artifacts and assigned catalog numbers to all diagnostic artifacts. All landsnails were weighed and counted and were usually discarded unless they were burned or were shells unique to the assemblage that may have been imported. Likewise, all quartz stones were weighed and counted whether they were artifacts or not. The purpose of this was to be able to look at relative densities of quartz *in situ* as a result of the forces of natural deposition as opposed to human action. All of these artifacts were washed in water only and scrubbed with a soft toothbrush or dental pick to loosen up dirt or calcium carbonate—no acids were used in processing artifacts.

Flotation samples were collected at both sites. Samples between five to ten liters were collected by toweling dirt directly into a plastic bag. Flot samples were collected from all surfaces with evidence of cultural occupation and control samples were taken from several levels that had no evidence of occupation. No preference for or against artifacts going into the sample bags was made. Flotation samples were not floted at the site, but were saved until clean water was available for fear that river water could contaminate the samples.

Profile maps of all trenches were drawn and classified based on the Munsell soil color chart, United States Soil Survey soil composition guide and the USDA system of differentiation between soil and sediment particle sizes (Soil Survey Staff 1975, 1993). Sediments were classified and transport mechanisms interpreted using standard geological procedures regarding particle size and degree of sorting (Hassan 1978b; Paton et al. 1995; Soil Survey Staff 1993; Young 1976). Consistency throughout the over two months of excavation fieldwork spread over three years at three different sites was difficult to maintain, but samples were collected for later verification and clarification.

Radiocarbon samples were wrapped in aluminum foil and removed from moisture or contaminative elements. Otherwise, absolute dating samples were collected as Infrared Stimulated Luminescence (IRSL) specimens. A variety of collection methods had to be employed to minimize contamination from light but be able to successfully extract the soil from the profile wall. The soils through which the units were excavated were either indurated silts and fine sands or were clays that were also very difficult to extract. It was recommended that a tomato paste can be driven into the profile wall with a rubber mallet. But, upon attempting to do this, the tin can folded because the profile walls were so rigid. After a series of experiments, aluminum beer cans were cut in half and taped at the bottom to disallow light to enter from the drinking orifice. The can was then twisted gently against the profile wall until it could go no further in (usually, the can went in halfway before stopping altogether). During the 2004 field season, PVC tubes were pounded into the profile walls using a rubber mallet. A rock hammer was then used to gouge a hole above the can or tube and dirt was scooped into the container with either the hammer or a trowel. The container was then wrapped with brown cellophane tape and labeled according to its provenience and notes were taken on the likelihood of light contamination affecting the veracity of the sample.

Site maps were created for Kahinju, Kathuva and Mwiitu (Figures 20, 21 and 22). Data from an optical transit was used to create a topographic (x, y, z) plot of the site of Kathuva. These data were then interpreted for the creation of the site maps. In 2004, the British Institute in Eastern Africa provided a total station and operator for topographic mapping at Kahinju and Mwiitu. All measurements presented are plotted relative to a datum point. The datum point at the site of Kahinju is approximately 220 meters above sea level (m.a.s.l.) and Kathuva is approximately 190 m.a.s.l.

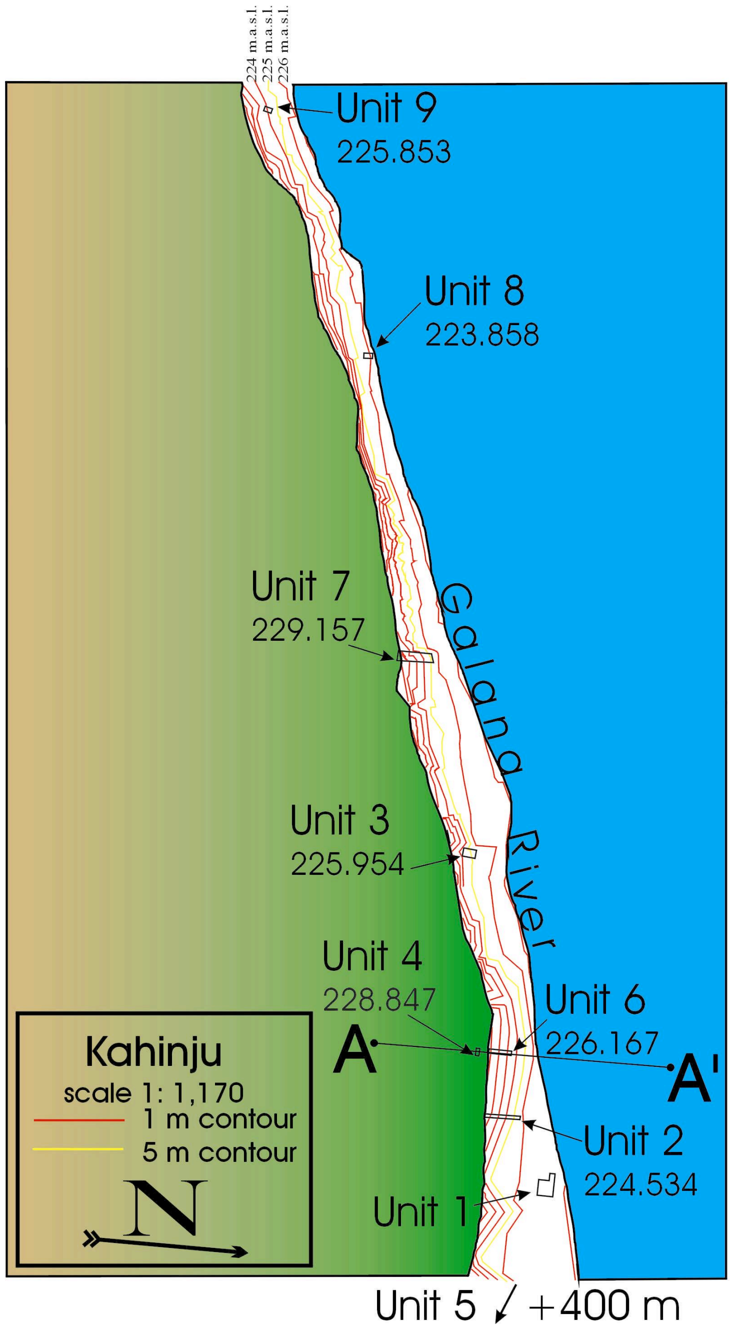

Figure 20. Plan map of Kahinju constructed from total station measurements. Unit datum points are recorded in meters above sea level and arrows point toward datum locations. Note: A and A' refer to reference points for an aerial photograph presented and a cross-sectional profile rendered in Chapter 6.

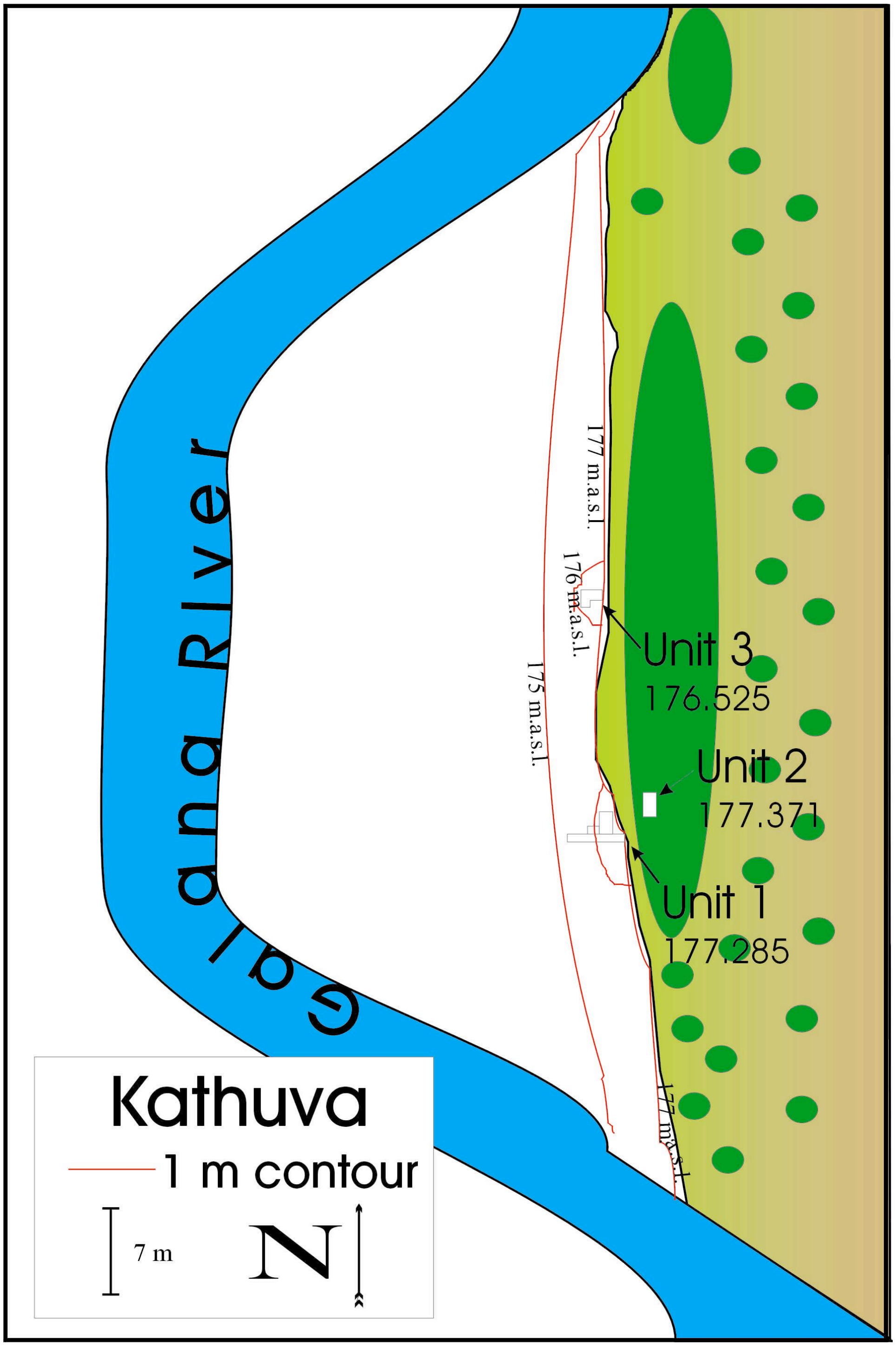

Figure 21. Plan map of Kathuva constructed from transit and stadia rod measurements. Unit datum points are recorded in meters above sea level and arrows point toward datum locations.

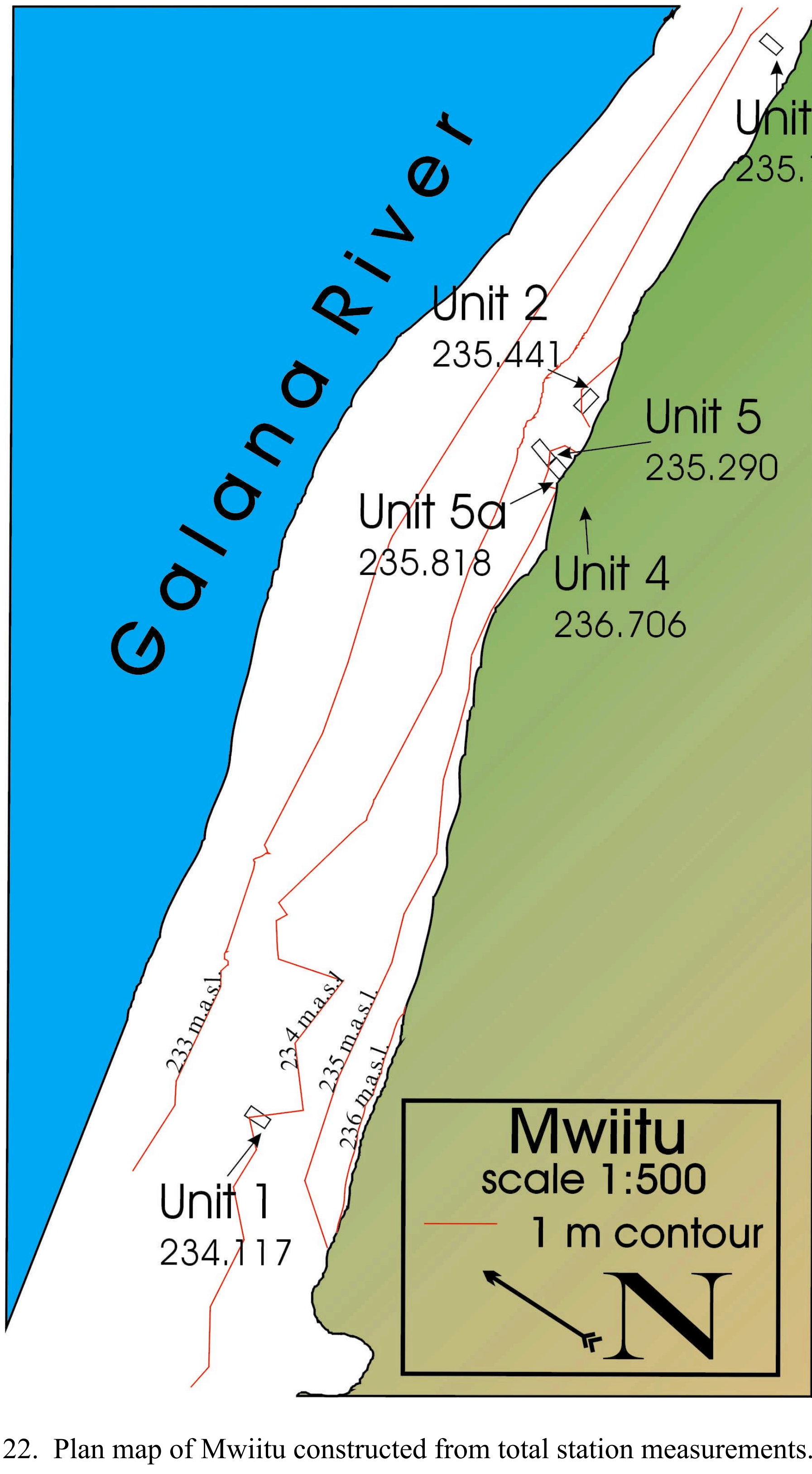

Figure 22. Plan map of Mwiitu constructed from total station measurements. Unit datum points are recorded in meters above sea level and arrows point toward datum locations.

5.3.2 Summary of Excavation Techniques

The excavations that commenced in 2001 and 2004 within the floodplain of the Galana River were designed to reconstruct the temporal, material and spatial distribution of human occupations that on eroding terraces adjacent to the active fluvial channel. The methodology employed followed established protocols for archaeological excavations and data recovery procedures in fluvial depositional environments (e.g. Guccione et al. 1988; Jing et al. 1997; Joyce and Mueller 1997; Mapunda 1995; Mapunda and Burg 1991). Detailed geomorphic profile maps and age generation samples were collected in order that successive deposition and occupation horizons could be understood within the context of material cultural finds. Topographic site maps were generated by a total station at Kahinju and Mwiitu and a transit and stadia rod at Kathuva. The data were limited by exposure and erosional preference of archaeological material from the laterally accreted terraces, which was not even throughout the three sites that were tested. The remainder of this thesis is devoted to presenting the results of analyses generated from the archaeological surveys and excavations of the Galana River basin in 2001 and 2004.

Chapter 6. Geochronology of Galana River Sites

6.1 Introduction

There are no published reports that date the occupations of Pastoral Neolithic (PN) sites within Tsavo National Park prior to the 2001 and 2004 TARP field seasons.[6] The previous studies of the PN have primarily focused on the Rift Valley and Kenyan Central Highlands. Prior to TARP investigations beginning in the late 1990s, it was assumed that pastoralism entered Tsavo with the Orma expansion in the 17th century A.D. (Thorbahn 1979). Therefore, it was necessary to obtain a suite of radiometric dates that could be used to develop a baseline geochronology for the initial settlement of the region. Coupled with a geomorphological and environmental reconstruction of the Galana River for the past ca. 5 ka, credible ages are critical for understanding settlement chronology and land use strategies of the Tsavo sites. This chapter will outline the dating methods employed following the 2001 and 2004 field seasons and develop a geomorphological interpretation of the settlement chronology and depositional sequence of the three sites tested.

6.2 Geomorphology

Tsavo is dissected by numerous seasonally flowing tributaries that drain the upland sedimentary ridges into the Galana River. During the rainy seasons the tributaries are fed by runoff and facilitate the movement of water toward the Galana River. Some channels are filled >2 m deep with water catching runoff for hundreds of km^2 inland. Riparian foliage grows year-round on the banks of the tributaries regardless that this channel carries water for < 8 months of the year (Figure 23). During the dry season, the

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[6] Thorbahn (1979) reports his discovery of several pre-Swahili settlements, but did not excavate these nor date the sites. He concludes that intensive occupation of Tsavo by agricultural or pastoral groups was unlikely because the environment was too harsh to sustain large populations of people (1979: 226).

channels remain dry riverbeds and are not a reliable source of water for the mammalian biota of the park, except for elephants and small burrowing animals that are capable of accessing the water table by digging (Leuthold and Leuthold 1973). Numerous grave cairns were recorded in the vicinity of tributary river beds attesting to the fact that these locations were preferred seasonal habitation areas for later-era pastoralists who lived in Tsavo through the 1940s (Chapter 5).

Figure 23. Foliated Galana Catchment tributary during the dry season

The Galana River is a meandering river system comprised of numerous meander scars, oxbow lakes and scroll plains. Vertically accreting terraces are the dominant surficial process associated with the location of *in situ* cultural material (*sensu* Moody et al. 1999). Deposition of the sediments upon which the archaeological settlements were discovered clearly indicates ephemeral discharge and river aggradation during large storm events (*sensu* Waters 1988). The sediment deposition history reflects a mid- to late-Holocene fluvial aggradational sequence, which has been recently exposed by fluvial downcutting. The terrace sequence outlined in this manuscript reflects the order of deposition of the sedimentary units and also the proximity of the terrace to the modern active channel.

The earliest dated portion of the sequence appears to have been deposited as overbank deposition based on horizontal lamination of varying sediment grain sizes and inclusions of structureless units of fine silt and sand. Sediments at the top of the sequence include intact primary sedimentary structures, weak soil horizon development with little evidence of bioturbation and a well-preserved artifactual taphonomy. Such deposition patterns are consistent with rapid fluvial deposition as a result of system aggradation (Baker et al. 1983; Ferring 1986; Graf 1988; Waters 1988). High proportions of suspended load sediments entrained in a generally aggrading channel flow periodically overran its levees and deposited large quantities of sediments distal to the main channel. There is also evidence for small-scale cut and fill erosion/deposition that may have truncated incipient soil formation in some areas of the sites.

Fluvial terraces are formed by downcutting and abandonment of the active fluvial channel sequence. Downcutting has resulted in the exposure of five terraces at the site of Kahinju, three terraces at Kathuva and three terraces at Mwiitu. Figure 24 shows the distribution of terraces along the current floodplain of the Galana River at Kahinju. Erosion of deposited sediments at the sites discovered during the 2001 and 2004 field seasons are pervasive resulting from downcutting associated with lateral spreading and planar sliding associated with a meandering river (Ritter et al. 2002: 200-2). The result of these processes is the erosion of deposited sediments into which the archaeological sites are located. Incision into the landforms has exposed archaeological sites that would have otherwise been obfuscated by several meters of sediment, but also gravely threatens the archaeological integrity of the sites if erosion continues. Although damage to the terrace closest to the modern course of the Galana River is pervasive, many of the terraces remain intact.

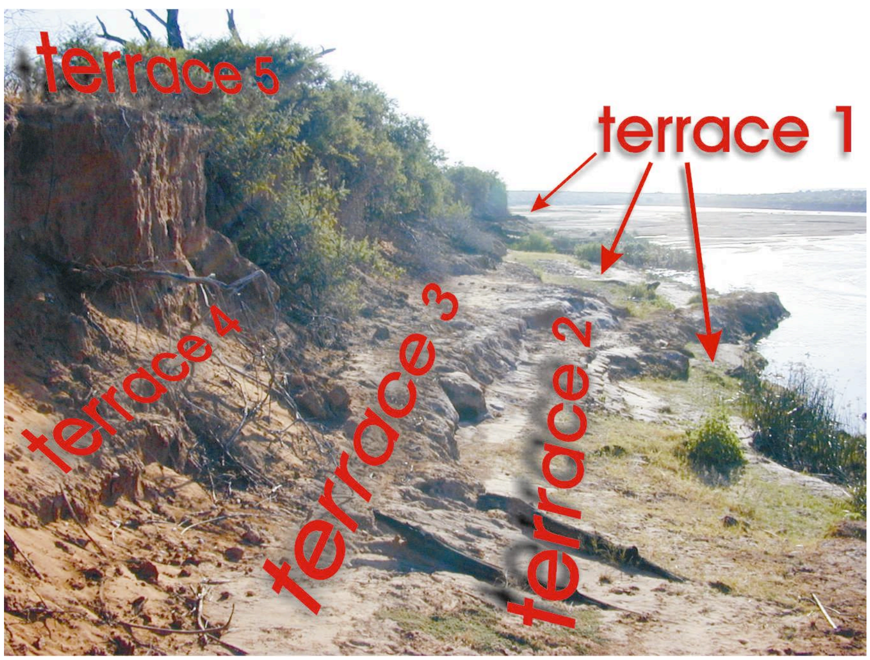

Figure 24. Terraces at Kahinju

At the archaeological sites discussed in this chapter, Kahinju has five terraces, while Kathuva and Mwiitu each have three separate terraces exposed. Each of these terraces has evidence for archaeological inhabitation except for the terrace that accreted in the final deposition of the sites. In this manuscript, terraces are classified as "T" followed by a number that signifies the deposition episode (1 is the oldest). Thus, T2 is the second fluvially deposited terrace in a sequence of between 3 and 5 terraces (depending on which site is under discussion).

The soils classified for the Kahinju and Mwiitu area are a complex of well-drained, shallow, dark reddish brown to dark red stony and gravelly sandy clay loam over quartz gravel and petrocalcic material (Wijngaarden and Engelen 1985). B-horizon development at Kahinju includes both argillic (B_t) and cambic (B_s, B_k) horizons depending on the predominance of silts versus sands in the deposition episode. The paleosols are not well developed except in locations of sheet middens and buried horizons show only pedogenic processes extending weakly no more than 20 cm below an exposed or buried ground surface.

The soils for the Kathuva area are similarly classified as well-drained, shallow, dark reddish brown to yellowish brown, stony and gravelly sandy clay-loam some of which is also situated over petrocalcic material (Wijngaarden and Engelen 1985). Argillic B-horizons were located in two of the test units excavated at Kathuva, but had evidence for pedogenesis never >20cm. The lack of strong horizon development in the terraces of the Galana River may reflect three potential processes: 1. relatively rapid accretion of terraces that did not allow soil horizon formation to occur, 2. soils at all three sites are classified as ferralic inceptisols with high weathering rates that do not retain soil nutrients as rapidly as they are leached and 3. truncation of soils during cut and fill erosion/deposition events.

Initial classification of soils in the Tsavo region categorize soils along the Galana River as "calcic cambisols" based on the UNESCO–FAO soil taxonomy (Wijngaarden and Engelen 1985).[7] There is no linear fit between the FAO and USDA soil taxonomies (Nachtergaele 2003), so observations made on the ground during the 2001 and 2004 field seasons allow for a reclassification of Galana River basin soils as torrifluvent entisols using the USDA taxonomy (Soil Survey Staff 1975: 189-190). This description designates the soils as fluvially deposited sediments within a torric moisture regime that are calcareous and salty (Soil Survey Staff 1975). Entisols generally show weak horizon development (< 25 cm) with a loss of carbonates and clay in the upper 12 cm of the profile (Soil Survey Staff 1975: 179). In the case of the Galana River, weakly developed soil horizons are probably the result of the alacrity with which terraces were deposited as opposed to erosion and redeposition of pedogenic units as colluvium.

6.3 Geochronology

AMS radiocarbon and infrared stimulated luminescence (IRSL) dating have been used to construct a geochronology of PN sites in Tsavo (Table II, III). The luminescence ages were determined at the University of Illinois Luminescence Dating Research Laboratory under the supervision of Dr. Steven L. Forman. AMS radiocarbon dates were processed at the AMS Radiocarbon Dating Laboratory at the University of Arizona in Tucson. The advantage of IRSL (and other OSL techniques) is that the aliquots consist entirely of sediments rather than preserved, carbon-based artifacts. Using IRSL, chronological control can be made on non-artifact bearing strata or on strata where

[7] The USDA *Soil Taxonomy* includes descriptions of cambic (Soil Survey Staff 1975: 33-36) and calcic (Soil Survey Staff 1975: 45-46) soil horizons. However, these categories only generally describe processes occurring in the B-horizon and therefore are not descriptive of the deposition and evolution of the total soil matrix.

carbon preservation is absent. However, IRSL ages date the burial time of the sediments and not the artifacts entrained in the sediments. Thus, there may be a lag period between artifact production/usage and burial into sediment (Srivastava et al. 2003). On the other hand, AMS radiocarbon ages have the advantage of producing highly accurate estimates from low masses of organic carbon (<10 mg charcoal). Unfortunately, preserved charcoal was not found in all artifact bearing strata and the difficulties and cost associated with radiocarbon dating bone excluded this material from being used. Thus, a combination of both techniques was employed, the results of which are presented below.

All luminescence samples were collected after cleaning the profile walls of excavation trenches. An aluminum can or PVC tubing was pounded into the profile wall, packed tightly with sediment and covered for transport back to the United States. Great care was taken to ensure that the samples were not exposed to light or extreme heat during collection or transport. The samples were later opened in a controlled laboratory setting under low wavelength, low-pressure sodium lamps. Aliquots extracted and analyzed are the fine-grain polymineral fraction (4-11μm).

Geochronology determined from IRSL is based on time-dependent dosimetric properties of silicate minerals, predominantly feldspar and quartz (Aitken 1985, 1998). During burial of sediments, ionizing radiation from the decay of U and Th series and ^{40}K produces free electrons that are subsequently trapped in crystallographic-charge defects in silicate minerals. The electron traps continue to fill until the sediment is exposed to sunlight and the population of electrons is released as photons resetting the luminescence clock to a low definable level.

The multiple aliquot additive dose (MAAD) protocol was utilized on all samples (see Aitken 1985). In the MAAD technique, additive doses of β-radiation ($^{90}Sr/^{90}Y$) ranging from 16.7 to 272.4 grays simulates the effect of *in situ* dosimetric processes to generate a growth curve from which the equivalent dose (D_e) can be assessed. A Daybreak 1100 reader with infrared diodes (880 ± 80nm) stimulated all Tsavo samples to induce a recombination of the stored charge that produces luminescence emissions. The discharge of luminescence was measured by a silicon photomultiplier connected to a resistive current. In the procedure, the intensity of the measured D_e is divided by an estimate of the radioactivity that the sample received during burial (dose rate, D_r), which produces a luminescence age.[8] Generally, the greater the D_e, the longer a sediment has been buried without exposure to light.

The majority of the ionizing radiation that contributes to the D_r comes from decay of isotopes in the U and Th series. This determination is made based on thick-source α-counting, which assumes secular equilibrium in the decay series (Akber et al. 1985; Soumana et al. 1997). Another significant contribution is the radioactive potassium component (^{40}K) that is made from the assayed K_2O content of the sediment using inductively coupled plasma mass spectrometry (ICPMS) at Activation Laboratory Ltd., Ontario, Canada. The contribution of the cosmic radiation to the D_r of the sample is from calculations presented by Prescott and Hutton (1994).

All samples were tested for anomalous fading (e.g. Balescu et al. 2003) by irradiating four aliquots at 30 minutes (ranges of 100.2 – 136.2 Gys), subsequent preheat using the same controls run during the age-generating experiments, stimulating the samples and then performing a post normalization. Concurrently, another four aliquots

[8] The equation can be restated as Burial time (years) = Burial dose (Gys) / Dose rate (Year/year)

from the same prepared sediment were irradiated and preheated, but were stored for a period of 30 days at room temperature. After this interlude, the samples were stimulated and post normalization was executed and the values were compared to evaluate the extent of anomalous fading.

In luminescence dating, the percent of water content of the soils attenuates α, β and γ radiation during the burial period. Estimates for the Tsavo sample were based on 1. a sediment's proximity to the water table and averaged amount of the year that the sediment is inundated with raised water levels (following Wijngaarden and Engelen 1985), 2. the hygroscopic saturation limits for fluvial silts and sands as outlined in Brady (1974), and 3. actual wet and dry weights taken on samples UIC1008 and UIC1009.[9] The wet and dry weights of these two samples reflect the absorptive properties of the sediments and the water content of the remaining samples was conservatively estimated based on the samples' relative proximity to the modern water table and flood horizons.

In addition to IRSL ages, eight AMS radiocarbon ages have been obtained from charcoal samples submitted to the University of Arizona AMS Laboratory in Tucson, AZ, USA. AMS samples were taken from preserved charcoal recovered *in situ*. Samples were wrapped in aluminum foil and transported to the USA in tamper-proof containers. Samples were then mailed to the University of Arizona in September 2002 and the first set of results was received in April 2003. Tables II, III and IV show the distribution of IRSL ages and AMS ages to constrain ages of fluvial units.

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[9] Actual wet weight of UIC1008 was 4.700 g. Actual wet weight of UIC1009 was 5.4432 g. Samples were dried for a period of 7 days and reweighed. Dry weight of UIC1008 was 4.1380 g. Dry weight of UIC1009 was 4.9952 g. The average wet and dry weight contents differed by 11.96% (UIC1038) and 8.23% (UIC1039) with an average combined water content of 10.1%. This number was used as a base line for water content with the assumption that water had evaporated since downcutting had exposed the terrace and the time it took to transport the sediment sample from Kenya to the United States for processing (4 months).

TABLE II. IRSL FADE TEST RESULTS AND AGES FOR SITES OF KAHINJU, KATHUVA, MWIITU AND MTEMBEA KWA BARAFU ADJACENT TO THE GALANA RIVER, KENYA

Laboratory #	IRSL test dose (kGy) and days stored	IRSL thermal stability ratio	IRSL equivalent dose (Gys)	IRSL age (years)	fading?
UIC921	0.196 / 30	1.023 ± 0.001	13.303 ± 0.121	3,450 ± 290	no
UIC932	0.193 / 30	1.048 ± 0.002	14.093 ± 0.157	4,020 ± 320	no
UIC943	0.196 / 30	0.987 ± 0.002	13.506 ± 0.186	2,960 ± 280	no
UIC944	0.193 / 30	0.956 ± 0.001	12.778 ± 0.214	3,000 ± 260	no
UIC1006	0.096 / 33	1.098 ± 0.001	4.224 ± 0.056	940 ± 70	no
UIC1007	0.096 / 33	0.979 ± 0.003	12.562 ± 0.274	3,160 ± 280	no
UIC1008	0.087 / 33	0.125 ± 0.001	5.784 ± 0.061	2,300 ± 180	yes
UIC1009	0.092 / 38	0.656 ± 0.003	7.425 ± 0.089	2,730 ± 230	yes
UIC1035	0.087 / 33	1.051 ± 0.005	11.372 ± 0.144	3,200 ± 260	no
UIC1036	0.087 / 33	0.987 ± 0.006	16.212 ± 0.204	5,160 ± 410	no
UIC1037	0.085 / 34	1.006 ± 0.003	15.522 ± 0.231	4,970 ± 400	no
UIC1038	0.092 / 38	0.976 ± 0.002	18.764 ± 0.244	5,960 ± 480	no
UIC1068	0.117 / 34	1.014 ± 0.002	12.472 ± 0.108	3,870 ± 330	no
UIC1069	0.120 / 34	0.921 ± 0.002	12.937 ± 0.160	3,120 ± 270	No
UIC1070	0.115 / 34	0.959 ± 0.002	16.995 ± 0.128	3,600 ± 320	No
UIC1071	0.085 / 34	1.010 ± 0.004	16.213 ± 0.262	4,830 ± 390	No
UIC1153	0.094 / 30	0.934 ± 0.003	7.310 ± 0.066	1,720 ± 150	No
UIC1392	0.092 / 38	0.988 ± 0.001	5.182 ± 0.084	1,020 ± 80	No
UIC1393	0.092 / 38	0.994 ± 0.002	13.170 ± 0.144	3,020 ± 270	No
UIC1437	0.092 / 38	1.097 ± 0.003	8.547 ± 0.205	2,170 ± 170	No

TABLE III. ALPHA COUNTS, POTASSIUM RATIOS AND DOSE RATES FOR IRSL SAMPLES ANALYZED FROM SITES OF KAHINJU, KATHUVA, MWIITU AND MTEMBEA KWA BARAFU ADJACENT TO THE GALANA RIVER, KENYA

Laboratory #	alpha count Rate (ks/cm^2)	Th (ppm)	U (ppm)	unsealed/ Sealed	% K_2O	IRSL A value	IRSL dose rate Gy/ka
UIC921	0.565 ± 0.03	5.305 ± 0.913	2.999 ± 0.357	0.986 ± 0.07	2.46 ± 0.02	0.068 ± 0.001	3.857 ± 0.4
UIC932	0.593 ± 0.03	8.813 ± 1.040	2.202 ± 0.387	0.932 ± 0.07	2.67 ± 0.02	0.060 ± 0.001	3.506 ± 0.5
UIC943	0.644 ± 0.03	11.229 ± 1.430	1.972 ± 0.496	0.988 ± 0.07	2.55 ± 0.02	0.083 ± 0.001	4.562 ± 0.6
UIC944	0.696 ± 0.04	8.968 ± 1.256	3.072 ± 0.464	1.025 ± 0.07	2.43 ± 0.02	0.072 ± 0.001	4.259 ± 0.8
UIC1006	0.494 ± 0.03	6.540 ± 0.800	2.072 ± 0.308	0.979 ± 0.07	2.62 ± 0.02	0.098 ± 0.001	4.494 ± 0.8
UIC1007	0.553 ± 0.03	8.569 ± 1.189	1.950 ± 0.408	0.979 ± 0.07	2.68 ± 0.02	0.036 ± 0.001	3.973 ± 1.0
UIC1008	0.468 ± 0.02	5.977 ± 0.768	2.029 ± 0.295	0.951 ± 0.07	2.66 ± 0.02	0.066 ± 0.001	2.515 ± 0.3
UIC1009	0.569 ± 0.03	8.172 ± 1.171	2.200 ± 0.417	0.988 ± 0.07	2.67 ± 0.02	0.053 ± 0.001	2.720 ± 0.4
UIC1035	0.522 ± 0.03	6.330 ± 0.921	2.357 ± 0.346	0.983 ± 0.07	2.74 ± 0.02	0.046 ± 0.001	3.553 ± 0.6
UIC1036	0.491 ± 0.03	7.143 ± 0.860	1.869 ± 0.321	0.992 ± 0.07	2.58 ± 0.02	0.051 ± 0.001	3.142 ± 0.5
UIC1037	0.492 ± 0.03	6.407 ± 0.804	2.092 ± 0.310	0.971 ± 0.07	2.44 ± 0.02	0.065 ± 0.001	3.123 ± 0.6
UIC1038	0.494 ± 0.03	7.234 ± 0.854	1.868 ± 0.320	0.972 ± 0.07	2.47 ± 0.02	0.065 ± 0.001	3.148 ± 0.5
UIC1068	0.635 ± 0.03	10.053 ± 1.327	2.179 ± 0.458	0.994 ± 0.07	2.53 ± 0.02	0.085 ± 0.001	3.223 ± 0.3
UIC1069	0.563 ± 0.03	7.444 ± 1.108	2.366 ± 0.401	0.957 ± 0.07	2.73 ± 0.02	0.056 ± 0.001	4.146 ± 0.6
UIC1070	0.722 ± 0.04	8.961 ± 1.286	3.201 ± 0.481	1.041 ± 0.08	2.42 ± 0.02	0.089 ± 0.001	4.721 ± 0.4
UIC1071	0.605 ± 0.03	8.122 ± 1.164	2.499 ± 0.424	0.950 ± 0.07	2.70 ± 0.02	0.054 ± 0.001	3.357 ± 0.7
UIC1153	0.529 ± 0.03	5.760 ± 0.759	2.529 ± 0.307	1.012 ± 0.07	2.58 ± 0.02	0.072 ± 0.001	4.250 ± 0.4
UIC1392	0.670 ± 0.03	10.477 ± 1.495	2.335 ± 0.508	1.009 ± 0.07	2.45 ± 0.02	0.111 ± 0.002	5.080 ± 1.1
UIC1393	0.553 ± 0.03	8.065 ± 0.976	2.100 ± 0.353	0.960 ± 0.06	2.31 ± 0.02	0.153 ± 0.001	4.361 ± 0.5
UIC1437	0.531 ± 0.03	5.695 ± 0.932	2.613 ± 0.351	1.002 ± 0.07	2.46 ± 0.02	0.065 ± 0.001	3.940 ± 1.2

TABLE IV. AMS ^{14}C AGES AND CALIBRATIONS (Stuiver et al. 1998a; Stuiver et al. 1998b) GENERATED FROM SAMPLES COLLECTED AT THE SITES OF KAHINJU AND KATHUVA ADJACENT TO THE GALANA RIVER, KENYA[10]

laboratory #	$\delta^{13}C$	% modern	^{14}C age (yrs.) ± σ	cal years B.P.
AA51442	-19.4	73.01 ± 0.76	2,527 ± 84	2358 – 2754
AA51443	-25.7	68.95 ± 0.49	2,987 ± 57	2973 – 3339
AA51444	-23.7	65.31 ± 0.45	3,423 ± 55	3483 – 3830
AA51445	-24	69.07 ± 0.45	2,973 ± 52	2970 – 3322
AA51446	-24.6	106.83 ± 0.44	post bomb	post bomb
AA51447	-28.1	83.11 ± 0.40	1,486 ± 39	1297 – 1510
AA51448	-27	82.70 ± 0.62	1,526 ± 61	1307 – 1530
AA51449	-25.4	81.22 ± 0.50	1,671 ± 49	1420 – 1701

[10] Note: IRSL ages are calculated from the year of analysis, whereas AMS ^{14}C ages are calibrated from the year A.D. 1950. Therefore, ~50 years should be added to the radiocarbon ages in order to obtain a precise calendar correlation of "years before present."

6.4 Discussion

6.4.1 Kahinju

The distribution of ages suggests the following pattern:

Sample #	Est. Age (years B.P.)	Occupation Horizon[3]	Temporal Affiliation
UIC1038	5960 ± 480	Kh1	Late Eburran
UIC1036	5160 ± 410	Kh2	Late Eburran
UIC1037	4970 ± 400	Kh2	Late Eburran
UIC1068	3870 ± 330	Kh3	Early PN/Late Eburran
AA51444	3483 - 3830	Kh3	Early PN/Late Eburran
AA51443	2973 - 3339	Kh4	Middle PN
AA51445	2970 - 3322	Kh4	Middle PN
UIC1035	3200 ± 260	Kh4	Middle PN
UIC1007	3160 ± 280	0—contemporaneous with Kh4	No occupation
UIC944	3000 ± 260	Kh4	Middle PN
UIC943	2960 ± 280	Kh5	Middle PN
AA51442	2358 - 2754	Kh5	Middle PN
UIC1006	940 ± 70	0	No occupation

TABLE V. RADIOMETRIC AGE CLUSTERS FOR THE KAHINJU SITE.

[11] An occupation horizon is defined as a group of artifacts that can be provenienced to the same geomorphological and/or radiometrically-dated stratum. Artifacts recovered in an occupation layer show similar stylistic characteristics and will be discussed in detail in subsequent chapters.

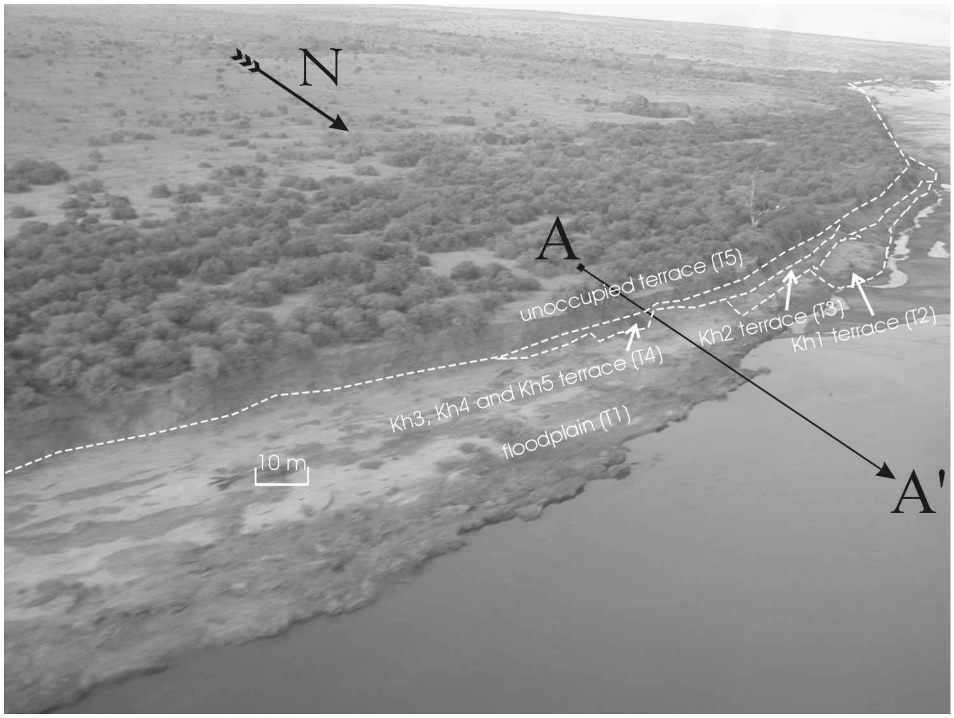

Figure 25. Aerial photo of Kahinju with the distribution of occupied landforms present at the site.

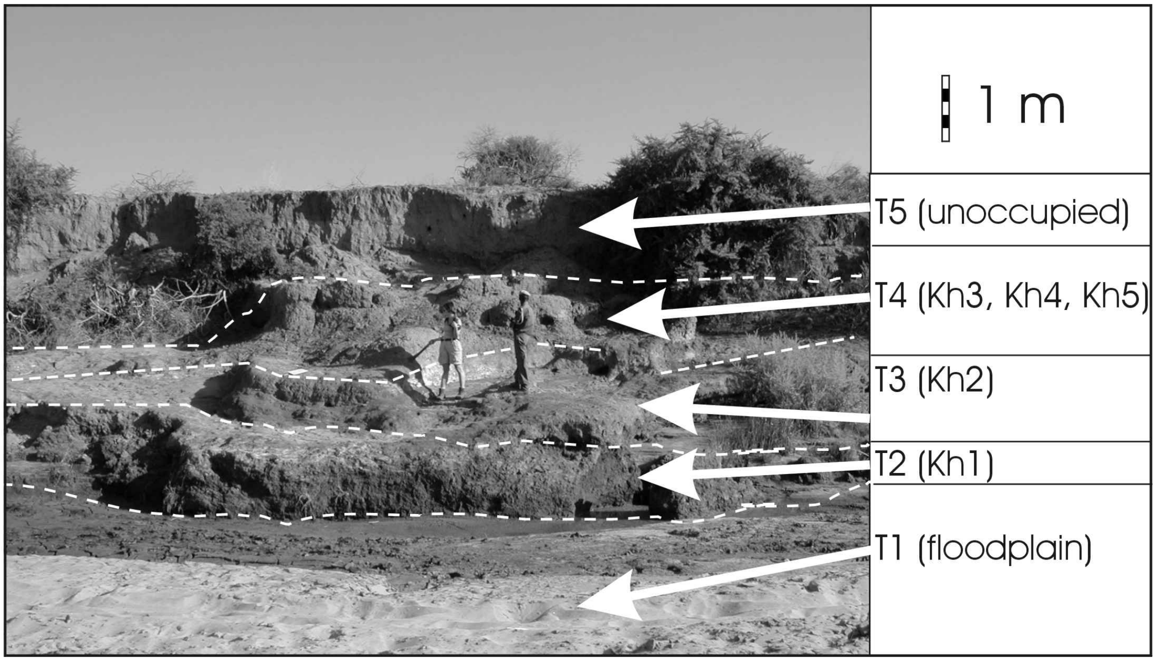

Figure 26. Terrestrial view of Kahinju landforms

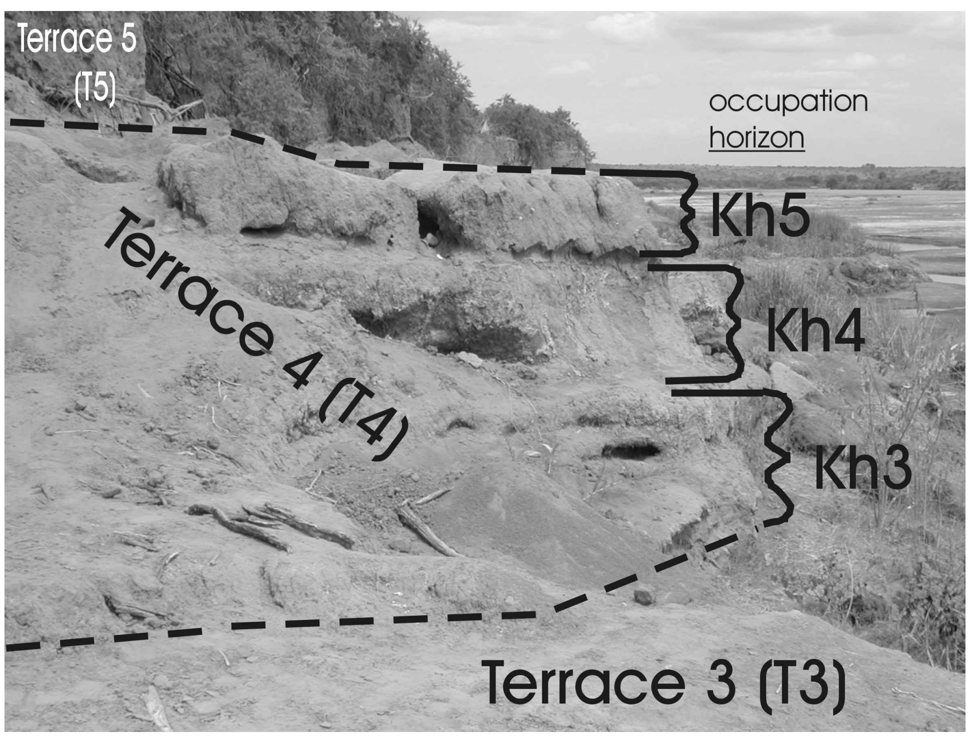

Figure 27. Internal stratigraphy of T3 as exhibited at location of Kahinju, Unit 4 test unit

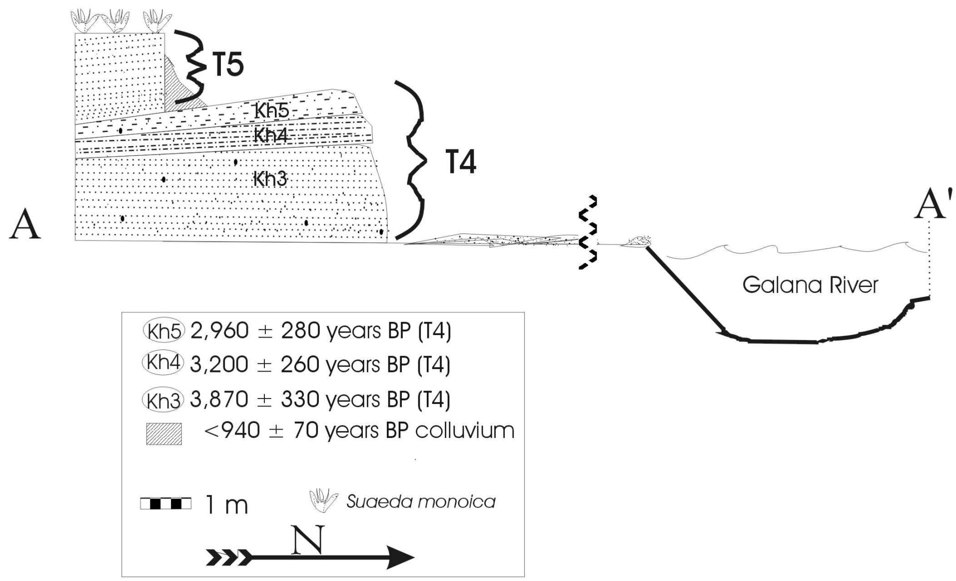

Figure 28. Transect of Kahinju site at Unit 6 showing vertically accreted terrace resulting from river aggrading[12]

[12] Note: A and A' refer to the transect defined in plan view of Kahinju, Figure 21 and aerial photograph, (Figure 25).

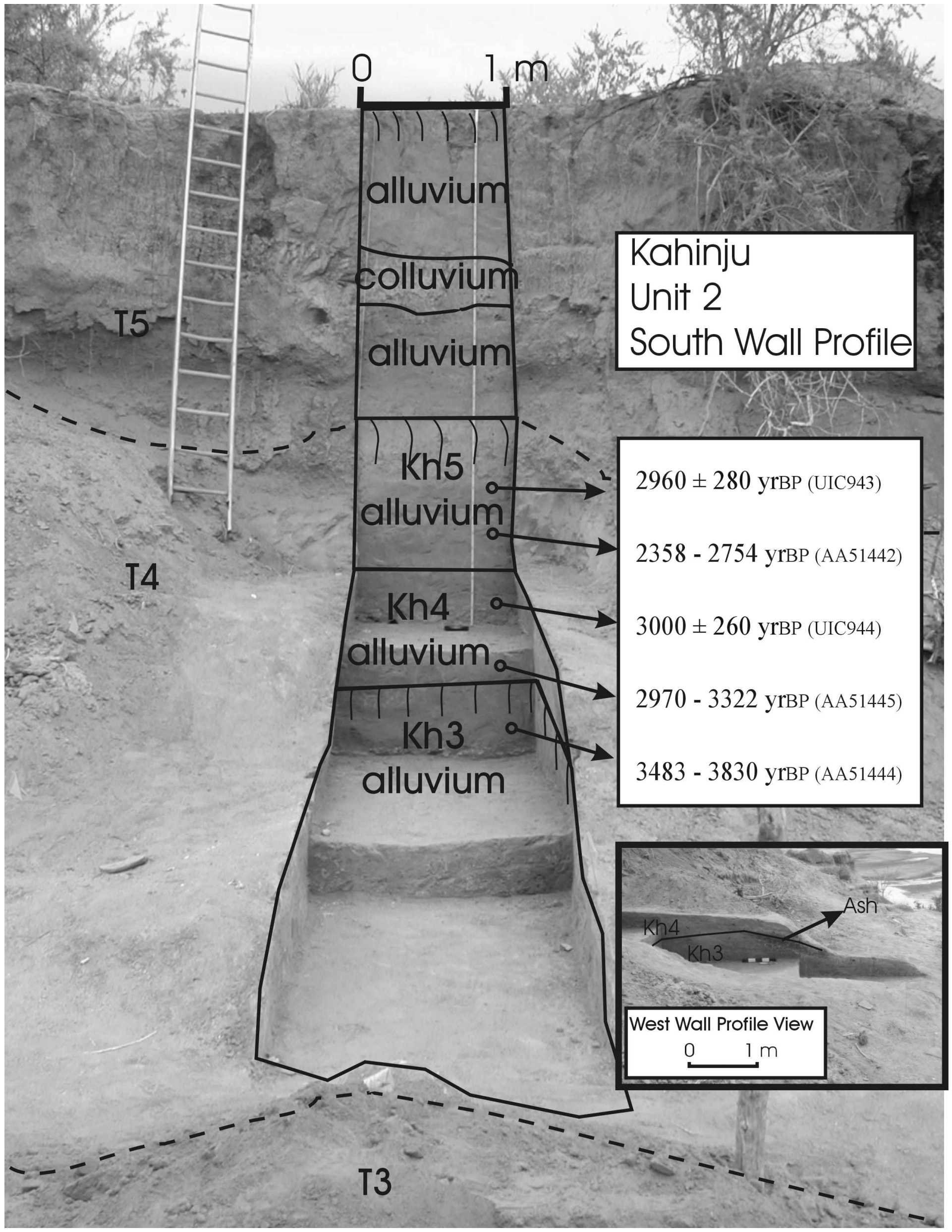

Figure 29. Kahinju, Unit 2 profile stratigraphy and radiometric ages

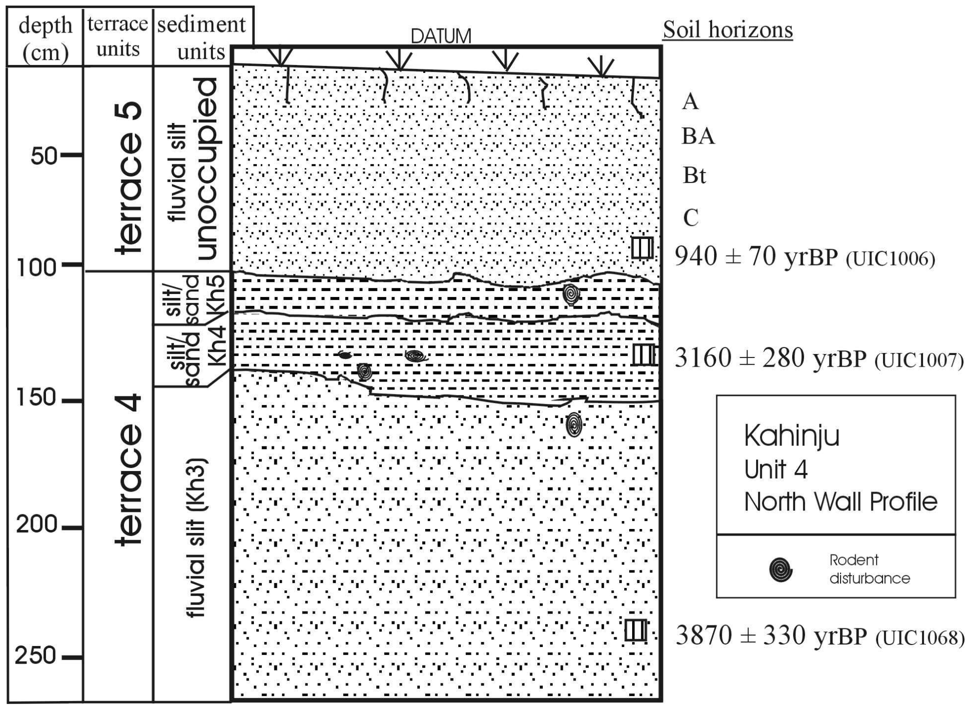

Figure 30. Kahinju, Unit 4 profile stratigraphy and radiometric ages

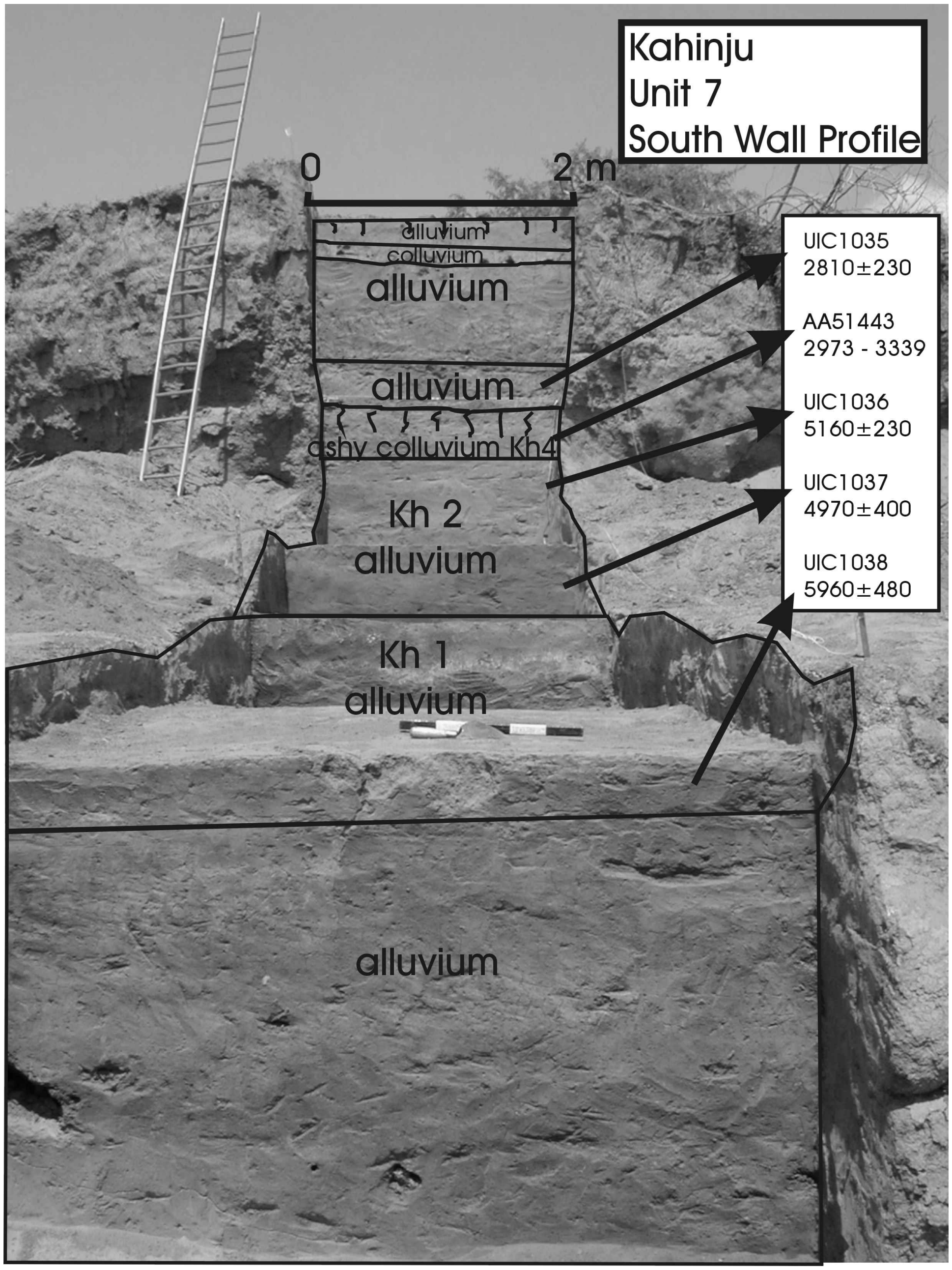

Figure 31. Kahinju, Unit 7 profile stratigraphy and radiometric ages

6.4.1.a Interpretation of Kahinju Geochronology

Kahinju is located at 03˚ 02' S and 38˚ 55' E on the right bank of the Galana River. The site has been tested as measuring, minimally, 581 meters east-west and is estimated as extending 50 m north-south. Estimated from surface scatters of artifacts, the settlement covers 7.18 acres (2.91 ha) although the southern limits of the site have not yet been detected because it is buried under >1 m alluvium. Occupations at Kahinju have been dated between 5,960 ± 480 years and 2,358 – 2,754 years B.P. by a combination of IRSL and AMS ^{14}C ages.

Occupation horizons were determined based on the geomorphology of the artifact-bearing landforms, the distribution of datable artifact assemblages in one or more landforms and the radiometric ages obtained from either artifacts or sediments that temporally distinguish landform strata accretion. The soils were predominantly torrifluvent entisols with weak horizon development. Soil structure was largely indiscriminate except for subtle changes in texture resulting from differential deposition patterns. Most landforms were predominantly composed of primary sedimentary and depositional structures with little pedogenesis or other *in situ* transformation of sediments. The correlation between soil horizon development and the inferred stability of the landscape is addressed below in the general discussion section of this chapter.

6.4.1.b Kahinju Stratigraphic Sequence

Five primary sedimentary units have been identified at Kahinju and reflect a fluvial aggradational sequence. The majority of the sediments are comprised of silts and fine sands that are overbank torrifluvent entisols laid down in successive flooding events that occurred between ca. 6,000 years and 1,000 years B.P. Terraces were exposed during recent fluvial channel degradation dating to after ca. 1,000 years B.P.

1) Sedimentary unit 1 (222.5 – 223.0 m.a.s.l.) is comprised of loose, poorly sorted sands (7.5YR 7/6) and is the modern floodplain of the Galana River.

2) Sedimentary unit 2 (223.0 – 224.0 m.a.s.l.) is comprised of sandy clay loam with a B_{sb} catena detected in Units 7, 8 and 9 (5YR 4/6 – 7.5YR 5/8). This sedimentary unit has largely been eroded during fluvial downcutting and only a small portion remains intact.

3) Sedimentary unit 3 (224.0 – 226.2 m.a.s.l.) is comprised of sandy clay loam with a B_{kb} catena detected in Unit 9, but not present in Unit 7 (7.5YR 4/6 – 7.5YR 5/8). This sedimentary unit has largely been eroded during fluvial downcutting and only a small portion remains intact.

4) Sedimentary unit 4 (224.3 – 227.2 m.a.s.l.) is comprised of multiple layers of loamy sediments primarily of silt and fine sand grain fractions (7.5YR 4/6 – 7.5YR 5/8). This sedimentary unit is largely intact and is capped by a B_{wb} horizon (0.2 m thick).

5) Sedimentary unit 5 (227.2 – 229.2 m.a.s.l.) is comprised of two primary alluvial deposition (7.5YR 5/4 – 7.5YR 5/6) episodes separated by a colluvial interstice (7.5YR 4/6).

6.4.1.c Kahinju Occupation Horizons and Archaeological Evidence

Settlement of the site of Kahinju occurred on a series of terraces of the Galana River inside Tsavo East National Park. Cultural occupations extend as far back as ~6,000 years B.P. and correlates to the Late Eburran[13] to Middle PN time period (Table V). Decorated ceramics include several previously unidentified wares and Narosura and Maringishu Wares that are found at other sites in East Africa (Chapter 9). Horton (1996) sees a strong stylistic connection between Maringishu Wares and various types of EIW wares found later on the coast. Chapter 9 will discuss similarities between ceramics discovered *in situ* at Kahinju and later vessels previously recorded by other authors.

A total of five archaeological horizons were recorded from the nine test units dug at Kahinju. Downcutting of terraces has produced differential geomorphic preservation conditions, which complicates interpretations of the vertical distribution of artifacts. Within sedimentary units, the law of superposition applies, however the terraces are uneven in their altitudinal distribution across the site. Most of the artifacts were interpreted as having been recovered in secondary cultural deposits.[14]

1) Occupation horizon 1 (Kh1) has been found in sedimentary unit 2 (223.0 – 225.5 m.a.s.l.). This occupation horizon is between 0.2 m and 1.0 m thick and was excavated from Units 7 and 8. Artifacts

[13] The term "Eburran" is generally assigned to a specific tool typology (Ambrose 1980b, 1984b, 1984c). However, there is also a chronological component to their manufacture and use (e.g. Ambrose 1980b, 1984b, 1984c; Marshall 1994). The tool kits manufactured at Galana River archaeological sites do not resemble Eburran assemblages from the Rift Valley, but do conform to the chronological association. Therefore, rather than derive a new terminology for these occupations, I have chosen to classify the early settlements of the Galana River sites as "Eburran" until such time as a comprehensive definition can be determined.

[14] A secondary cultural deposit occurs when an artifact is discarded and then is moved from its initial discard location to another. This can occur as a result of human sweeping or cleaning, scavanger activity, entrainment of an artifact in colluvium, etc.

are interpreted as coming from a secondary cultural context. The stratum is dated to 5,960 ± 480 years by means of an IRSL age (UIC1038). The IRSL age on T1 constrains the age of deposition of the landform, and artifacts entrained in the sediments postdate terrace accretion. This occupation was likely ephemeral and was located in the area that is now largely eroded although some vestiges of the terrace remain undisturbed.

The lack of temporally diagnostic artifacts necessitates that the Kh1 occupation be designated as Late Eburran-phase foragers based strictly on the IRSL age (6000 ± 480 years B.P., UIC1038) obtained from the terrace. The recovered material from this stratum includes one non-diagnostic potsherd, six indeterminate bone fragments, a humerus shaft fragment from a class 2 bovid (see Chapter 7 for a complete discussion of faunal classifications), three end scrapers, one reduced core and eight lateral flakes. All artifacts recovered from this interpreted occupation layer were found in an intact fluvial landform, which stratigraphically distinct from surrounding landforms.

2) Occupation horizon 2 (Kh2) has been found in sedimentary unit 3 (222.5 – 223.0 m.a.s.l.). This occupation horizon is approximately 0.5 cm thick and was excavated from Units 7 and 9. Artifacts are interpreted as coming from a secondary cultural context. The

stratum is dated to 5,000 ± 400 years by means of two IRSL ages (UIC1036, UIC1037).

Artifact finds for Kh2 include copious amounts of pottery, lithics, snail shell, and burnt and cut bone from class 1, class 2 and class 4 bovids. However, all artifacts were temporally non-diagnostic and determining whether the material remains belong to a culture that herded domesticated animals remains unclear. Based on the current chronology of the movement of domesticated plants and animals into East Africa, it is probable that this occupation is a late phase Eburran 5 settlement (Ambrose 1984b, c). Further testing of this occupation phase is necessary to obtain more information about the nature of this occupation and whether data exist regarding transitions from foraging to food production.

3) Occupation horizon 3 (Kh3) has been found in sedimentary unit 4 (224.1 – 227.3 m.a.s.l.). This occupation horizon varies between 0.2 and 1.0 m thick and was excavated from Units 1, 2, 4 and 6. Artifacts are interpreted as primarily coming from a secondary cultural context, however artifacts recovered from Units 2 and 6 are likely from an *in situ* primary deposition context. This occupation horizon contains the earliest evidence for the existence of fully domesticated cattle (*Bos taurus*) on the coastal plains of East Africa based on one IRSL age and one AMS ^{14}C age dating to approximately 3,700 years B.P. (UIC1068; AA51444).

Following the abandonment of occupation horizon Kh2, Kahinju appears to have been unoccupied for ~1,200 years. Artifacts from this level at Unit 4 were recovered from a sheet midden that was composed primarily of faunal material and some lithic debitage. Artifacts recovered from Unit 2 include diagnostic Narosura Wares, which were produced during the early to middle PN period (Bower et al. 1977; Soper 1989). Based on these finds, Kh3 is interpreted to be an early variation of the PN culture. Currently, this is the earliest discovery confirmed of PN material outside of the Rift Valley. Chapters 7 and 11 will discuss the implications of these findings in more detail.

4) Occupation horizon 4 (Kh4) has been found in sedimentary unit 4 (224.5 – 227.2 m.a.s.l.). This occupation varies between 0.4 and 1.0 m thick and was excavated from Units 2, 3, 4, 5(?), 6 and 7. Artifacts are interpreted primarily from a secondary cultural context, however primary deposition of *in situ* artifacts were recovered from Units 2, 6 and 7. Unit 7 yielded an ashy hearth of 0.5 m thick from which numerous bone fragments were removed. This strata is well dated with three IRSL ages (UIC944; UIC1007; UIC1035) and two AMS ^{14}C ages (AA51443; AA51445) with a mean aggregate age dating to ca. 3,140 years B.P. (Table VI).

Kh4 is designated a PN cultural layer based on the recovery of diagnostic pottery (Narosura Wares and Maringishu Wares) *in* *situ*. No confirmed domesticated animal bones were recovered from this occupation layer, but a number of class 2 and class 4 bovid bones were retrieved, which could represent the remains of domesticated goats and cattle, respectively.

TABLE VI. ROOT MEAN SQUARE OF RADIOMETRIC AGES FROM KH4 OCCUPATION LEVEL

$RMS(Kh4)=((X_1+X_{2\ldots})/n) \pm (\sqrt{(\sigma_1)^2+(\sigma_2)^2\ldots}/n$

$RMS(Kh4)=((3200+3160+3200+3000)/4) \pm (\sqrt{(120)^2+(160)^2+(260)^2+(260)^2}/4$

RMS(Kh4)= 3140 ± 110 years B.P.

5) Occupation 5 (Kh5) has been found in sedimentary unit 4 (224.5 – 227.2 m.a.s.l.). This occupation is found in sediments exceeding 1.0 m thick. However, the majority of the artifacts were recovered from an A_b and B_{tb} (0.25 m thick). Artifacts found below the soil horizon may be entrained in reworked sediments associated with the Kh4 occupation, although not enough data is available to make this hypothesis into a certaintude. Based on this interpretation, the artifacts recovered from this occupation horizon are believed to come from a secondary deposition context, but may also contain

Sample #	Est. Age (cal B.P.)	Occupation Horizon	Temporal Affiliation
UIC1071	4830 ± 390	Kt1	Early PN/Late Eburran
UIC1070	3600 ± 320	Kt2	Early PN/Middle PN
UIC921	3450 ± 290	Kt2	Early PN/Middle PN
UIC1069	3120 ± 270	Kt3	Early PN/Middle PN
UIC1153	1720 ± 150	Kt4 or Kt5	Late PN
AA51449	1420 - 1701	Kt4	Late PN
AA51448	1307 - 1530	Kt5	Late PN
AA51447	1297 - 1510	Kt5	Late PN

primary deposition context artifacts as well. Evidence of this occupation horizon was excavated from Units 2 and 6. This stratum is dated on the basis of one IRSL age (UIC943) and one AMS ^{14}C age (AA51442) to ca. 2,700 years B.P. This occupation overlaps in the 2 σ confidence interval with Kh4.

Kh5 possessed diagnostic ceramics that are classified as being made by PN cultures. Relative artifact densities were high in relation to other test units dating to later time periods. Future investigations may prove that Kh5 is a later variation on Kh4, but the geomorphological interpretation of these strata as distinct occupations is based on differential deposition patterns (Figure 28) and variance in the radiocarbon ages between the two landforms.

6.4.2 Kathuva

The distribution of ages suggests the following pattern:

TABLE VII. RADIOMETRIC AGE CLUSTERS FOR THE KATHUVA SITE

Figure 32 below shows an aerial photo of Kathuva with the distribution of occupation terraces present at the site

Figure 33. Kathuva, Unit 3 deposition sequence

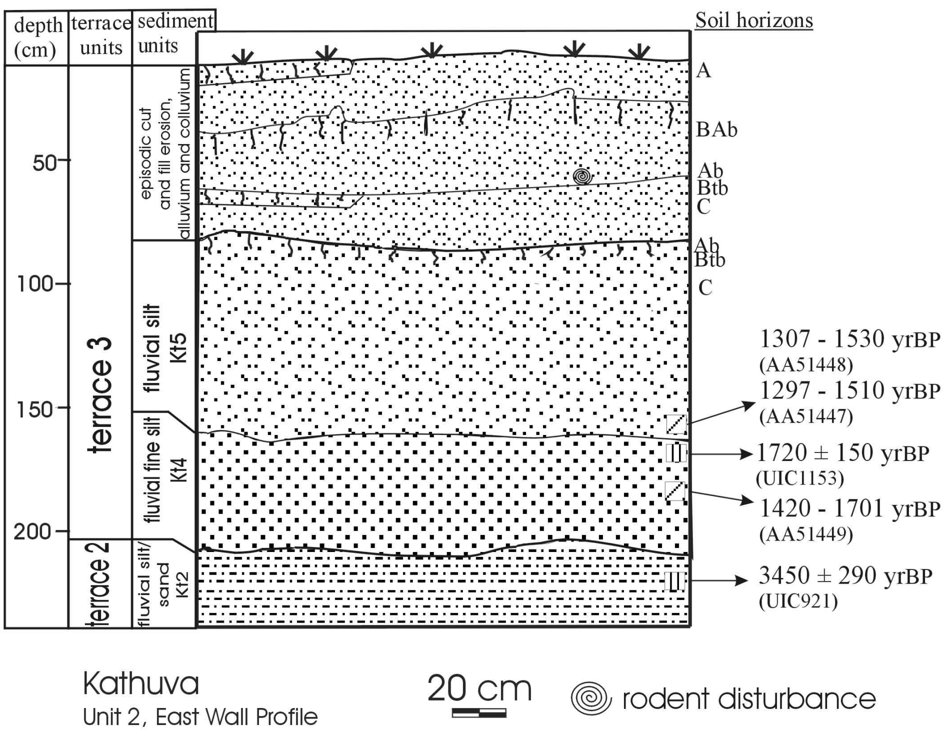

Figure 34. Kathuva, Unit 2 stratigraphy and radiometric ages

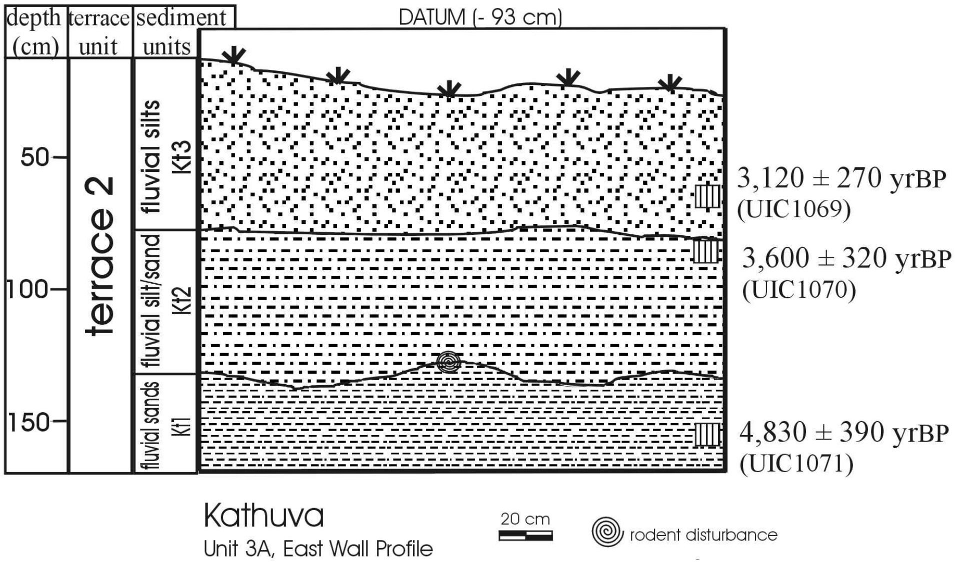

Figure 35. Kathuva, Unit 3 stratigraphy and radiometric ages

Figure 36. Cowry shell recovered from Kathuva, Unit 2 (Kt5)

6.4.2.a Interpretation of Kathuva Geochronology

Kathuva is located at 03˚ 04' S and 39˚ 10' E on the right bank of the Galana River. The site has been tested as measuring, minimally, 105 meters north-south and is estimated as extending 50 m east-west. Estimated from surface scatters of artifacts, the settlement covers 1.29 acres (.53 ha) although the eastern limits of the site have not yet been detected because it is buried under >1 m alluvium. Occupations at Kathuva have been dated between 4,830 ± 390 years and 1,300 – 1,530 years B.P. by a combination of IRSL and AMS ^{14}C ages.

6.4.2.b Kathuva Stratigraphic Sequence

Three primary sedimentary units have been identified at Kathuva and reflect a fluvial aggradational sequence. The majority of the sediments are comprised of silts and fine sands that are overbank torrifluvent entisols laid down in successive flooding events that occurred between ca. 5,000 years and 1,000 years B.P. Terraces were exposed during recent fluvial channel degradation dating to after ca. 1,000 years B.P.

1) Sedimentary unit 1 (174.5 – 176.0 m.a.s.l.) is comprised of loose, poorly sorted sands (7.5YR 7/6) and is the modern floodplain of the Galana River.

2) Sedimentary unit 2 (176.0 – 177.0 m.a.s.l.) is comprised of loams that are dominated by silt and fine sand grain fractions (7.5YR 4/6 – 7.5YR 5/8). No paleosol development was detected in this sedimentary unit.

3) Sedimentary unit 3 (177.0 – 177.4 m.a.s.l.) is comprised of loams that are dominated by silt and fine grain fractions, although some

medium-grained sand particles (~10%) were also detected (7.5YR 5/4 – 7.5YR 5/6).

6.4.2.c Kathuva Occupation Horizons and Archaeological Evidence

Radiometric ages and geomorphological analysis have shown that five separate occupations of Kathuva occurred. There is little change in material technology between the various occupations of the site of Kathuva. Domesticated cattle are found during the second (3,500 years B.P.) and fifth (1,400 years B.P.) occupations of the site. PN stone tools and ceramics were recovered from all occupied deposition sequences. The last two known occupations of the site did not contain any evidence of iron working or use of iron technology, despite the occurrence of this technology in other parts of East Africa after ca. 1,000 years B.P. (Kusimba 1993; Schmidt 1997). Economically, the inhabitants of Kathuva engaged in mixed pastoralism and foraging, and wild animal bones were recovered from all occupied levels.

Downcutting of terraces has produced differential geomorphic preservation conditions, which complicates interpretations of the vertical distribution of artifacts. Within sedimentary units, the law of superposition applies, however the terraces are uneven in their altitudinal distribution across the site. Most of the artifacts were interpreted as having been recovered in secondary cultural deposits.

1) Occupation horizon 1 (Kt1) has been found in sedimentary unit 2 (176.0 – 177.0 m.a.s.l.). This occupation horizon is 0.2 m thick and was excavated from Unit 3A. Artifacts are interpreted as coming from a secondary cultural context. The stratum is dated to 4,830 ± 390 years by means of an IRSL age (UIC1071).

The terrace on which Kt1 is located has largely been eroded and few vestiges of the occupation remain. Only a few bone fragments were recovered from this occupation layer, all of which were non-diagnostic. Based on the luminescence age obtained from this strata (4,800 ± 390 years B.P., UIC1071) and the lack of other temporally diagnostic material, this occupation chronologically conforms to Late Eburran foraging sites found in the Central Kenyan Highlands and Rift Valley (Ambrose 1984b, c). However, it is not well defined archaeologically and has little interpretative value except to say that late Eburran-phase occupations can be traced to Tsavo from this time period.

2) Occupation horizon 2 (Kt2) has been found in sedimentary unit 2 (176.0 – 177.0 m.a.s.l.). This occupation horizon ranges between 0.2 and 1.0 m thick and is detected in all test units at the site. No radiometric dates were obtained from Unit 1, but a thick cultural lens that included burnt animal bones and non-diagnostic pottery was found in the same landform that was dated to this period. Artifacts are interpreted as primarily coming from a secondary cultural context, except in Unit 1, where there is evidence of an *in situ* hearth. The stratum is dated to ca. 3,500 years by means of two IRSL ages (UIC921; UIC1070).

One premolar and one molar fragment were recovered *in situ* from domesticated cattle (*Bos taurus*) in this occupation horizon. No other diagnostic material was present in this assemblage, although copious amounts of undecorated ceramics and quartz tools were recovered. Based on the luminescence ages of 3,450 ± 290 years B.P. (UIC 921) and 3,600 ± 320 years B.P. (UIC1070) as well as the unearthing of domesticated animal faunal remains, this occupation level is an Early to Middle PN settlement.

3) Occupation horizon 3 (Kt3) has been found in sedimentary unit 2 (175.5 – 177.0 m.a.s.l.). This occupation horizon is 0.8 m thick and was excavated from Units 3A and 3B. Artifacts are interpreted as coming from a secondary cultural context. This stratum is dated to 3,120 ± 270 years on the basis of an IRSL age (UIC1069), and statistically falls within the 2 σ confidence interval for overlapping with Kt2.

No diagnostic artifacts were recovered from this occupation horizon, although copious amounts of general PN-type artifacts were salvaged. Distinguishing Kt2 from Kt3 is based on the weighted means of the two sets of luminescence dates and the geomorphological and sedimentological assessment that these two strata are distinct fluvial deposition episodes (Figure 33). It is, however, possible that artifacts categorized as part of Kt3 may be entrained in reworked colluvium associated with Kt2 sediments.

4) Occupation horizon 4 (Kt4) has been found in sedimentary unit 2 (175.5 – 177.0 m.a.s.l.). This occupation horizon is 0.4 m thick

and was excavated from Unit 2. Artifacts are interpreted as coming from a secondary cultural context. This stratum is dated to 1420 – 1701 years B.P. based on an AMS ^{14}C age (AA51449). An IRSL age of 1720 ± 150 years straddles the sedimentological boundary between Kt4 and Kt5 (UIC1153).

The artifact assemblage from this level does not differ drastically from other PN cultural occupations discovered in Tsavo during the 2001 field season, although no diagnostic ceramics were recovered from this level. This represents one of the latest known PN settlements in East Africa (Marshall 2000). Early Iron Age sites are found in the western and coastal regions of Kenya dating to this period, but are typically associated with domesticated plants, iron working technology and Urewe Ware ceramics (Bisson and Horne 1974; Chami 1994, 1994-1995; Kusimba 1993; Schmidt and Childs 1985; Soper 1967a; Thorp 1992; Van Noten 1979), none of which were recovered from Kathuva. Based on the available data, this occupation level is determined to be a Late PN settlement.

5) Occupation horizon 5 (Kt5) has been found in sedimentary unit 2 (175.5 – 177.0 m.a.s.l.). This occupation horizon is 0.3 m thick and was excavated from Unit 2. Artifacts are interpreted as coming from either a primary or secondary cultural context based on the density and positioning of artifacts. This stratum is dated to

ca. 1297 – 1530 years B.P. based on two AMS ^{14}C ages (AA51447; AA51448). An IRSL age of 1720 ± 150 years straddles the sedimentological boundary between Kt4 and Kt5 (UIC1153). This estimate falls within the 2 σ confidence interval for both Kt4 and Kt5, but probably reflects the fact that stratum deposition necessarily predates cultural occupation. Therefore, the separation of these two occupations is based solely on the geomorphological interpretation of having accreted in two separate fluvial depositional events. It is plausible that numerous seasonal occupations of this landform occurred, as is the pattern of many nomadic pastoralists throughout the world (refer to Chapter 2).

Kt5 has produced solid evidence in the form of a molar fragment recovered from Unit 2 that domesticated animals were present at this site. Furthermore, a cowry shell that could only have come from the Indian Ocean was discovered in the occupation layer (Figure 36). Given that the coast of the Indian Ocean is >100 km to the east of this site, the inhabitants of Kathuva were engaged in long-distance exchange either directly or indirectly. Trade of non-perishable commodities is well documented in the archaeological record in the later periods of East African prehistory when the Swahili civilization on the coast was thriving (Kusimba 1999b), but little is known of the modes of exchange from periods prior to 1,000 years B.P.

To obtain a cowry shell, goods or services would have been exchanged either directly or through trade networks established between different communities on the way to the coast. Alternatively, cowry shells may have been collected directly by herders who could have grazed their animals in far flung regions during especially dry periods in Tsavo. Given the preponderance of indirect evidence assembled suggesting that trade between the coast and the hinterland had been established by this time (Allen 1993; Horton 1987, 1990, 1996; Kusimba 1999b; Kusimba 2003; Pearson 1998; Wilding 1987), the former scenario seems more likely than the latter (see Chapter 10 for a more detailed analysis).

Based on the available data, Kt5 falls within the range of cultural material and relative ages expected from a Late PN settlement. This occupation may be roughly contemporaneous to Kt4, but not enough data are presently available to make that assessment. The determination that Kt5 is a Late PN settlement is based on the lack of iron-producing technology or diagnostic ceramics to indicate an Early Iron Age component and the stylistic similarities between the artifact assemblages recovered in this occupation layer and that of older PN lenses at the site.

6.4.3 Mwiitu

The distribution of ages suggests the following pattern:

Sample #	Est. Age (cal B.P.)	Occupation Horizon	Temporal Affiliation
UIC1392	3020 ± 270	<Mw1	Early PN/Middle PN
UIC1393	1020 ± 80	>Mw 2 and 3	Late PN

TABLE VIII. RADIOMETRIC AGE CLUSTERS FOR THE MWIITU SITE

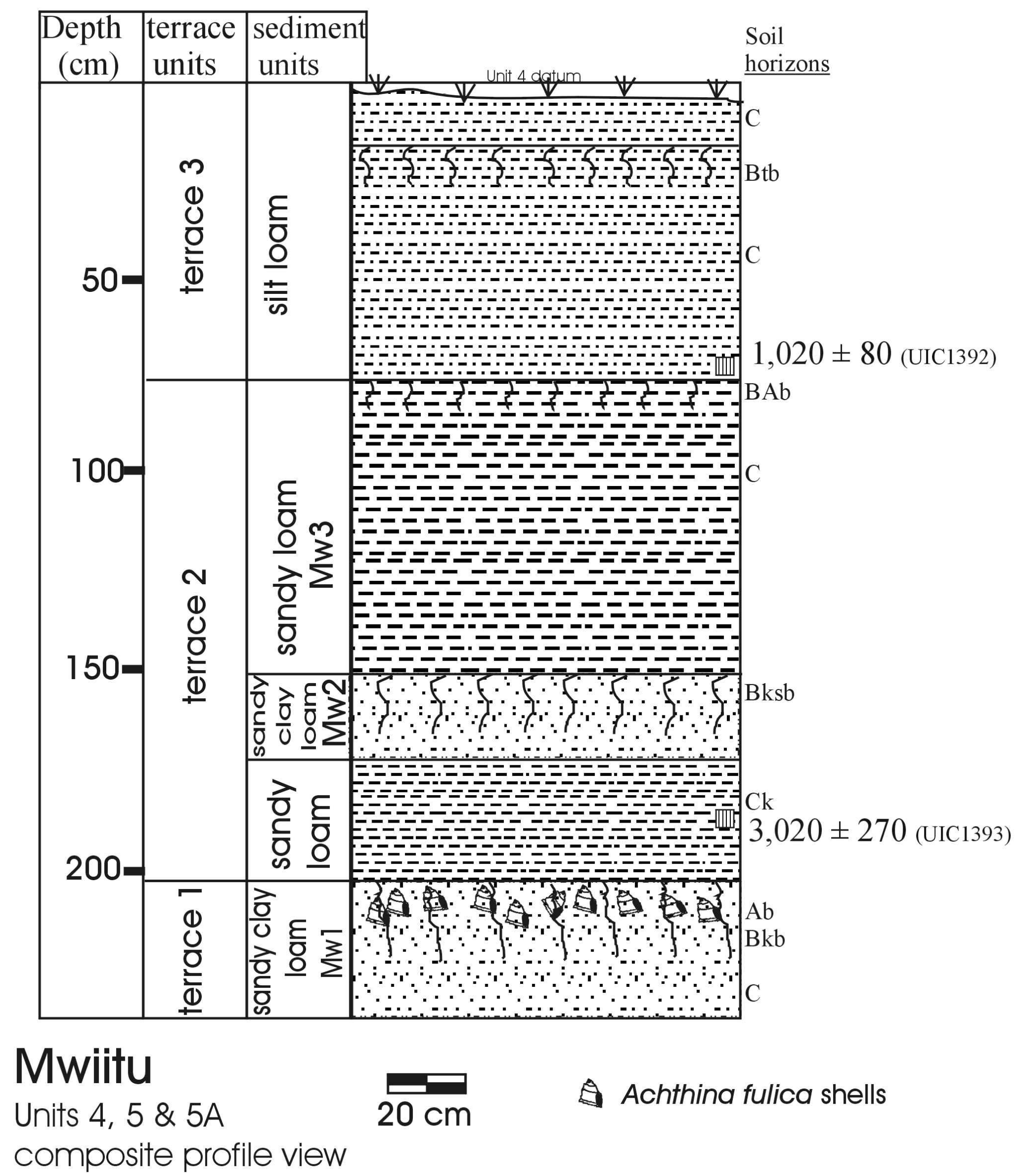

Figure 37. Mwiitu, composite stratigraphy from Units 4, 5 and 5A and radiometric ages

6.4.3.a Interpretation of Mwiitu Geochronology

Mwiitu is located at 03˚ 02' S and 38˚ 56' E on the right bank of the Galana River. The site has been tested as measuring, minimally, 50 meters north-south and 90 m east-west. Estimated from surface scatters of artifacts, the settlement covers 1.11 acres (.45 ha) although the southern limits of the site have not yet been detected because it is buried under >1 m alluvium. Occupations at Kathuva have been dated before 3,020 ± 270 years and ending after 1,020 ± 80 years by means of two IRSL ages.

Geoarchaeological approaches to understanding the relative stratigraphic positioning of artifacts at the site of Mwiitu differs from the sites of Kahinju and Kathuva. At Mwiitu, IRSL ages were used as minimum constraints of the landform deposition as opposed to directly dating the occupation horizons themselves. This is because radiocarbon ages are not available from this site and buried soils on stabilized landforms were more strongly developed than at the other sites tested. The IRSL method cannot be used to date pedogenic horizons due to leaching and enriching of organics and minerals within a soil profile that contaminate *in situ* parent material (C-horizon) sediments with those that have been more recently exposed to light. Thus, occupation horizons have been determined to predate or postdate the minimum constraining ages available at Mwiitu.

Radiometric ages and geomorphological analysis have shown that three separate occupations of Mwiitu occurred. Similar to Kahinju and Kathuva, there is a negligible detectable change in material technology between the various occupations of the site of Mwiitu. Diagnostic fauna include suni (*Neotragus moschatus*—MNI = 1) and a rodent mandible. The suni heralds from the second occupation of the site (Mw2), which dates to after 3,020 ± 270 years B.P. but occurred before 1,020 ± 80 years B.P. Domesticated cattle are not found in archaeological deposits at the site. PN stone tools and ceramics were recovered from all occupied deposition sequences.

6.4.3.b Mwiitu Stratigraphic Sequence

Three primary sedimentary units have been identified at Mwiitu and reflect a fluvial aggradational sequence. The majority of the sediments are comprised of silts and fine sands that are overbank torrifluvent entisols laid down in successive flooding events that began before 3,000 years and ended after 1,000 years B.P. Terraces were exposed during recent fluvial channel degradation dating to after ca. 1,000 years B.P.

1) Sedimentary unit 1 (232.5 – 234.7 m.a.s.l.) is comprised of sandy clay loam with an A_b catena and associated B_{kb} (5YR 4/4 – 5YR 5/6). Numerous terrestrial mollusks (esp. *Achatina fulica*) inhabited the A_b and likely colonized abandoned sheet middens. This sedimentary unit has largely been eroded during fluvial downcutting and only a small portion remains intact.

2) Sedimentary unit 2 (234.7 – 235.8 m.a.s.l.) is comprised of sandy loam and sandy clay loam (7.5YR 4/4 – 7.5 YR 5/6). A B_{ksb} paleosol measuring 0.2 m thick is a colluvial interstice within poorly sorted alluvial C-horizon sediments. A weak BA_b (<0.1 m thick) caps sedimentary unit 2.

3) Sedimentary unit 3 (235.0 – 236.7 m.a.s.l.) is comprised of silt loam (7.5YR 4/4 – 7.5YR 5/6). A B_{tb} paleosol measuring 0.2 m thick is traced from 0.15 m below the modern ground surface.

6.4.3.c Mwiitu Occupation Horizons and Archaeological Evidence

A total of three archaeological horizons were recorded from six test units dug at Mwiitu. Downcutting of terraces has produced differential geomorphic preservation conditions, which complicates interpretations of the vertical distribution of artifacts. Within sedimentary units, the law of superposition applies, however the terraces are uneven in their altitudinal distribution across the site. Most of the artifacts were interpreted as having been recovered in secondary cultural deposits.

1) Occupation horizon 1 (Mw1) has been found in sedimentary unit 1 (232.5 – 234.7 m.a.s.l.). This terrace has largely been eroded leaving few vestiges of the occupation intact. This occupation horizon is 0.4 m thick and was excavated from Unit 5. Artifacts are interpreted as coming from a sheet midden. The stratum is dated to >3,020 ± 270 years by means of one IRSL age (UIC1393).

Bone fragments were recovered in copious amounts from Mw1, however all of the faunal material was non-diagnostic. The poor condition of the faunal material in this occupation horizon is largely due to the presence of hundreds of *Achatina fulica* terrestrial mollusks, which apparently colonized the site subsequent to human abandonment. In one 20-cm spit in Unit 5 (measuring 1-x-2 m), 2.95 kg of *Achatina fulica* shells were unearthed. Other finds include non-diagnostic ceramics and lithic tools and debitage.

2) Occupation horizon 2 (Mw2) has been found in sedimentary unit 2 (234.7 – 235.8 m.a.s.l.). This occupation horizon is situated on T2, which overlies the relic sediments of T1. Mw2 was found within a B_{ksb} paleosol and was detected in Units 2, 3, 4, 5, 5A and 6. Artifacts are interpreted as coming from a primary cultural context in Units 3, 4, 5 and 5A, but from a secondary cultural context in Units 2 and 6. This analysis is based on the provenience of primary cultural context artifacts entrained in soils and the secondary context artifacts were recovered from colluvium. This stratum is dated to <3,020 ± 270 years and >1,020 ± 80 years by means of two IRSL ages (UIC1392; UIC1393).

Decorated, crosshatched Narosura tradition ceramics were recovered from this level. Lithic finds include numerous stone shaped tools fashioned from quartz (Chapter 8). Tool manufacture debris from chert and obsidian raw materials were also recovered from this level indicating that the inhabitants of the site at this time either migrated to obsidian-bearing regions (the closest source of obsidian would be located in the Central East African Highlands—a minimum of 150 km from the site) or were in contact with people from these areas. Five worked shells with drill holes were recovered from Mw2 that appear to have been made from local terrestrial mollusks (most likely *Achatina fulica*). Mw2 represents the most intensive inhabitation detected at Mwiitu with the vast majority of artifact finds from the 2004 field season hailing from this occupation horizon.

3) Occupation horizon 3 (Mw3) has been found in sedimentary unit 2 (234.7 – 235.8 m.a.s.l.). Mw3 was found primarily within C_k sediments and is interpreted as coming from a secondary cultural context. Mw3 was detected in Units 2, 3, 4, 5, 5A and 6 and directly overlies Mw2. This stratum was separted from Mw2 by means of artifact distributions in the profiles of the test trenches in which this occupation was traced. In each case, 10 – 15 cm of sterile sediment separates Mw3 from Mw2, however soil development between the horizons is lacking. It is possible that artifacts connected to Mw3 are reworked sediments associated with the Mw2 occupation horizon. It is also plausible that Mw2 and Mw3 were separated by only a short time period in which colluvium was deposited on top of Mw2. This stratum is dated to <3,020 ± 270 years and >1,020 ± 80 years by means of two IRSL ages (UIC1392; UIC1393).

Some non-diagnostic ceramics and stone tool debitage have been detected from this level indicating that there is little change in hunting, processessing and storage techniques between the two occupations. However, this hypothesis is largely made on the basis of negative evidence for iron working technology or other forms of intensive land usage (such as horticultural techniques, pastoralism or storage pit construction).

6.5 General Discussion of Sedimentary and Archaeological Sequences of Mid- to Late Holocene Galana River Sites

Ferring (1986) argues that there is no one-size-fits-all ratio between quantity and rate of sediment accumulation in fluvial terraces. Some of the prime factors that suggest rapid sedimentation include well preserved primary sedimentary structures, weak soil horizon development, little evidence of bioturbation and a well preserved fossil taphonomy (Ferring 1986)—all of which are present at the sites of Kahinju, Kathuva and Mwiitu. Rates of sedimentation are controlled by internal thresholds such as stream dynamics and external factors such as climate or tectonics (Ferring 1986; Gladfelter 2001; Joyce and Mueller 1997; Reid and Frostick 1989; Ritter et al. 2002; Shams et al. 2002). Rapid sedimentation of archaeological sites promotes preservation of distinct occupation horizons and reduces the chances of mixing between assemblages in earlier and later phases of site inhabitation (Ferring 1986).

Some components of the stratigraphy recorded from the Galana River sites tested in 2001 and 2004 indicate that colluviation of the sloped terraces leading to the river banks occurred periodically. Eriksson et al. (2000) assert that mass movement of colluvium on hillslopes in Tanzania occurs after pronounced periods of extreme aridity that deprive the landform of vegetation necessary to prevent erosion. In their study, Eriksson et al. (1999, 2000) found that middle to late Pleistocene aridification of the Irangi Hills was followed by early Holocene pluvial episodes. The abruptness of the transition from arid to wet did not allow the landscape enough time to regenerate vegetation necessary to prevent erosion. Thus, strong rainfall events entrained large amounts of sediment resulting in rapid deposition of colluvium (Eriksson et al. 1999). Colluviation events on the terraces situated along the Galana River left laminae of angular, poorly sorted silts and fine sands that sealed some fluvially accreted deposition episodes.

The generally poor development of paleosols in the sequences along the Galana River in Tsavo is indicative of either a rapid depositional environment, generally poor conditions for pedogenesis, truncated soil horizons due to fluvial incision, or some combination of the these factors. Development of soils that sustain biota require the nutrient influx of trees, which can take decades or centuries depending on the local parent material, surface relief, climate and indigenous soil-dwelling microfauna (Wild 1993). To understand which of these factors may have provided the strongest impetus for weak soil development during a particular phase of terrace formation, one must first contextualize the data with the likely paleoenvironmental and depositional environment at the time of terrace formation.

6.5.1 Paleoenvironmental Backdrop to Terrace Formations

Along the Galana River, luminescence ages show that the accretion of sediments on which the archaeological sites are situated occurs in several phases. The initial phase of terrace formation at Kahinju is dated to between 6,000 and 5,000 years B.P., which correlates to the close of the Mid-Holocene Climatic Optimum (MHCO), a period when deciduous forests expanded and lake levels rose throughout the continent in response to relatively high precipitation on the continent (Butzer et al. 1972; Damnati 2000; Gasse

2000, 2001; Gasse and Van Campo 2001; Grove 1993; Maley 1993; Vincens et al. 1999). During this period, tributaries that fed the Galana River would have been charged owing to increased rainfall in the central Kenyan Highlands and around Mount Kilimanjaro (Butzer et al. 1972; Karlen et al. 1999; Thompson et al. 2002b; Vincens et al. 1991). In addition, interannual fluctuation in precipitation was low as a strongly seasonal climate is documented throughout the range of the Indian Ocean monsoons (Kutzbach and Liu 1997; Mulitza and Ruhlemann 2000; Overpeck et al. 1996; Prentice and Jolly 2000). This is owing to the fact that periodicities in the occurrences of El Niño/Southern Oscillations (ENSO) cycles are measured in centuries during this time period (Clement et al. 2000; Corrège et al. 2000; Gagan et al. 1998; Liu et al. 2000; Moy et al. 2002b; Sandweiss et al. 2001; Shulmeister and Lees 1995; Tudhope et al. 2001).

However, between 5,000 and 4,000 years B.P., the climate in East Africa rapidly turns more arid and less seasonal (Butzer et al. 1972; Damnati 2000; Gasse 2000, 2001; Gasse and Van Campo 2001; Grove 1993; Maley 1993; Peyron et al. 2000; Vincens et al. 1999). Acceleration in the periodicities of ENSO cycles culminates around 1,200 years B.P. (Moy et al. 2002b) and would have made the distribution and intensity of precipitation throughout eastern Africa more erratic than it was during the MHCO (Damnati 1993) or today (Camberlin and Philippon 2002; Charles et al. 1997; Indeje et al. 2000; Jury et al. 2002; King'uyu et al. 2000; Mutai and Ward 2000; Ward 1998). Under these circumstances, the onset of pluvial and arid phases throughout a classified "region" (such as "East Africa") will be localized.

Along the Galana River in Tsavo, fluvial terrace accretion stops at ca. 1,000 years B.P. This correlates well with the time period when ENSO periodicity occurs in subdecadal intervals (Moy et al. 2002b), but may be indicative of more pluvial conditions in the region than earlier in the Holocene. In another semiarid ecosystem in northern Arizona, the Colorado River has been documented as responding to massive influxes of sediment by rapidly aggrading and once the sediment input subsides, rapid downcutting ensues (Lucchitta et al. 2000). Strong correlations between stream downcutting and pluviation have been detected in the Thar Desert in western India as well (Jain and Tandon 2003). Jain and Tandon (2003) posit that incision of the system occurs as a result of restricted sediment input because the catchment basin is more heavily vegetated than in aggradation periods. However, other studies have shown that terrace formation and erosion cannot be correlated directly to climate and are a function of numerous variables such as internal stream dynamics and sedimentation of regions far afield from the specific site being studied (Bogaart et al. 2003; Shams et al. 2002; Verster and van Rooyen 1999).

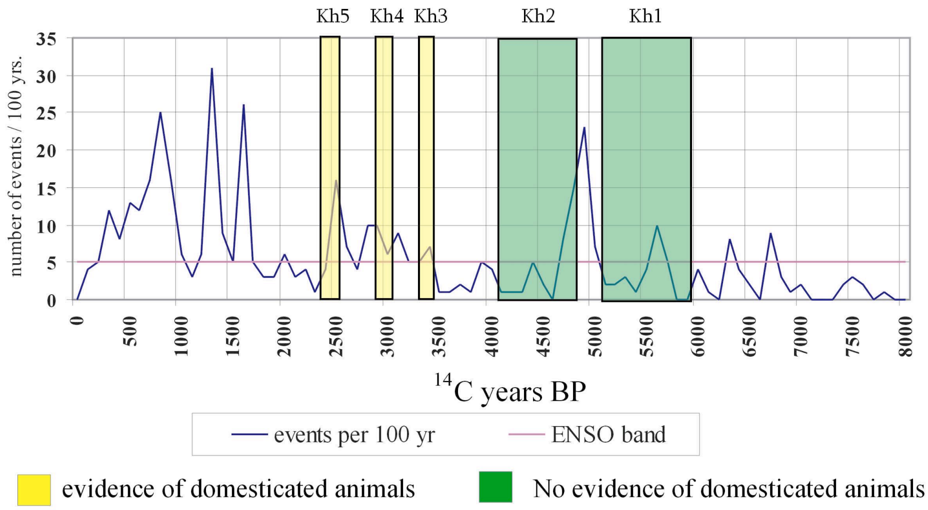

Figure 38. ENSO periodicity (Moy et al. 2002a, b) correlated with occupations at Kahinju[15]

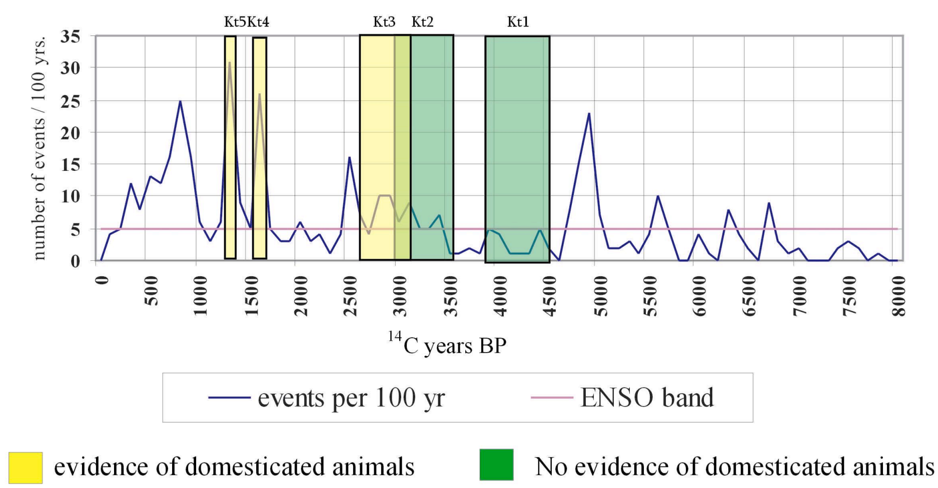

Figure 39. ENSO periodicity (Moy et al. 2002a, b) correlated with occupations at Kathuva

[15] The figures below are constructed using uncalibrated radiocarbon years because the source data from Moy et al. (2002a) and Thompson et al. (2002a) use uncorrected ages. Luminescence ages from Kahinju and Kathuva were therefore "uncorrected" using the equation Th=0.87873C+0.03911C-0.00111C+0.00111 (Bard et al. 1990).

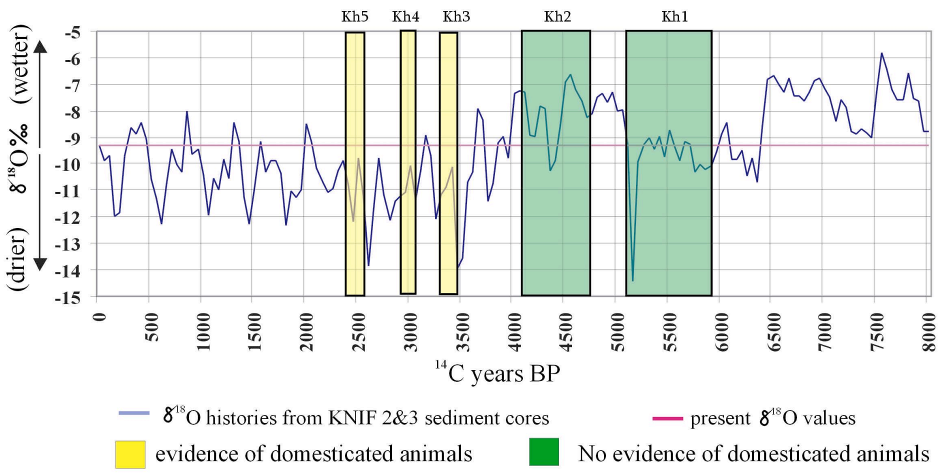

Figure 40. Aridity index (δ18O‰) from sediment cores extracted from Mount Kilimanjaro (Thompson et al. 2002a; Thompson et al. 2002b) correlated with Kahinju occupations

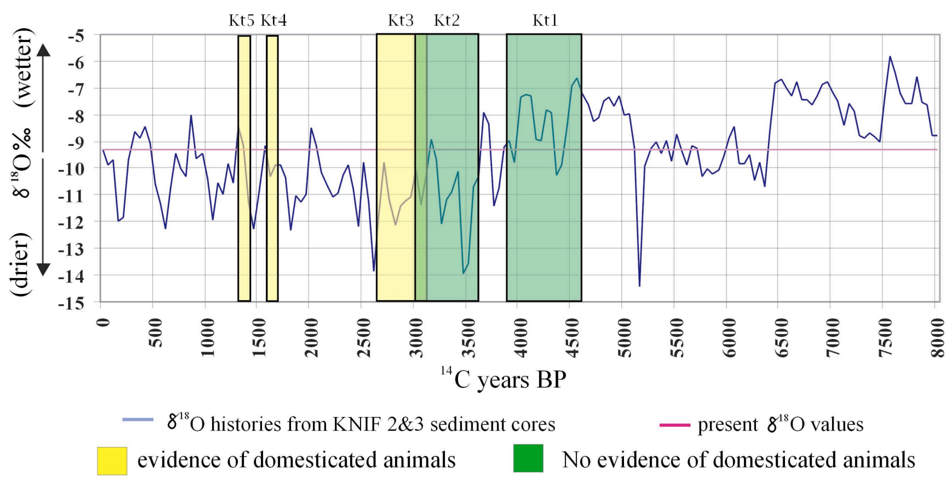

Figure 41. Aridity index (δ18O‰) from sediment cores extracted from Mount Kilimanjaro (Thompson et al. 2002a; Thompson et al. 2002b) correlated with Kathuva occupations

6.5.2 Geoarchaeological Interpretation of the Holocene Inhabitation of Tsavo

The figures above were constructed using the assumptions that artifacts entrained in alluvium or colluvium slightly predate or are contemporaneous to the actual occupation of the stratum being dated (depending on the radiocarbon age of the strata), periodicity of ENSO cycles as recorded in coastal South America correlates to episodes in East Africa through Walker Cell circulation (Camberlin and Philippon 2002; Charles et al. 1997; Mutai and Ward 2000), and the general aridity recorded on Mount Kilimanjaro following the end of the MHCO is reflective of a regional phenomenon (Thompson et al. 2002b).

6.5.2.a ENSO's Impact on East African Weather

Monte Carlo simulations of annual global precipitation between 1948 and 2000 show that during El Niño years, coastal East Africa receives higher-than-mean rainfall (Shi et al. 2002) attributable to mass mixing and wind-induced warm water upwelling in the Indian Ocean (Grumet et al. 2004; Nicholson and Kim 1997; Richard et al. 2000). Conversely, La Niña events are generally associated with lower-than-mean rainfall in East Africa (Anyamba et al. 2002) because Indonesian low-pressure centers weaken westerlies generated from the western Pacific Ocean displacing cool Antarctic waters into the tropical western Indian Ocean (Hamada et al. 2002; Mandke et al. 1999; Meyers 1996; Nicholson and Kim 1997; Vranes et al. 2002). In non-ENSO years, the onset and cessation of MAM monsoon-driven rains ("long rains") in Kenya are strongly correlated to the development of a low-pressure ridge over the southern Atlantic which forces warm Indian Ocan water westward and generates humid air masses over eastern Africa (Camberlin and Okoola 2003; Ntale et al. 2003). During La Niña events, the Atlantic low-pressure ridge is weakened vis-à-vis Walker Cell Teleconnections (Houseago-Stokes and McGregor 2000) and the probability of the onset of MAM (Ntale et al. 2003; Reason et al. 2000) and OND (Clarke et al. 2003) rains in East Africa is greatly reduced.

However, the impact of ENSO on the East African environment is generally felt as a function of regional variability in the overall precipitation and temperature regime (Ogallo 1988; Plisnier et al. 2000). Thus, high periodicity in ENSO is not exhibited linearly as either increased or diminished precipitation or temperature in the region, but as a spatially and temporally stochastic indicator of the two factors (Camberlin et al. 2001; Indeje et al. 2000; Ogallo 1988; Schreck III and Semazzi 2004). The impact of ENSO is expressed non-linearly across the landscape because not all weather and land surface variables are equally teleconnected to ENSO (Plisnier et al. 2000). Therefore, the magnitude, timing and impact of an event is controlled by a variety of topographic and land cover feedback mechanisms in addition to how ENSO expresses in western Indian Ocean SSTs.

6.5.2.b Mathmatical Tests of the ENSO and Precipitation Variability Hypothesis

Minitab® calculation of Pearson's R correlations between $\delta\ ^{18}O$ values from the Maiana Atoll (1°N, 173°E), Republic of Kiribati (Urban et al. 2000a, b) and Malindi (3°S, 40°E), Kenya (Cole et al. 2000a; Cole et al. 2000c) in annual intervals dating from 1840 – 1993 (n = 154 years). The results show a moderately positive correlation between the two datasets (see also Appendix B). A positive relationship is expected given that the during positive El Niño events, the high pressure ridge that dominates the western Pacific Ocean pushes warm tropical waters to the eastern Pacific Ocean and western Indian Ocean (Glantz 1996; Vranes et al. 2002; Xie et al. 2002). Thus, the $\delta\ ^{18}O$ record from

Kiribati and Malindi reflect corresponding 1-2° C warmer SSTs during positive (El Niño) years (Glantz 1996).

Correlation of Kiribati and Malindi = 0.414, P-Value = 0.000

TABLE IX. CORRELATION (PEARSON'S R) BETWEEN δ [18]O VALUES AT MALINDI AND KIRIBATI RECORDED BETWEEN 1840 – 1993 AT ANNUAL INTERVALS (FULL MATHMATICAL PROOF IS IN APPENDIX B)

The data confirm that teleconnections extend from the western Pacific Ocean across the Indian Ocean and are shown to at least nominally affect $\delta^{18}O$ records for a significant time period. The null hypothesis of this model is that no statistical correlation between $\delta^{18}O$ proxy records at the two locations should be found if teleconnections do not exist. The null hypothesis is disproven, although not significantly, and the data indicates that $\delta^{18}O$ coral records are reflecting a response to the same general climate mechanisms. The data leave open the interpretation that more mechanisms are at work than just ENSO (Camberlin et al. 2001; Camberlin and Philippon 2002; Clark et al. 2003; Cook 2001; Grotzner et al. 2000; Indeje and Semazzi 2000; Indeje et al. 2000; Jury et al. 2002; McHugh and Rogers 2001; Osman and Shamseldin 2002; Qian et al. 2002; Semazzi and Indeje 1999).

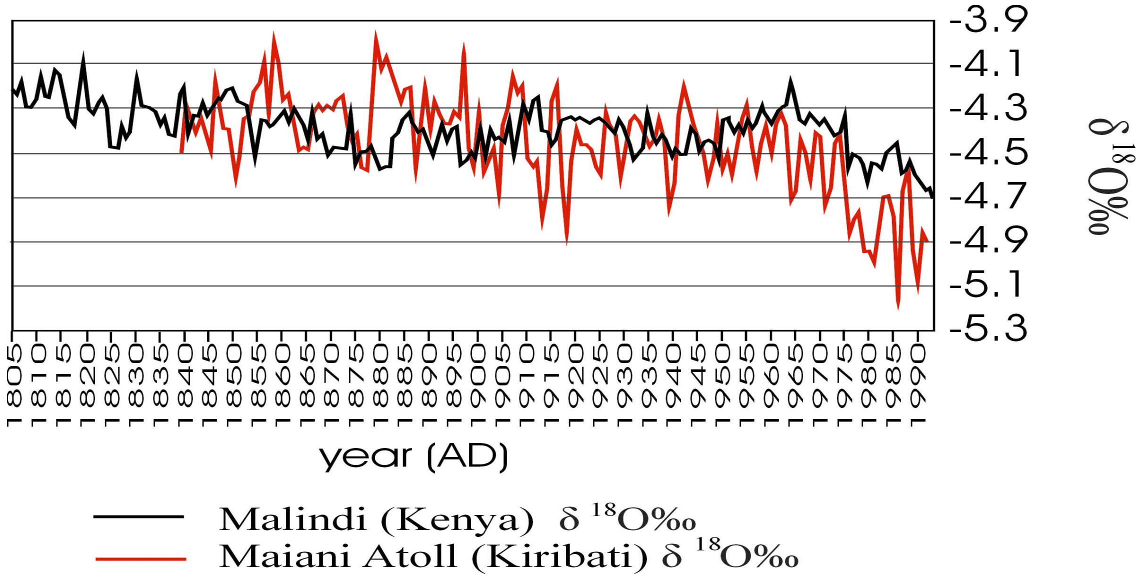

Figure 42. Plotted $\delta^{18}O$ values of Malindi and Maiani Atoll coral data

The results below show the Minitab® calculated Pearson's R correlations between rainfall anomalies ([*x* year's rainfall total/mean rainfall for all years measured]-1) at Malindi, Mombasa and Makindu (see also Appendix B). The results show strong positive correlations between rainfall totals at the three stations in the sample. However, there is a very weak overall correlation between SOI and precipitation in East Africa for the years studied.

TABLE X. CORRELATIONS (PEARSON'S R) OF ALL SOI ANOMALIES MODELED AGAINST PRECIPITATION ANOMALIES AT MAKINDU, MALINDI AND MOMBASA FROM 1961 – 1990 (APPENDIX B)

```
         Makindu   Malindi  Mombasa
Malindi   0.721
          0.002

Mombasa   0.682    0.892
          0.004    0.000

SOI      -0.101    0.113   -0.431
          0.671    0.676    0.096

Cell Contents: Correlation
               P-Value
```

The results below show the Minitab® calculated Pearson's R correlations between rainfall anomalies ([*x* year's rainfall total/mean rainfall for all years measured]-1) at Malindi, Mombasa and Makindu (see also Appendix B). SOI anomaly events that exceeded the first standard deviation for the years 1961 – 1990 (± 0.719 from a mean index value of –0.09867 compared to the 0-sum anomaly barometric pressure calculations from Papeete, Tahiti and Darwin, Australia since 1866) were excluded from the overall correlation coefficient calculation. The results show stronger positive correlations between rainfall totals at the three stations in the sample than when the total sample was tabulated. These results indicate that total precipitation values are 4% more positively correlated at Makindu/Malindi, 12% more positively correlated at Makindu/Mombasa and 8% more positively correlated at Malindi/Mombasa in non-ENSO years than during ENSO years.

TABLE XI. CORRELATIONS (PEARSON'S R) OF SOI ANOMALIES BEYOND 1 σ NOT REPRESENTED MODELED AGAINST PRECIPITATION ANOMALIES AT MAKINDU, MALINDI AND MOMBASA (1961 – 1990)

	Makindu	Malindi	Mombasa
Malindi	0.756		
	0.004		
Mombasa	0.804	0.966	
	0.003	0.000	
SOI	-0.003	0.096	-0.081
	0.991	0.704	0.814

Cell Contents: Correlation
P-Value

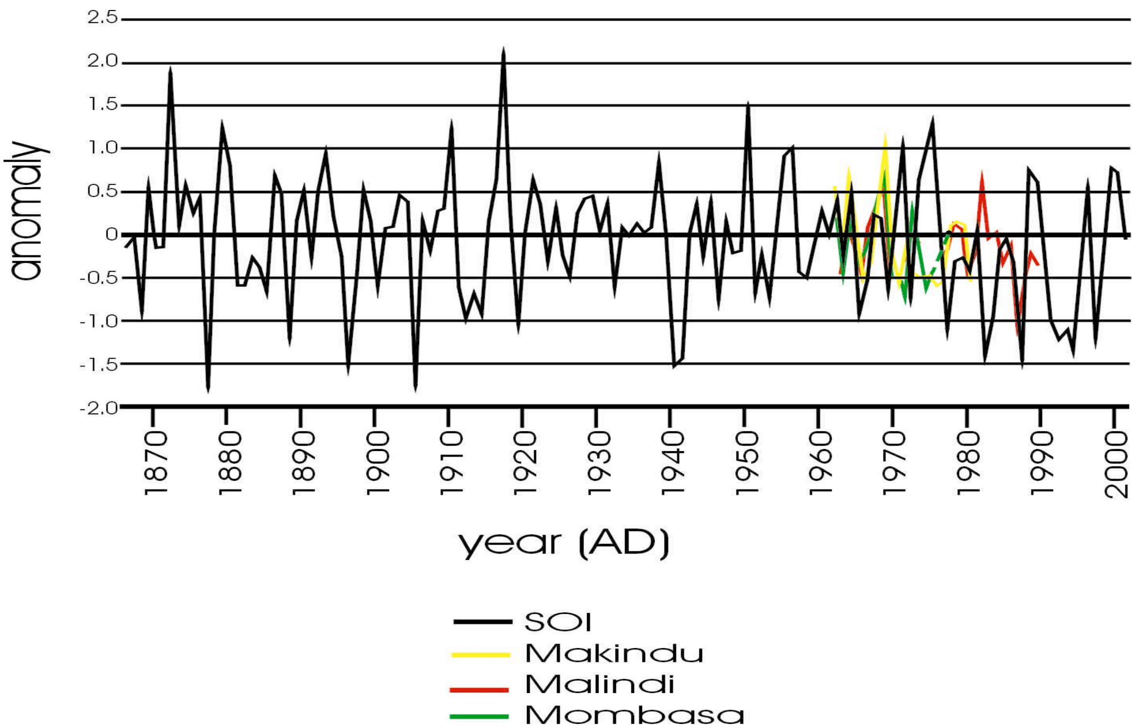

Figure 43. Rainfall anomaly data (standard deviations from the mean of annual rainfall) from Malindi, Mombasa and Makindu modeled with SOI anomalies

The results of the two Pearson's R correlations show significant positive correlations between mean annunal precipitation anomalies at Malindi, Mombasa and Makindu stations for all years for which data is available (n = 30). However, these positive correlation coefficients increase on the order of 4 – 12% if years in which SOIs that exceed 1 σ are removed from the dataset (removed n = 9). The data indicates that interregional precipitation variability in Tsavo increases during strong SOI events and is more predictable (positively correlated) when the SOI is between –0.818 and +0.620 (1 σ). These analyses agree with previous studies that argue that ENSO does not have a linear expression as either increased or decreased precipitation across the East African landscape, but rather expresses itself as high interregional variability of local weather conditions (Camberlin et al. 2001; Indeje et al. 2000; Ogallo 1988; Schreck III and Semazzi 2004). In the following sections, human responses to high or low climate variability in Tsavo as expressed by ENSO will be gauged against endoaquatic settlement patterns expressed in the archaeological record along the Galana River during the mid- to late-Holocene.

6.5.2.c Climate Variability as a Predictor of Forager Settlements along the Galana River

The earliest Eburran-stage foraging occupations of Kahinju (Kh1) occur during the period when a strongly seasonal climate is recorded and periodicities of ENSO events are relatively low, with <5 events occurring every 100 yrs (Figures 38 and 39; also refer to Chapter 3). Aridity measured for this period at Mount Kilimanjaro is variable, with some 50 yr intervals within the first standard deviation of occupation slightly drier than present while others are slightly more pluvial. However, it must be stated that the region as a whole is currently classified as semiarid and water is regarded as a scarce commodity amongst pastoralists and farmers who still live around the perimeter of the park (Chapter 5).

Later foraging occupations of Kahinju (Kh2) and Kathuva (Kt1, Kt2) occur when ENSO periodicity occurs between 0 and 15 events per 100 yrs. A dry phase is recorded in the $\delta^{18}O$‰ record at Mount Kilimanjaro at around 5,200 years B.P., but more pluvial conditions return by 5,000 years B.P. Because radiocarbon ages of this occupation were not obtained, it is difficult to discern precisely whether this occupation phase began during an arid or pluvial period. Generally speaking, periodicity in the ENSO cycle is low during the time periods delineated and correlations between the aridity proxy from

Mount Kilimanjaro and the site occupations at Kahinju and Kathuva lack sufficient resolution to determine whether inhabitation of the riparian landscape occurred during pluvial or arid conditions. It is sufficient to say that during occupations where there is no positive evidence for the presence of domesticated animals, climatic variability vis-à-vis ENSO periodicity was low and precipitation is not a predictive variable in so far as the evidence at hand allows.

Proxy data from other locations in East Africa indicate that regional climate conditions during the occupations that lack evidence for domesticated animals at Kahinju and Kathuva were generally wetter and warmer than present (Chapter 3). Regional climate conditions are generally recognized as having turned more arid between 4,000 and 3,000 years B.P. (Bonnefille and Chalié 2000; Gasse 2000). A strong dust spike detected in sediment analysis of the Kilimanjaro ice core at ca. 4,000 years B.P. indicates that eolian activity generally associated with pronounced aridity is detected in the atmosphere (Thompson et al. 2002b). Likewise, proxy data from East African lake systems and show an abupt shift to arid conditions after 4,000 years B.P. (Beuning et al. 1997b; Gasse 2000; Ricketts and Johnson 1996; Stager and Johnson 2000a). The evolution of strongly seasonal climate conditions is traced from Lake Victoria after 7,800 years B.P. and is detected until 2,200 years B.P. (Stager et al. 1997a; Stager and Mayewski 1997). However, how these proxy data relate to environmental conditions in Tsavo at this time remains unclear.

At other archaeological sites in East Africa, foragers are documented as periodically relying on an exploiting an endoaquatic food base (Gifford-Gonzalez et al. 1999). Typically, foragers migrate in response to cyclic availability and distribution of resources (Kusimba 2003; Marean 1997; Stephens and Charnov 1982; Winterhalder 1981), and predation on endoaquatic products was a crucial factor in early human settlement patterns (Mannino and Thomas 2002). During this time period, settlement adjacent to a fluvial system would not have necessarily occurred only during an arid period. During the rainy season in Tsavo, bovids disperse away from the permanent bodies of water in search of new pasture (Leuthold and Leuthold 1973). Therefore, the predictability of that particular resource is greatly diminished close to a permanent water body. However, other species such as crocodiles (*Crocodilus niloticus*), hippos (*Hippopotamus amphibus*), fish and freshwater mollusks remain a dependable meat source living in the riverine environment when ungulates are unobtainable (Chapter 7).

Based on the archaeological evidence available, site occupations during Kh1, Kh2, Kt1, Kt2 do not appear to have been multi-seasonal given the paucity of artifacts recovered from test units on these terraces. It is possible that the Galana River was part of a seasonal migration strategy utilized by humans and animals during the early to middle Holocene. Based on ethnoarchaeological data from foragers occupying strongly seasonal climates, high mobility is commonly employed in pursuit of seasonally available resources (Binford 1991; Mutundu 1998; Winterhalder 1981). In a seasonal climate, the availability of game adjacent to the Galana River would have occurred only several months in a given year. At the end of the dry season, there would have been little incentive to settle next to the Galana River when the majority of wild resources were to be found away from its banks.

6.5.2.d Climate Variability as a Predictor of PN Settlements along the Galana River

Occupations after 3,500 years B.P. where bones from domesticated animals are found in limited quantities (Kh3, Kh4, Kh5 and Kt3, Kt4, Kt5) occur when the global ENSO periodicity is >5 events per 100 yrs, and when $\delta^{18}O$ on Kilimanjaro generally registers <9.3‰.[16] With the exception of Kt2, occupations detected after 3,500 years B.P. along the Galana River bear evidence of domesticated stock and utilize stone tools and ceramics characteristic of PN people. In this environment, predicting when and where a group could find the resources necessary its survival would have been difficult away from the river. However, aggregation proximal to a river has the advantages of providing a permanent water source for domestic animals and presenting easy predation opportunities on wild fauna who would have been drawn to the river to quench their own thirst. The reliance on endoaquatic resources through all phases of occupation corroborates that the river was an important resource for the inhabitants of both Kathuva and Kahinju (see Chapter 7).

Occupation of both sites appears not to conform to the pattern that is expected of seasonally mobile pastoralists, but rather represents a more permanent form of occupation (cf. Stein et al. 2002). Campsites of nomadic pastoralists are generally small and leave little artifactual traces in the ground owing to the ephemeral nature of the occupations (Barker et al. 1990; Binford 1991; Binford 1977; Conte 1991; Cribb 1991; Hassan 1978a, b; Hole 1974). The discovery of several large ceramic vessels (see Chapter 9) as well as faunal elements taken from large, wild bovids (Chapter 7), which would have been very difficult to transport, supports this hypothesis. With the exceptions of occupation layers

[16] Thompson et al. (2002a, 2002b) report that the modern $\delta^{18}O$ level on Mount Kilimanjaro is 9.3‰. We can therefore interpret $\delta^{18}O$ values <9.3‰ as wetter than present and values >9.3‰ as drier than present conditions.

Kh1, Kh2 and Kt1, artifact densities suggest that the sites were occupied for a time period that exceeded one season.

Owing to the suitability of the location to both pastoral and foraging pursuits, relatively intense occupations may have persisted into pluvial periods. The greatest obstacle to pastoral inhabitation of the river margins in Tsavo is the presence of copious amounts of tsetse flies (*Glossina* sp.) whose habitats are the shady riparian forests that line the Galana River and its tributaries. Tsetse flies present a significant health risk to both humans and livestock because they carry the disease trypanosomiasis, or African sleeping sickness, which causes paralysis and eventual death of the host (Majiwa et al. 1993). Some believe that they were a major factor in precluding the movement of domesticated stock through sub-Saharan Africa until the late Holocene (Gifford-Gonzalez 2000; Pennington 1997). However, evidence for burning found at both Kahinju at Kathuva indicate that a deliberate attempt was made to burn the overbrush—possibly to eradicate the habitat of the tsetse fly (Figure 44). This phenomenon has been witnessed at PN sites and in ethnographic examples from East Africa (Marean 1997: 191; Reckers 1992: 22). Fire has also been used as a tool to facilitate hunting and was documented as a common practice in the Tsavo region by early European explorers in the late nineteenth century (New 1971 [1873]).

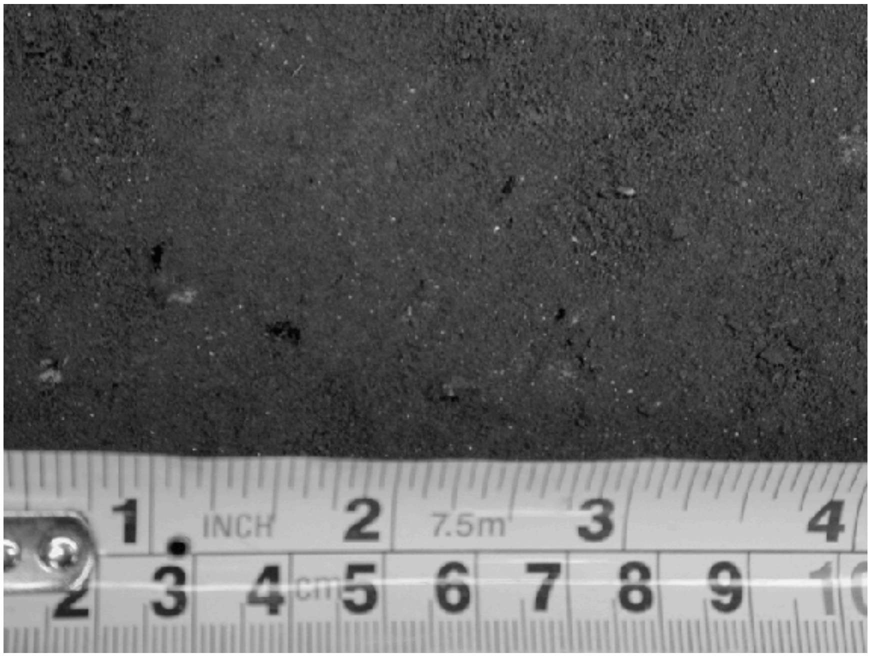

Figure 44. Burning lens at Kahinju

The site occupation patterns suggest that after the sites' inhabitants are confirmed as possessing domesticated animals, settlements shift from ephemeral to multiseasonal with a strong emphasis on utilization of an endoaquatic resource base. Archaeological interpretations are augmented with available paleoclimatic data, which suggest that East African climate was less seasonal than during the middle Holocene and strong ENSO periodicity would have made resources difficult to predict away from the margins of a permanent water body. The data indicate that investment in non-portable infrastructure such as ceramics and brush clearing occurred. Later inhabitants of the sites who have evidence as possessing domesticated animals also discard higher quantities of fauna, lithic and ceramic artifacts than earlier foraging occupations.

6.6 Summary of Galana River Mid- to Late-Holocene Geoarchaeology

Inhabitation of Kahinju and Kathuva occurred when the Galana River was aggrading. Evidence of a generally aggrading fluvial system is traced to the first landform on T1 dating to 5,960 ± 480 years B.P. and continues until a downcutting system begins after 940 ± 70 years B.P. These ages fit well into the data set from Kathuva as well, with the last known occupation associated with the vertically accreting T2 occurring between 1,310 and 1,410 years B.P. Downcutting and the resulting erosion of the site occurred at an unknown period after final site abandonment, and likely occurred at or near the same time that downcutting is recorded at Kahinju (ca. 1000 years B.P.). Figure 45 illustrates the aggradational sequence associated with human occupation episodes at Kahinju. This model is equally applicable to Kathuva where compared radiocarbon and luminescence ages show little lag time between sediment deposition of an occupation horizon and discarding of charcoal and other artifacts into the sediments.

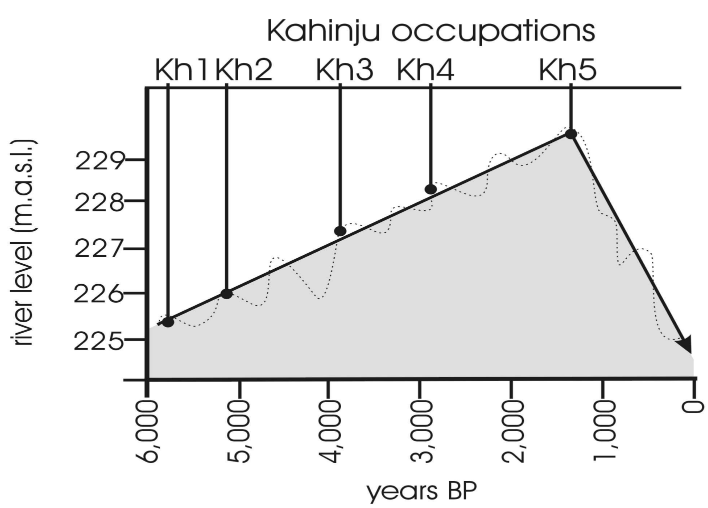

Figure 45. Model of human occupations along the Galana River since 6,000 years B.P. correlated with the aggradational sequence at Kahinju

The downcutting that has occurred over the last ~1,000 years is interpreted as the primary erosion control on the sites and has positive and negative implications for future archaeological investigations. The positive effect of erosion associated with incision of the terraces is that it exposed artifact-bearing landforms that would have otherwise been buried and undiscovered (Brown 1997: 34). However, the erosion of the sites has been pervasive and threatens to completely destroy their archaeological integrity.

Unfortunately, not enough data exist to hypothesize why these two settlements were occupied multiple times over such a long time period. Survey work of the Galana River is ongoing and a representative and comprehensive study sample of Neolithic settlements adjacent to this fluvial system is needed in order to determine what factors influenced the perceived attractiveness of certain locations to prehistoric people. The fact that the Galana River is the only watershed for thousands of square kilometers certainly makes it an alluring feature for settlement compared to the surrounding landscape. Undoubtedly, the lateral migration of the Galana River has buried and eroded many such sites and so building a distance parity model that explains access to and availability of resources and proximity of sites to one another in space and time will be limited by the data set that is assayed in future surveys.

Future projects at the sites of Kahinju, Kathuva and Mwiitu will focus on expanding the geomorphological study. The site of Kahinju was determined to extend ~700 meters along the banks of the Galana. Further work is needed to date the complete terrace sequence and determine whether single occupations of this site cover the entire range in which the artifacts are found. Artifacts at Kathuva and Mwiitu are found eroding only from scarps extending <300 m along the Galana River. However, considerable portions of these sites are buried under alluvium and the probability for discovering intact subsurface features is high if ample sediment is removed by means of mechanical excavation.

Chapter 7. Fauna

7.1 Introduction

One of the most important endeavors in analyzing an archaeological site is to assess the diets of the inhabitants within a clear geomorphic context. Chapter 6 argued that the Galana River was a magnet for humans during periods of acute climate stress (i.e. high periodicity in ENSO and generally more arid conditions in East Africa). The geomorphology of the sites of Kahinju and Kathuva reflect five separate cultural occupations at each site occurring over ~4,700 years. Besides providing a permanent water source, it is my hypothesis that the ability of the river to attract a wide array of endoaquatic fauna made settlement proximal to the Galana River particularly inviting at times when resources elsewhere on the landscape were not predictable.

This chapter will review interpretations from other PN faunal assemblages in East Africa and then examine the faunal assemblages from the sites I excavated in 2001 and 2004 in order to detect changes in the culling strategies of the PN inhabitants of Tsavo, Kenya. Nowhere else in East Africa has such a deeply stratified sequence of PN occupations been reported. Therefore, this faunal analysis is concerned with documenting species diversity, evaluating the spatial integrity and identifying taphonomic factors that may influence potential human behavioral inferences based on the assemblages (*sensu* Widga 2004). The advantages and limitations of framing the discussion in this manner will be presented and discussed in light of the excavation methodology and research objectives.

7.2 The PN of East Africa—A View from the Bones

Identification of genus and species of faunal elements recovered from archaeological sites in Africa are difficult to make because of the numerous taxa of wild ungulates that possess similar diagnostic attributes to each other and to domesticated stock (Brain 1981). Classification of archaeological fauna is further complicated by the fact that the lines between pastoralists and foragers are very fluid (Chapter 2), thus there is an expectation for strongly mixed faunal assemblages. Teeth are most commonly used for identifications of species among East African faunal assemblages (e.g. Gifford et al. 1980; Gifford-Gonzalez 1985; Marean 1992; Marshall 1990a, b, c; Marshall et al. 1984; Phillipson 1984; Simons 2004). Nevertheless, the faunal identification process is exceptionally arduous in Africa and must be undertaken with a large comparative collection and by individuals with years of training and experience.

Marshall (2000) argues that PN assemblages are heavily fragmented and are therefore very difficult to identify. At Ngamuriak, only 0.4% of an assemblage of >60,000 faunal artifacts were identifiable. In a recent analysis of Sugenya (two ^{14}C ages generated date the site to 2,200 – 2,700 years B.P.) and Oldorotura 1 (~2,000 years B.P.), Simons (2004) detects a similar pattern of fracturing among faunal material. Marshall (2000) attributes the high degree of fracturing of PN assemblages to cultural rather than taphonomic factors. Heavy processing of available meat implies that it was not a resource that was wasted or taken for granted.

Marshall (2000) argues that assemblages like those at Prolonged Drift (Chapter 4), where wild animals outnumber the number of domesticated species, may be indicative of an early form of stock theft. Amongst historic-era pastoralists in East Africa such as the Maasai, cattle theft is a common procurement strategy (Galaty 1991). Even in modern times, raiding between Rendille and Samburu pastoralists occurs despite the Kenyan government's best efforts to end it (Fratkin 1994). Unfortunately, the assertion that stock theft was a means of the early spread of pastoralism through East Africa remains untestable, but an interesting point to consider nonetheless.

7.3 Faunal Artifact Assemblages of Tsavo Sites

Ideally, statistical comparisons of MNI and NISP counts would be generated to show the dietary preferences of the inhabitants of the sites of Kahinju, Kathuva and Mwiitu. If human predatory patterns exhibited a preference toward endoaquatic fauna and included a high proportion of skeletal elements that were not easily transported great distances, then the hypothesis would be accepted. If the faunal assemblages reflect heavy reliance on a single, non-mobile resource, such as domesticated cattle, and skeletal elements from wild taxa were represented predominantly by limbs, which are easily transported great distances, then the null-hypothesis would be accepted.

The current dataset exhibits that the inhabitants of Kahinju and Kathuva engaged in a broad-based subsistence strategy, but MNI counts were too low to exhibit the degree to which relative dependence on certain species existed (Reitz and Wing 1999). The paucity of diagnostic faunal material from Mwiitu makes any conclusions regarding general subsistence strategies employed at this site impossible to ascertain. It has been discussed in preceding chapters that selection of test units were based on preservation of the terrace visible from erosion. This excavation strategy successfully maximized our potential to elucidate past human occupations but is clearly non-random and statistically biased (Ebdon 1985; Flannery 1976a). Buried under >2 m of eolian and fluvial deposition, I was incapable of the defining the geographical extent of the sites' material culture distribution without excavating large trenches, which would have had a statistically low probability of yielding primary cultural deposits (e.g. Flannery 1976b). Therefore, this chapter will present a qualitative description of the faunal assemblages of Kahinju, Kathuva amd Mwiitu and offer directions that forthcoming research initiatives should pursue if the ultimate goal is to obtain statistically non-biased assemblages. Appendices C and D offer the complete faunal dataset from Kahinju and Kathuva, which are presented for consideration by future archaeologists working along the Galana River.

Because most of the artifacts were recovered from non-randomly stratified sample sets at the sites of Kahinju, Kathuva and Mwiitu, it is impossible to evaluate diet change through time with any statistical certainty. Therefore, the dataset reveals aspects of subsistence and technology that cannot be viewed as necessarily *representative* of the entire unexcavated assemblage, but are nonetheless windows into prehistoric activities that occurred along the Galana River in the mid- to late-Holocene. However, the tables below demonstrate that dietary diversity was probably an important survival strategy to the early pastoralists living along the Galana River. Based on the available evidence, reliance on a combination of wild and domesticated products remained an important survival strategy throughout the numerous occupations of the sites.

Modes of subsistence can be difficult to identify archaeologically because multiple, overlapping occupations can be found at the same site that confuse the archaeological signatures of each occupation (Maggs and Whitelaw 1991). This is particularly the case in colluviated sites where distinct cultural levels can become mixed during erosion processes (Brown 1997). However, it has been demonstrated in Chapter 6 that terrace aggregation was the dominant surficial process at both sites and artifacts entrained in the sediments of these landforms were *in situ* depositions. Therefore, the separation of faunal material into distinct geomorphically defined time periods is a viable undertaking at these sites.

Table XII shows the recovered faunal assemblage from the sites of Kahinju, Kathuva and Mwiitu. Kyenze Paul Watene, a staff archaeologist at the National Museums of Kenya, performed identification of faunal remains. All identifications were made on the basis of individual elements and were later transferred into a database and organized by taxa. In all cases, conservative identification of genus and species were made due too the frequent uncertainties of the element being identified.

TABLE XII: MNI COUNTS FOR 2001 AND 2004 EXCAVATIONS

Kahinju

MNI	**Genus**	**Species**	**Common Name**
2			Bovid 2
2			Bovid 3
1			Bovid 4
1	*Syncerus*	*Caffer*	Buffalo
1	*Madoqua*	sp.	Dik dik
2	*Bos*	*taurus*	Domesticated cattle
1			Fish
1	*Giraffa*	*camelopardis*	Giraffe
1	*Gezella*	*Granti*	Grant's gazelle
1	*Hippopotamus*	*amphibius*	Hippopotamus
1	*Aepyceros*	*melampus*	Impala
1	*Leo*	*Leo*	Lion
1			Snake
1	*Cercopithecus*	*aethiops*	Vervet monkey
1	*Suid*		Warthog
1	*Equus*		Zebra

Number of bone fragments = 2,104

TABLE XII: MNI COUNTS FOR 2001 AND 2004 EXCAVATIONS (CONTINUED)

Kathuva			
MNI	**Genus**	**Species**	**Common Name**
3	*Aepyceros*	*melampus*	Impala
1	*Alcelaphus*	*buselaphus*	Hartebeest
1			Bird
1	*Bos*	*taurus*	Domesticated cattle
1			Bovid 1
4			Bovid 2
2			Bovid 3
1			Bovid 4
1	*Crocodilus*	*niloticus*	Crocodile
4	*Madoqua*	sp.	Dik dik
1			Fish
1			Monkey
1	*Syncerus*	*caffer*	Buffalo
1			Tortoise
Number of bone fragments = 3,403			

Mwiitu			
MNI	**Genus**	**Species**	**Common Name**
1	*Neotragus*	*moschatus*	Suni
1			rodent
Number of bone fragments = 324			

TABLE XIII. MNI COUNTS BY OCCUPATION LEVEL

Occupation	**Taxa**	**MNI**
Kh1	Bovid 2	1
	Bovid 3	1
	Madoqua sp.	1
Kh2	Bovid 2	1
	Bovid 4	1
Kh3	*Aepyceros melampus*	1
	Bos taurus	2
	Bovid 2	1
	Bovid 3	1
	Bovid 4	1
	Hippopotamus amphibius	1
	Leo leo	1
Kh4	Bovid 2	1
	Bovid 4	1
	equid	1
	Gezella granti	1
	Lizard	1
	Suidae	1
	Syncerus caffer	1
Kh5	*Bos taurus*	1
	Bovid 2	1
	Bovid 3	1
	Bovid 4	1
	Madoqua sp.	1
	Equus sp.	1
	Fish	1
	Hippopotamus amphibius	1

TABLE XIII. MNI COUNTS BY OCCUPATION LEVEL (CONTINUED)

Occupation	**Taxa**	**MNI**
Kt2	*Aepyceros melampus*	1
	Alcelaphinae sp.	1
	Avian	1
	Bos taurus	1
	Bovid 1	1
	Bovid 2	2
	Bovid 3	1
	Bovid 4	1
	Crocodilus niloticus	1
	Madoqua sp.	1
	Fish	1
	Monkey	1
	Syncerus caffer	1
	Tortoise	1
Kt3	Bovid 2	1
	Madoqua sp.	1
Kt4	Bovid 2	1
	Bovid 3	1
	Madoqua sp.	2
Kt5	*Bos taurus*	1
	Bovid 1	1
	Bovid 2	1
	Bovid 3	1
	Madoqua sp.	2

Occupation	**Taxa**	**MNI**
Mw1	Bovid 1	1
Mw2	*Neotragus moschatus*	1
	rodent	1

7.4 Interpretations of Faunal Data from Tsavo

Minimum Number of Individual (MNI) counts were made on the Tsavo 2001 assemblages using the methodology first proposed by White (1953). This approach is based on the understanding that vertebrate skeletal morphology is symmetrical on the right and left sides of the body. The skeleton can thus be divided along the midline and identifications of skeletal elements can be compiled based on their provenience on the body. The minimum number of species counted is based on the greatest number of identified elements that come from the same bone in the body (White 1953). In the case of the Kathuva 2001 assemblage, hundreds of individual elements from dik dik taxa were found during occupation Kt4. However, the MNI is 2 individuals based on the discovery of two right astralagi from the hindlimb with no other overlapping elements identified. It must be emphasized at this point that the MNI does not represent the total number of different taxa recovered from an archaeological assemblage—it is only the minimum of the identifiably separate individuals (e.g. Reitz and Wing 1999).

The ultimate goal of creating a large dataset of MNIs at the sites excavated in Tsavo in 2001 was hindered by difficulties in identifying faunal material. Appendix A includes antelope classes from Africa with their associated weight ranges and common names (Brain 1981). With such a broad range of wild and domestic bovid species, identification of taxa in Africa is challenging because the high number of bovid species that inhabit the landscape (Klein and Cruz-Uribe 1984: 43). Each of these animals has a different ethology and migration behavior, which affects the interpretation of the potential range of human responses in procuring the animals (Delany and Happold 1979; Netting 1977).

The faunal assemblages of Kahinju and Kathuva should be approached carefully. At first glance, the MNIs represented are low and do not seem to represent a site that was occupied intensively or for a long time. However, most faunal elements were fragments that were unidentifiable and the total sample size of the excavations was relatively low (Chapter 5C). Additionally, the giraffe faunal material was not in a clear geomorphic context and may have been transported to the site by fluvial processes. The presence of hippopotamus and crocodile faunal material is in a clearer context, but was represented only by teeth, which are known to be decorative items and not necessarily reflective of dietary practices.

7.4.1 Faunal Assemblage of Tsavo Sites in Context—Food Production

The best context for early indigenous domestication of cereal grains is in Ethiopia (tef, millet) from approximately 2,200 years B.P. (Phillipson 1993b). However, little direct evidence has been found of grain cultivation due to preservation and so much of the data is based on indirect evidence (Phillipson 1993b). In many parts of the world, the introduction of agriculture and pastoralism are intrinsically linked to one another (e.g. Reddy 1997). However, Phillipson (1982) argues that agriculture and pastoralism in Africa are often found encroaching on new territory at roughly the same time, but they are not "invariably linked."

Likewise, the spread of food production is often associated with an end to foraging subsistence strategies (Baruch and Bottema 1991; Flannery 1973; MacNeish 1992; Price 1995; Reed 1977; Watson 1995). However, Nelson and Kimengich (1984) show that for 3,500 years the presence of pastoralists and agriculturalists did not affect the lifestyle of foragers at Lukenya. Lukenya had a high floral and fauna biomass during forager occupations that date to the approximate time period of the MHCO (Marean 1997). Mobility was generally low during the early occupations given the ample biomass in close proximity to the site (Kusimba 2003: 178). Settlement of Lukenya during the later Holocene involved high mobility as exhibited by the presence of numerous imported obsidian stone tools and could have been necessary due to the lack of locally available prey (Kusimba 2003). Similarly, the PN site of Prolonged Drift relied primarily on wild animals even though domesticates are present throughout the occupation of the site (Gifford et al. 1980).

Today, Kenyan forests and montane regions do not contain areas of highly productive edible plants—a situation that forces foragers to trade their goods with pastoralists (Ambrose 1984b; Gifford-Gonzalez 1998b; Marean 1992; Mercader 2002; Vincent 1985). Traditionally, pastoralists occupy (more productive) grasslands and marginalize the indigenous hunting and gathering populations (Marean 1997). Thus, prior to the introduction of livestock, full-time foraging was a viable option, but subsequent to the invasion of pastoralists onto the savanna, foraging options are limited *de facto* forcing more foragers to adopt a pastoral lifestyle. Herding changes the types of vegetation available on the landscape and forces wild ungulates away from territory that pastoralists occupy (Talbot 1964). Furthermore, foragers are not able to compete with highly organized pastoralists militarily and were forced to watch as their ecological niche was destroyed (Marean 1997; Mutundu 1998).

Pastoralism is generally associated with low species diversity in the archaeological fauna material (Marean 1997: 212). In general, faunal material recovered at early PN sites are primarily wild animals while domesticated animals represent the greatest majority of fauna the assemblages at Elmenteitan and Narosuran sites (Bower 1991). However, after domesticated animals appear at Dongodien, hunting virtually ceases but fishing continues (Barthelme 1985). Despite their proximity to Lake Naivasha, the occupants of Masai Gorge relied very little on aquatic resources (Ambrose 1985). Highly specialized pastoralism takes root in Rift Valley from 3,000 to 2,000 years B.P. (Bower 1996; Marshall 1990c). For example, the faunal assemblage of Ngamuriak is comprised of 98% domesticated animals (Marshall 1990c).

Early pastoralists engaged in multiple subsistence strategies (including hunting and fishing) (Galaty 1991; Koster and Chang 1994). However, after agricultural practices were adopted in East Africa, an opportunity was provided for both subsistence groups to specialize in cattle and agricultural production (Ambrose 1984b; Galaty 1991; Robertshaw and Collett 1983a, b). Foraging among pastoral groups continued, but as time passed, fewer animals were hunted (Phillipson 1982) and presumably wild plant foraging became less significant. Early Chinese explorers to the East African coast record the presence of specialized pastoralists before A.D. 863 (Galaty 1991). Based on the archaeological evidence available, it is safe to say that the faunal assemblages from Kahinju and Kathuva do not represent that of a specialized herding economy. The presence of wild taxa throughout all occupations of the site conforms to a generalized foraging/herding strategy commonly found in early PN settlements.

One last scenario to explain the presence of domesticated animals on the sites of Kahinju and Kathuva must be discussed. Ambrose (1984b: 314) speculates that foragers of Enkapune ya Muto stole or traded for the domesticated animals present at the site. This interpretation is not implausible and must be explored in more detail in subsequent field seasons. Higher MNI representations would greatly assist in determining whether the presence of domesticated animals is anomalous or representative of a herding culture per se.

7.4.2 Faunal Assemblage of Tsavo Sites in Context—Food Foraging

The faunal assemblages from Kahinju, Kathuva and Mwiitu are difficult to interpret due to the relatively small MNIs recovered from *in situ* archaeological deposits. However, two preliminary conclusions can be drawn based on the available data.

1. Wild animals continue to be culled after evidence of domesticated animals is found on the site.
2. Prey includes a wide array of fauna ranging from mollusks to small and large mammals.

It has been argued that pastoral specialization is a relatively recent phenomenon (Bower 1997). Although some archaeological assemblages clearly show the existence of specialized a PN after 2,600 years B.P. (Ambrose 1984b; Bower 1991; Marshall 1990c), hunting remained an important staple of the subsistence regime of many East African people through the late 20th century (Almagor 1978; Dyson-Hudson 1972b; Galaty 1991; Kusimba 2003; Lindblom 1969; Massam 1968; Roscoe 1966; Schweinfurth 1969 [1873]; Taylor 1962). Hunting by people who labeled themselves pastoralists was not always opportunistic—organized parties of hunters were assembled for the express purpose of killing a wild animal for consumption (Smith 1992b). However, hunting is a high investment of labor and a risky undertaking that must be deemed worthwhile compared to other potential subsistence activities (Lee and DeVore 1968). I contend that hunting occurred close to the base camps of Kahinju and Kathuva and was focused on procuring game that came to the river to drink or seek forage.

The migration patterns of wild ungulates tend to be irregular and therefore unpredictable (Talbot and Stewart 1964). Seasonal migration routes follow rainfall and water availability, which in an environment like Tsavo, can be very erratic (Leuthold 1977; Leuthold and Leuthold 1973). However, during severe aridification events migration becomes more predictable and tied to a permanent water source (Aiyedun 1996). This is particularly the case for browsers who will feed on riparian forest products in the absence of other forage (Leuthold and Leuthold 1972).

Predation on small mammals such as dik diks (*Madoqua* sp.) or sunis (*Neotragus moschatus*) is found in most occupation horizons of the sites. Smaller mammals have lower return rates (in terms of energy input/output ratio) than larger mammals in open plains hunting potential (Ambrose 1984b: 17). Thus, animals such as dik diks are not generally procured on long-distance hunting expeditions due to their generally low return rate (Szuter and Bayham 1989). Other taxa including monkey, hippopotamus, freshwater mollusk, fish and crocodile would also have been caught in or near the river.

Furthermore, the high proportion of faunal elements that are not easily transported indicate that hunting of wild animals was not necessarily undertaken at great distances from the base camp (Fullagar 2003/2004; Perkins and Daly 1968; Redding 1994: 287). Studies among the Hadza of Tanzania indicate that elements such as heavy head and limb bones are not transported great distances from the kill site. Rather, time is taken at the kill site to remove the meat from the bone, package only the consumable portions of the animal and transport the meat to the home base where it can be redistributed throughout the community (Fullagar 2003/2004). Appendices C and D comprise the entire faunal analysis from the 2001 Tsavo field season. Due to the high number of fragmented elements, a statistical study of the MNE (minimum number of elements) comparing long bones and other elements such as sternums, skulls and pelvises would be unfruitful (see for example Gifford-Gonzalez 2003: 92-93).

It was impossible to quantify the amount of mollusks recovered from the archaeological assemblages. Freshwater specimens recovered were highly fractured, and there is no evidence of processing (burning, cutting) on any of the specimens. Terrestrial mollusks bore some evidence of processing (e.g. Figure 46) and were highly fractured as well. These lines of evidence suggest that mollusks played an important role in supplementing the diets of the inhabitants of Kahinju, Kathuva and Mwiitu. The terrestrial mollusk assemblage at Mwiitu was heavily processed and appears to have been an extremely important component of the diet of the site inhabitants. The lack of evidence of processing of the freshwater specimens is problematic toward this interpretation, and it is possible that they were deposited during terrace formation. However, given the evidence for consumption of terrestrial specimens, it is highly probable that freshwater specimens were consumed, but processed differently than their terrestrial cousins. Ethnographic examples of freshwater mollusk exploitation abound from Africa (Evans 1969) and there is little probability that this resource was ignored while terrestrial species were consumed.

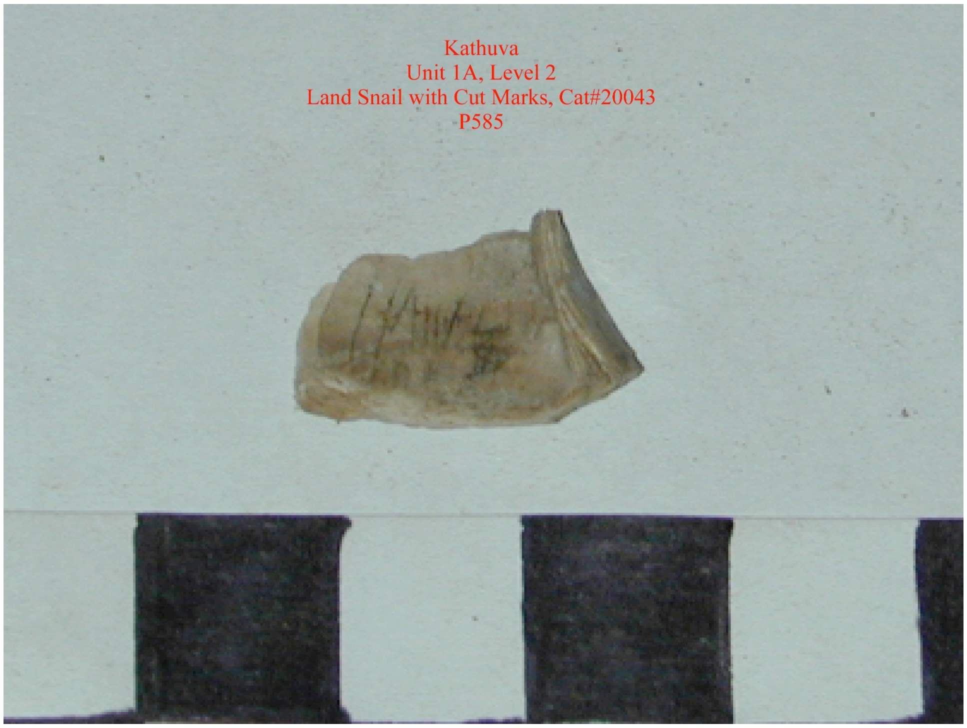

Figure 46. Terrestrial mollusk with cutmarks

Fish vertebrae were also recovered from Kahinju and Kathuva. Most of the fish found at Mijikenda archaeological sites are mudfish, which was locally available in the rivers (Mutoro 1987: 248). Other small game such as birds, tortoises, lizards and monkeys are found in limited numbers at Kahinju and Kathuva, but may be represented in low proportions due to possible carnivore activity at the site. Small game taxa such as fish, birds and small mammals are known to preserve poorly at sites where carnivores are present (Lyon 1970). Many faunal elements show evidence of carnivore damage (Appendices C and D), although it is impossible to say whether this occurred subsequent to abandonment of the site by hyenas (*Hyena hyena* and *Crocuta crocuta*) or by domesticated dogs (*Canis familiaris*) that lived on the site.

Sibel Barut Kusimba (2003: 217-220) reports faunal material from a later context in excavations at Kisio Rockshelter in Tsavo West National Park. The vast preponderance of identifiable taxa is from small mammals, reptiles, birds, mollusks and amphibians (S. Kusimba and Kusimba 2003). This site is interpreted as an ephemeral occupation due to the lack of a permanent water source in the immediate environs (S. Kusimba 2003: 221). Unfortunately, Thorbahn (1979) does not present his faunal data, which represents the only published report of LSA material excavated from Tsavo East National Park.

It is important to recognize that meat is not the most significant contribution of calories to most foragers' sustenance. Based on ethnographic studies of modern Hadza foragers, wild plants comprise the vast majority of their total caloric intake (Murray et al. 2001; Vincent 1985). In the riverine environment along the Galana, there are many plants available, which are palatable. A. Donaldson Smith (1969 [1896]: 38) records that fruits from doum palms (*Hyphaene coviacea*) were eaten as a common subsistence food. The fruits are hard and pithy, but have a taste similar to gingerbread (Smith 1969 [1896]). The Hadza are also known to exploit wild tubers that grow along the margins of the fluvial systems that drain into Lake Eyasi (Vincent 1985). Wild date palms (*Phoenix reclinata*) also produce edible fruits that are exploited by human and animal populations especially during the dry season (Wijngaarden 1985). Further from the river, the fruits of baobab trees (*Adansonia digitata*) can be consumed (Kusimba 2003: 40) and today remains palatable treats for many modern African children. The Waata are also documented as consuming raw wild berries such as *Grewia* sp., *Manilkara* sp., *Cordia sinensis*, *Euclea* sp., *Vangueri madagascariensis* and cooking *kumude* (*Lannea elata*) and *k'osaye* (genus/species unknown) (Ville 1995). The Waata also are documented as making flour from the resin of acacias and other seed-bearing trees (Ville 1995). *Acacia tortilis* and the fruits of *Acacia nilotica* also provide important fodder for livestock in times of drought and are particularly important to facilitate bovine lactation during the dry months among the Borana (Menwyelet et al. 1994).

7.5 Conclusion

This chapter has presented interpretations of the faunal material recovered from Kahinju, Kathuva and Mwiitu. Interpretations have been limited by the non-randomness of the test trenches excavated, the inability to place some elements into a clear geomorphic context and the relatively low number of diagnostic elements recovered. However, the conclusion the 2001 field season is that the diets of the inhabitants of Kahinju and Kathuva were broad-based and may have included plants and domesticated cattle. The presence of endoaquatic species in the faunal assemblage indicates that the river was an important resource in the predation strategy of the inhabitants of these sites. Low meat-yielding faunal elements (following Redding 1994) suggest that wild animals were likely procured nearby the base camp and group mobility was not very high during site occupation. Multiple successive occupations at Kahinju and Kathuva, where the faunal assemblages are relatively high, indicate that there is no shift toward an increasing reliance on domesticated animals as has been witnessed at other locations throughout the East African PN. Instead, reliance on a broad subsistence base continues throughout the Late Holocene. These interpretations are tentative and deserve further testing in subsequent field seasons in a randomized sample of excavation trenches. This methodology will allow statistically meaningful interpretations to be made of dietary and mobility practices throughout the Middle and Late Holocene at these sites.

A model of mobility and resource exploitation is presented in this chapter that can be used in subsequent analyses within not only Tsavo, but throughout East Africa. Early pastoral mobility strategies and the ratio between which PN communities relied on fully domesticated products and managed wild resources (a.k.a. domesticated landscape) are important tools to understand the conditions under which early protodomesticates were nurtured. This research elucidates the relationship between past lifeways and potentially applies to modern pastoralists who have come under increasing pressure to adapt to new environmental circumstances and broaden their subsistence options in the face of a constricted resource base.

Chapter 8. Lithics

8.1 Introduction

This review of the archaeological lithic assemblages recovered during the 2001 and 2004 field seasons in Tsavo National Park are intended to provide a background for understanding the material context of late Eburran through Pastoral Neolithic occupations found in Tsavo National Park. The archaeological assemblages from Tsavo augment our current understandings of stone tool production in East Africa. Previous researchers have found that microliths dominate tool assemblages at sites where wild animals represent the majority of faunal material and scrapers and hide processing tools are found in association with high proportions of domesticated animals (Barut-Kusimba 1999). However, the data presented here concurs with previous LSA intrasite analyses from East Africa (Mehlman 1989; Mturi 1986; Nelson 1973: 276) and finds that there is little observed temporal variability in the manufacture of stone tools at either Kahinju or Kathuva.

8.2 Stone Tools of the Pastoral Neolithic of Tsavo

Classification of lithic material generally followed Nelson's (1973) typologies but works by Cabel (in Robertshaw 1990b), Mehlman (1989) and Barthelme (1985) were also considered. The most problematic factor in this endeavor was that 87.6% of lithic material at Kahinju and 95.9% at Kathuva were manufactured from quartz. Pastoral Neolithic sites in the Rift Valley generally record very few quartz artifacts especially when compared to obsidian and chert artifacts (cf. Mehlman 1989). However, the dearth of locally available chert and obsidian sources in Tsavo explains why stone tools in this area were fashioned primarily from quartz.

When identifying diagnostic lithics, attributes that clearly showed evidence of retouch or use of the tool were examined. Quartz (SiO_2) is notoriously difficult to discern whether a fracture is formed by natural or cultural processes (Kooyman 2000; Mehlman 1989: 128; Nelson 1973: 179). However, an experimental data set was created and used to discern cultural from natural fracture processes. Samuel Munyiri, a staff archaeologist at the National Museums of Kenya who is very knowledgeable in Stone Age technologies of East Africa, provided further assistance.

The lithics recovered from the sites of Kahinju, Kathuva and Mwiitu in 2001 and 2004 were fashioned by hard-hammer reduction techniques. On the Mohs scale of hardness quartz registers at 7 due to the strong, relatively uniform SiO_4 tetrahedral bonds (Klein and Hurlbut 1993: 254). The inherent hardness of quartz rocks makes soft hammer reduction and pressure flaking virtually impossible to perform. Experiments using soft hammers in an attempt to knap quartz cores were unsuccessful. However, it should be noted that the author is not as experienced as perhaps some of the readers in the skill of stone tool manufacturing[17].

Due to the inherent ambiguity of flaked quartz as a function of natural or cultural processes, experiments were conducted using quartz cobbles collected along the banks of the Galana (following Patterson 1983). These experiments provided a useful comparative set of data from which the archaeological material could be interpreted. A variety of methods were attempted, but the only successful knapping experiments occurred when using hard hammer percussion methods. Basalts were sufficiently resilient to flake

[17] Pressure flaking of quartz has been noted elsewhere (Tindale 1985: 27), but never in East Africa. Given the global diversity of quartz compounds, this may be an effect of the local mineralogy of the materials.

quartz cores, however experiments with bone and wood showed that reduction was not possible by direct or indirect soft hammer percussion techniques.

The experimental set of cores was probably similar to the material available to the people who fashioned the archaeological material. The majority of quartz in the Tsavo region comes in the form of small river cobbles measuring no more than 7 cm in length from the longest ends, but some quartz veins can be found particularly in the Taru Grits bedrock region (Chapter 5A). Most of the cobbles were <4 cm long from their most disparate points, which makes holding and hitting the core a very difficult endeavor.

Two forms of hard hammer percussion were undertaken. The first type is the *high-force strike*. The high-force strike involves positioning the core in a position where it can receive a blow to remove the initial flakes. Lithics that had received one high-force strike were the most common of the assemblage. Most fragments recovered were block shatter or "low-angle pebble flakes." By weight, non-diagnostic debitage accounted for 79.7% of the quartz assemblage at Kahinju and 84.6% of the quartz assemblage at Kathuva.

The second type of hard hammer technique involves more finesse. The *precision strike* is a directed, low-velocity blow to remove small fragments (<10 mm^3) in an attempt to create a desirable form. While the high-force strike leaves large dimples along the surface of the flake, the precision strike dulls the surface to a less-abrasive texture. The ultimate aim of the precision strike is to alter the angle of the tool's cutting edge.

As has been found on other PN sites, the vast majority of diagnostic stone implements were microliths. In Tsavo, this is undoubtedly a function of the raw material available from which stone tools were crafted. Small-sized river cobbles do not leave much liberty for the creators of the tools to develop "macrolithic" technology. However, microliths can be traced from the last 40,000 years B.P. in Africa ranging from northeastern Congo to the Zambezi River plain (Phillipson 1980). Clearly, microlithic tools are preferred technology in Kenya even if the restricted size of the tool is a function of the available raw material. Diagnostic lithic tools found in Eburran Phases I-IV (previously referred to in literature as "Kenyan Capsian") have mean lengths that range between 24 to 50 mm (Ambrose 1980b).

Although the typologies delineated by Nelson (1973) are designed primarily for use with chert and obsidian tools, I was able to categorize some of the quartz artifacts from Tsavo using his classification scheme. Devising a new, simplified system had advantages and disadvantages. The primary advantage of a simplified system was that it would more accurately and universally reflect the tool production of the Tsavo region, which is fundamentally different than PN technology of the Rift Valley based on the material that it is using. However, the major disadvantage of a new classification system was that it could confuse a very established lithic sequence for the Pastoral Neolithic. The latter effect outweighed the benefit of the former and the artifacts of Tsavo were carefully provenienced into the established lithic typology.

Given these precautions, classifications of PN lithics from Tsavo were conservative. Each artifact was closely examined with a pair of jeweler's glasses and ambiguous artifacts were classified as debris unless it was very clear that the intent to create a clear form from the piece was made. It is logical to assume that the poor quality of quartz as a raw material would limit the precision with which the tools were made. That is to say that the intended form was not achieved as frequently with quartz tools as it would have been with chert. However in the assemblages at Kahinju diagnostic artifacts comprise 23.1% of the total chert assemblage (n=13) and 29.5% of the total quartz assemblage (n=549). At Kathuva, diagnostic artifacts represent 17.1% of the total chert assemblage (n=35) and 16.5% of the total quartz assemblage (n=2156). At Mwiitu, diagnostic artifacts comprise 2.0% of the total quartz assemblage (n=960). Other raw materials include obsidian, basalt, illumbrite, calcite and sandstone and comprise 4.6% of the assemblages from Kahinju, Kathuva and Mwiitu (total assemblage n=4,029). However, most of these materials are cores and radial flakes and are not shaped tools per se.

The categories into which the diagnostic lithics were classified are as follows:

1. **awl** (n=129, 3.2% of total assemblage): Truncated lengthwise and fashioned by removing numerous lateral flakes until a sharp tip is produced (Figure 47). Nelson (1973) recognizes two primary types of awls: 1. narrow, sharply pointed forms with truncations formed by two converging blunted lines, and 2. narrow, sharply pointed tools with oblique or diagonal truncations found at <20º. Sampson and Sampson (1968, in Nelson 1973) refer to awls that conform to Nelson's (1973) first category as "points." In the absence of forms that otherwise resemble points (Nelson 1973: 227) and the evidence for the presence of numerous wild fauna in the Tsavo 2001 assemblage, it is logical to assume that these tools could have easily been used as a form of projectile point.

In the Tsavo assemblage, they are small (>30mm) and could be hafted onto a shaft very easily. In the ethnographic accounts, awls are frequently dipped into a special poison that is so lethal it can send an adult elephant into cardiac arrest in 15 minutes (Ville 1995). Knowledge of the poisons is kept by special medicine men who live apart from the society-at-large and rely on their customers to bring them food to eat (Kusimba et al. in press). An awl may also be used as a drilling instrument. A depiction of a ceramic rim that has a mending hole is found in Chapter 9 and numerous terrestrial mollusk shells and one ostrich eggshell bead were recovered with evidence that they had holes drilled into them. All awls were examined closely for trace evidence of usewear, but no scratches were observed that would indicate that any of the collected pieces were used in any capacity.

2. **bec** (n=23, 0.6% of total assemblage): A pointed implement formed by retouching a natural spur on a piece of debitage (Nelson 1973: 242). In the Tsavo assemblage, the dorsal flakes were removed with one stroke and two anterior flakes are then removed to provide a steep cutting edge. The edges of the tools are frequently retouched with small notches removed for a jagged cutting surface. Becs were fashioned from basalt (n=3), quartz (n=18) and sandstone (n=1).
3. **burin** (n=61, 1.5% of total assemblage): Tools whose major working edge lies in the thickness of the implement (Nelson 1973: 227-9). Burins have been described from other assemblages as prehistoric chisels (Knecht 1988: 10). The edges are formed by trimming and measure <10mm in length. In

Nelson's (1973) classification typology, if the trimming extends to the margin parallel or subparallel to the plane of maximum extension, the tool is classified as a nosed scraper.

4. **casually retouched/trimmed implement** (n=7, 0.2% of total assemblage): A flake or angular waste piece with retouched edges. These tools are classified as separate entities in Nelson's (1973: 244) typology, but are grouped in the present analysis.
5. **convex scraper** (n=2, <0.1% of total assemblage): Scraper with a pronounced convex edge that truncates one or more end of the implement and occupies >40% of the periphery of the finished tool in one contiguous arc or retouch, shallow trimming or steep trimming (Nelson 1973: 194).
6. **crescent** (n=28, 0.7% of total assemblage): A biterminally truncated flake with truncations that occur as part of a convex edge formed by bi-directional or steep trimming (Nelson 1973: 149).
7. **curved back** (n=2, <0.1% of total assemblage): A microlithic flake with a uniterminal, convex truncation (Nelson 1973: 160). In quartz assemblages, these artifacts are frequently "intergraded" with crescents, obliquely truncated flakes and micropercoirs (Nelson 1973: 164).
8. **end scraper** (n=196, 4.9% of total assemblage): A scraper with truncated or distal or proximal ends that account for <40% of the periphery of the finished tool (Nelson 1973: 182). Trimming or retouch that occurs on the lateral margins adjacent to the definite convex edges are of secondary importance to typological assessment (Nelson 1973: 182).

9. **non-segmented blade** (n=2, <0.1% of total assemblage): Defined by Nelson (1973) as "flakes" and Mehlman (1989) as a form of debitage. However, in my sorting scheme these were artifacts that could have been classified as nosed scrapers to the extent that they had dorsal flakes removed, but lacked extensive retouch along the adjacent edges.
10. **nosed scraper** (n=97, 2.4% of total assemblage): A narrow, constricted convex or subrectangular edge produced by extensive trimming or retouch along one or both adjacent edges (Nelson 1973: 192). These tools are highly variable in their forms and intergrade with non-segmented blades.
11. **notched/concave scraper** (n=1, <0.1% of total assemblage): Scrapers with one or more concave scraping edges. Nelson (1973: 199-201) separates notched and convex scrapers, but the distinctions and total number of these forms identified were not significant enough to warrant a separate classification scheme for this analysis.
12. **oblique truncated** (n=5, 0.1% of total assemblage): A microlithic flake with a more or less straight, uniterminal oblique or diagonal truncation (Nelson 1973: 164). The angle formed by the truncation must be greater than 15º and truncations can be applied to both distal and proximal ends of the tools.
13. ***outils écaillés*** (n=2, <0.1% of total assemblage): An artifact with one or more unifacially or bifacially flaked or biclinal edge formed by step-flake retouch or trimming (Nelson 1973: 208). In fact, unifacially flaked *outils écaillés* are very rarely identified in East Africa (Nelson 1973). Bifacially flaked tools of this variety are very common in LSA assemblages in East Africa, but were not

identified in high numbers in the Tsavo 2001 assemblage. These tools are difficult to execute on quartz assemblages because of the precision necessary to form a biclinal edge. Because quartz fractures easily, the possible outcomes of any tool-making endeavor are limited. The bias against *outils écaillés* in the Tsavo 2001 assemblage should be interpreted as a testimony to the difficulties that toolmakers encountered when using quartz as a raw material.

14. **percoir** (n=1, <0.1% of total assemblage): A tool having a sharply pointed working edge formed by two lines of intersecting abrupt retouch or step trimming (Nelson 1973: 205). The angle of intersection must be less than 90º and is usually less than 60º.

15. **segmented blade** (n=22, 0.5% of total assemblage): Tool that intergrades with non-segmented blades and burins. The differentiation between a segmented blade and a burin is the angle of retouch on the anterior edge. A segmented blade generally has four primary flakes removed: one ventral, two dorsal and at least one anterior. The ventral flake exposes a flat surface on top of which the dorsal flakes are removed forming a >270° angle. An anterior flake is removed from this surface, which provides an edge angle of <45º. In other assemblages, blades have been defined as thin flakes with parallel edges that are at least twice as long as it is wide with a length exceeding 5 cm (Kooyman 2000; Owen 1988). However, this definition does not sufficiently describe the variability present in the Tsavo collection, nor is it commonly used in East African typologies.

16. **side scraper** (n=10, 0.2% of total assemblage): A flake with lateral margins on one or both sides modified by retouch, shallow trimming or steep trimming (Nelson 1973: 197).

The non-diagnostic assemblage was classified as follows:

1. **debitage** (n=3,067, 76.1% of total assemblage): Nelson (1973: 246) defines debitage as cores and debris that are produced as the byproduct of stone tool manufacturing processes. However, I chose to classify debitage on the basis of flake debris only, and created a separate category for core debris. Ostensibly, the separation of these artifacts was purely for laboratory sorting purposes and will allow any researchers who wish to revisit the assemblage in the future easier access to subdivisions of non-diagnostic specimens.
2. **core** (n=155, 3.8% of total assemblage): An artifact that has been flaked as a source of manufacture of stone tools (Nelson 1973: 248). Cores were difficult to discern whether there was intent to create workable shape or they were used merely as the source material from which flakes could be removed. Unless the artifact had a distinctive classifiable form, the flaked, but non-diagnostic artifact was labeled "core."
3. **flake with inverse retouch** (n=43, 1.1% of total assemblage): A flake with retouch or trimming on the flake release surface (Nelson 1973: 206). In most cases, I interpreted these artifacts on the basis of lacking diagnostic qualities of the shaped tools listed above, but possessing distinctive evidence that reworking of the stone had occurred.

4. **semi-radial pebble cores** (n=71, 1.8% of total assemblage): Manufactured by splitting a cobble transversely and creating subsequent flakes from the split surface by striking the cortical surface of the pebble (Nelson 1973: 254). In most cases, the secondary reduction of the artifact had not occurred among the Tsavo 2001 assemblages. Nelson's (1973) classification description of this category leaves room for pebble cores that have received only the primary "halving" but no further reduction. Essentially, these can be looked at as "half cores."

   Semi-radial pebble cores are commonly found in the Kansyore Island assemblage, but are not commonly reported in PN assemblages elsewhere in East Africa (Nelson 1973: 254). PN sites have typically been located in rockshelters or in open-air environments at some distance from running or standing water (Ambrose 1984b). However, the common denominator between Kansyore Island and the Galana River sites is that there are fluvial processes available to wear down river cobbles and fluvial systems were the source of the majority of raw material utilized in stone tool manufacture.

5. **low-angle pebble flakes** (n=64, 1.6% of total assemblage): A flake that has been diagonally removed from the cortical surface of a semi-radial pebble core (broadly following Nelson 1973: 254 typology). Nelson (1973: 253, FigIII-59a, d) classifies the cores that are the result of this technique, but does not distinguish the byproduct. Presumably, he lumps the byproduct of this manufacturing process under "debitage," but no illustrations or descriptions are available.

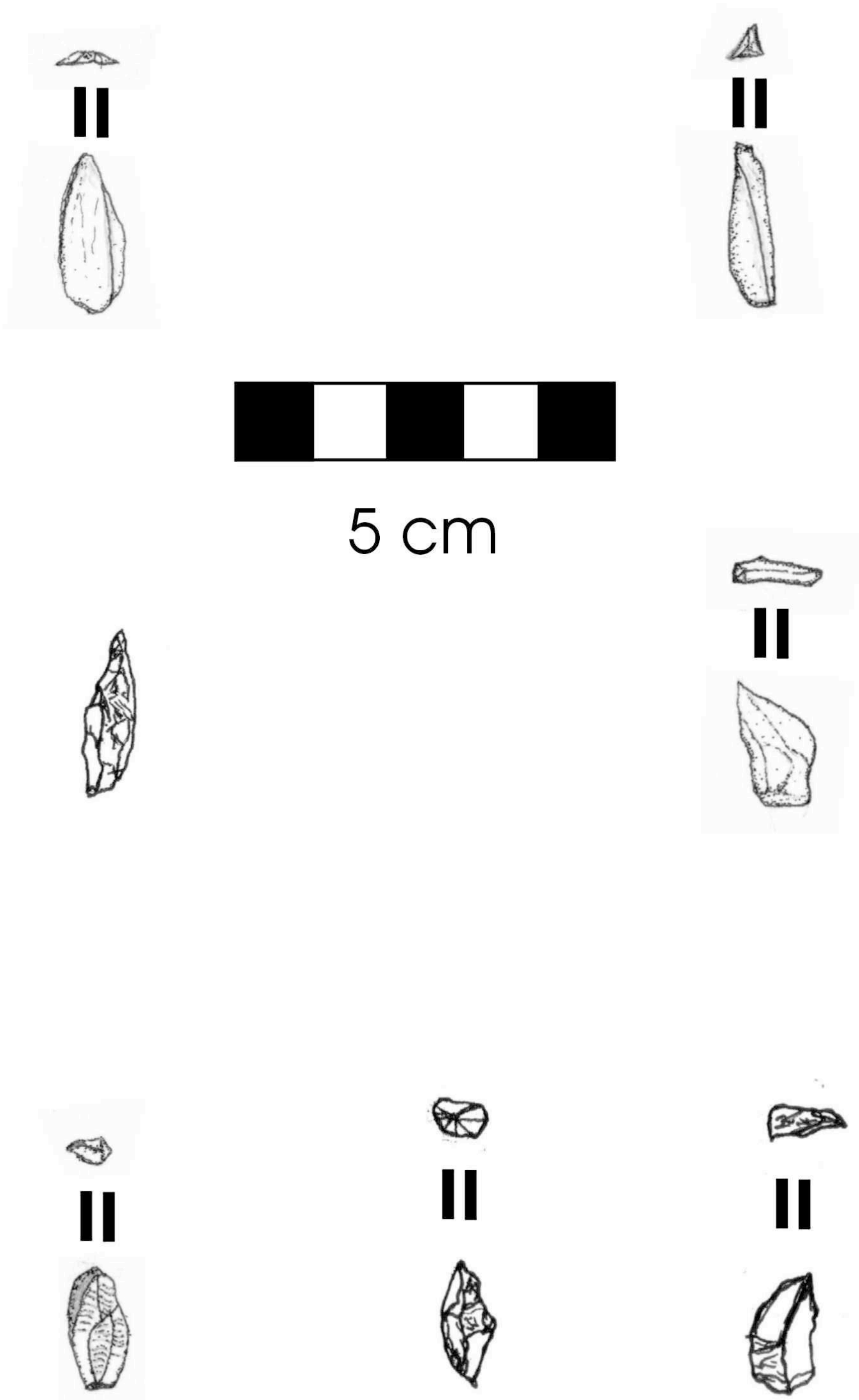

Figure 47. Representative sample of shaped stone tools from Tsavo 2001 and 2004 field season (awls)

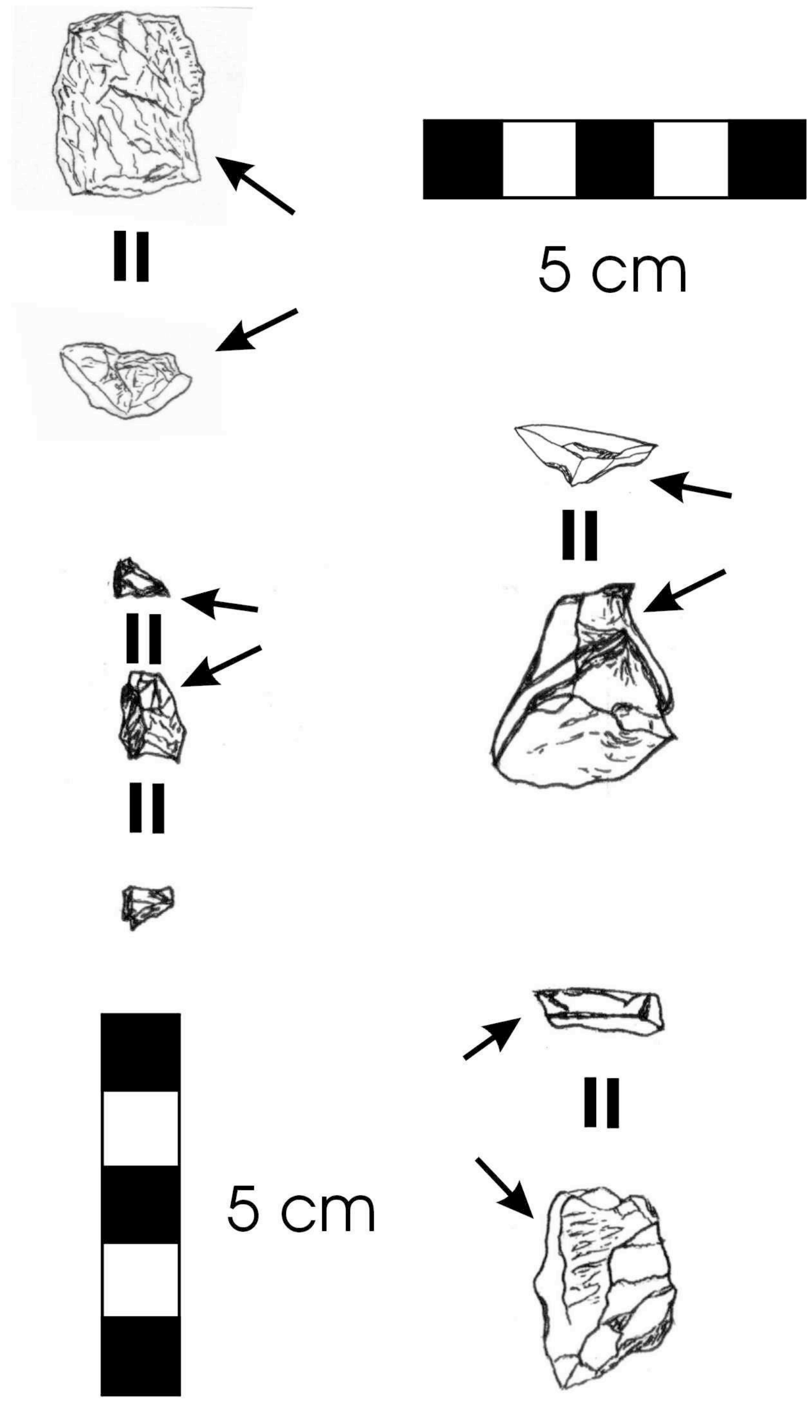

Figure 48. Representative sample of shaped stone tools from Tsavo 2001 and 2004 field season (burins)

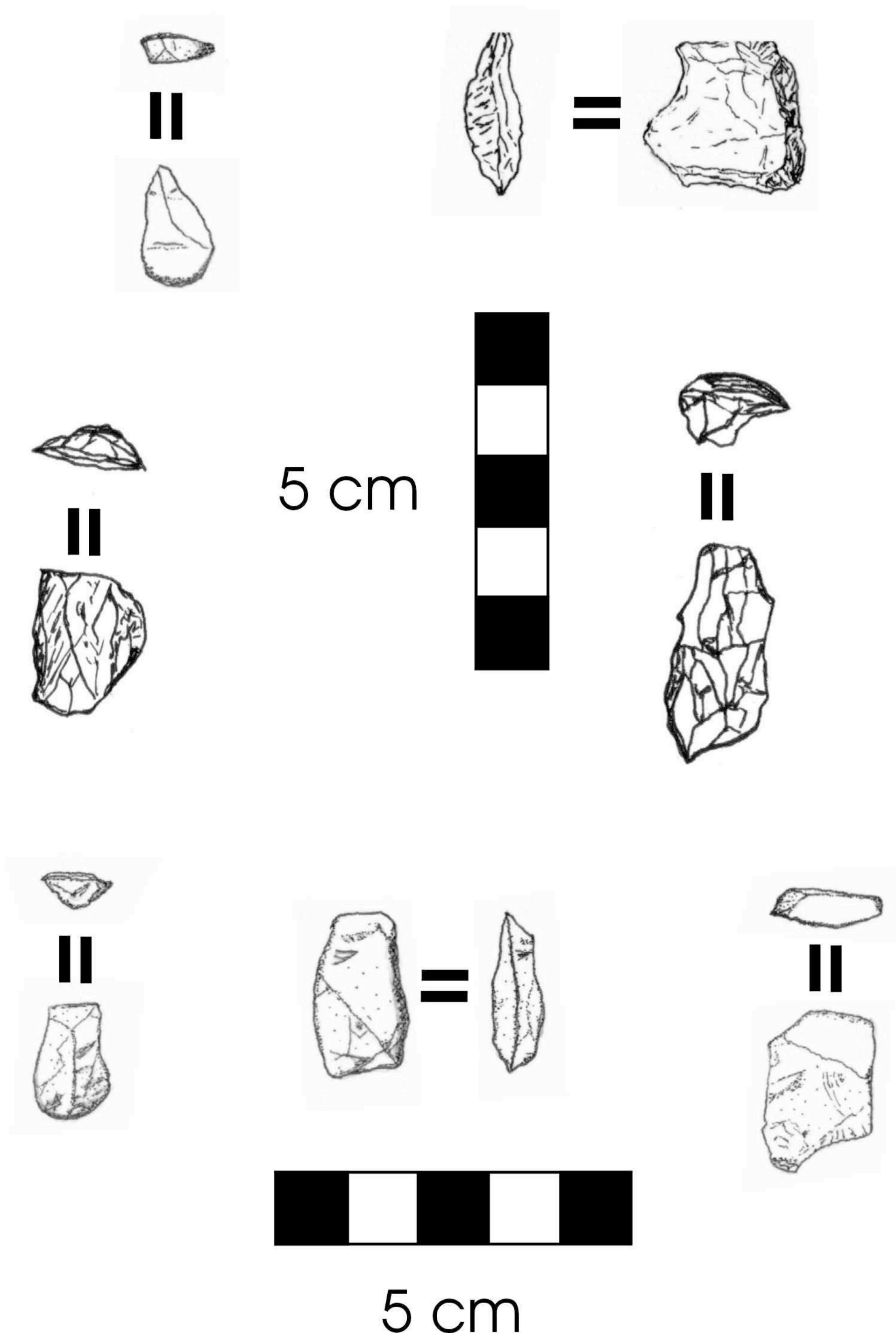

Figure 49. Representative sample of shaped stone tools from Tsavo 2001 and 2004 field season (scrapers)

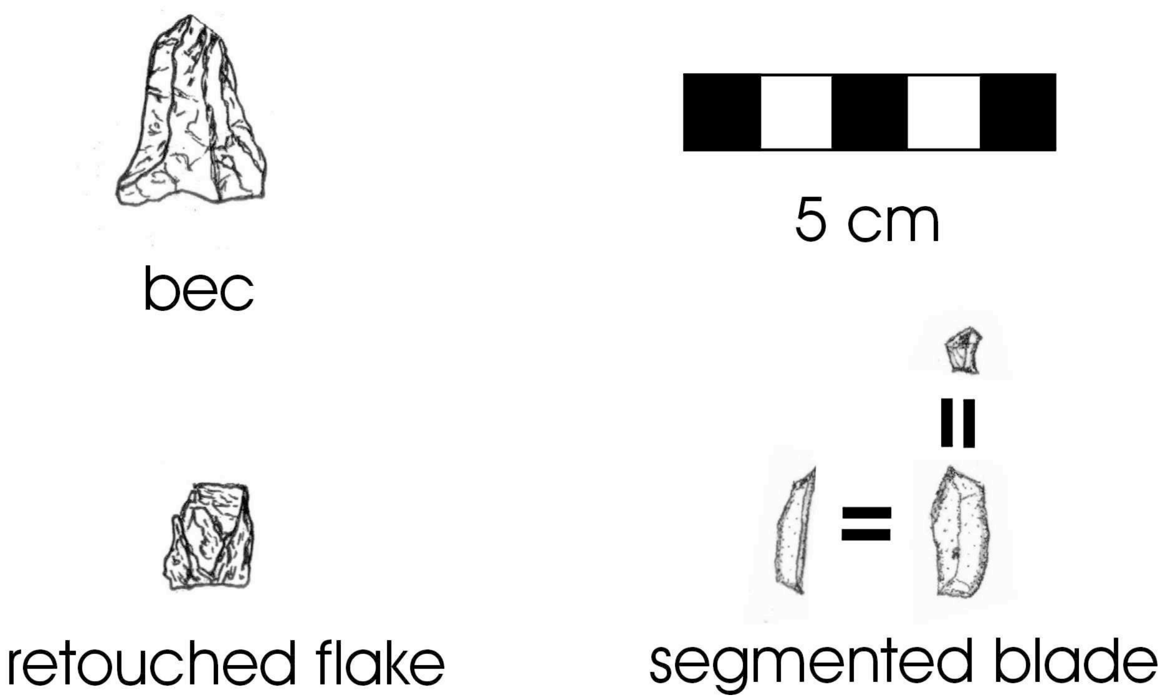

Figure 50. Representative sample of shaped stone tools from Tsavo 2001 and 2004 field season (other tools)

8.3 Discussion of Tsavo Lithics

A great deal of debate has occurred between archaeologists trying to resolve whether lithic forms relate to the function of the artifact (Hayden 1977; Keeley 1974b, 1980; Odell 1981; Yerkes and Kardulias 1993). For example, conventional wisdom attributes hide processing with scrapers (Hayden 1986). However, Odell (1981) shows by using usewear analysis that endscrapers have been used for a variety of functions other than hide working including boring, graving, chopping and as a projectile point. Nance (1971) argues that Stockton points from Late Horizon Central California were used for multiple purposes (but see Keeley 1974a). It is far too simplistic to argue that a high percentage of scrapers in a particular assemblage indicate that a particular function was occurring at a site.

Under optimal conditions, microwear analysis would be the perfect technique to resolve questions pertaining to how the PN inhabitants of the Galana River were utilizing their technology. However, performing microwear analysis on quartz and quartzite is not possible. Wear traces from polishes (hide, wood, soft plants) will not be detectable on the artifact and abrasive procedures such as boring/drilling, chopping, or graving objects like shell, ceramics and bone will not necessarily leave diagnostic scratches on a material as hard as quartz (Greiser and Sheets 1977; Keeley 1980: 168). Chert and basalt artifacts consisted almost entirely of manufacture debris, which would not have been used as tools. The dearth of tools fashioned from chert and basalt present in the assemblage attests to the rarity of this commodity, which would not have been as readily discarded as tools made from locally available materials. Nevertheless, all lithic artifacts were scrutinized for any evidence of wear traces using jeweler's glasses, but no dulling of edges on any artifacts were detected.

Figures 51, 52 and 53 show the distribution of shaped tools through the dated cultural occupations at Kahinju and Kathuva. These data show that there is little temporal variability in the stone tool assemblage despite the fact that the earliest and latest dated occupations of the sites are separated by ~4,700 years. Accordingly, there is little evidence to suggest that there was a radical altering of the subsistence base among the prehistoric occupants of these sites (Chapter 7). Therefore, the data presented below agree with Nelson's (1973: 276) findings that variability in the range of stone tools manufactured at a PN site do not generally show a marked change in form throughout the various occupations of the site. Subsequent analyses have been published showing that Nelson (1973) was incorrect that this is a general PN characteristic (Kusimba 2001; Robertshaw 1991), but this pattern works well for the Tsavo assemblages.

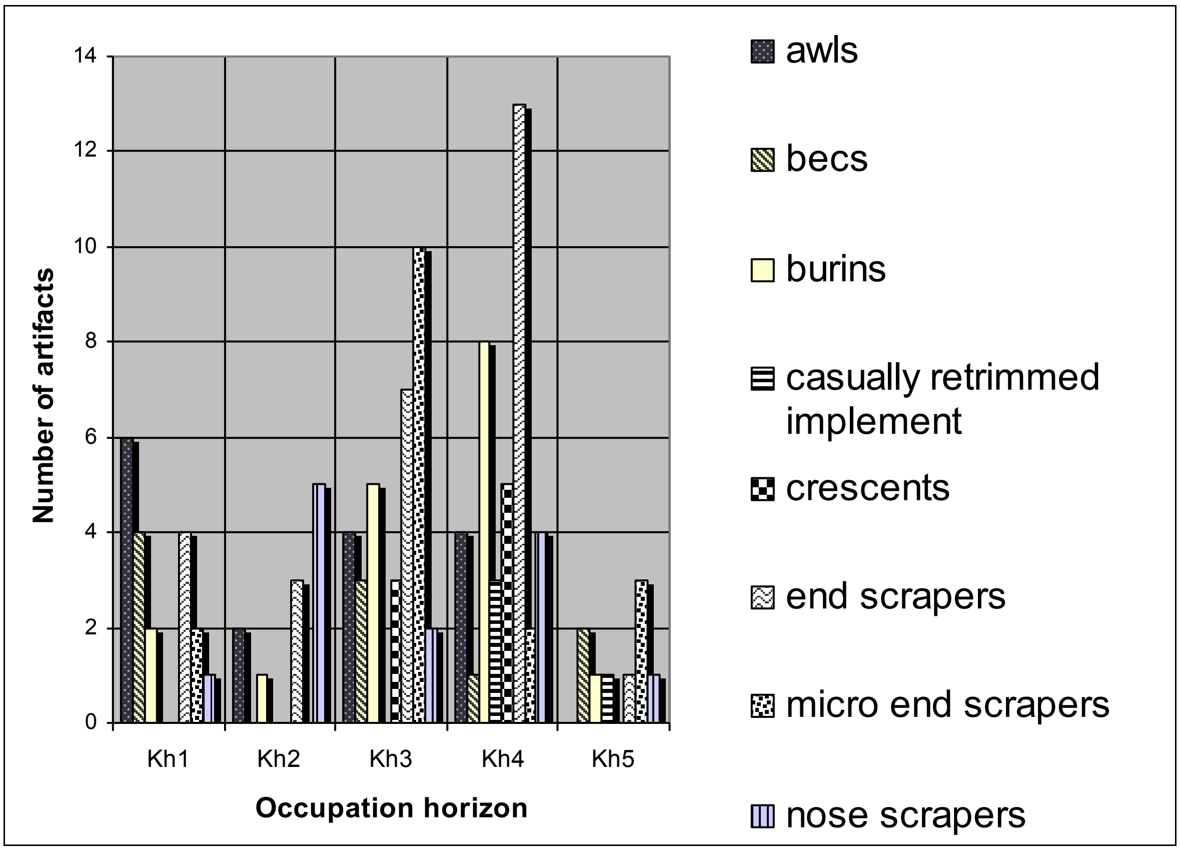

Figure 51. Numbers of shaped stone tools recovered and analyzed by occupation horizon from Kahinju 2001 and 2004

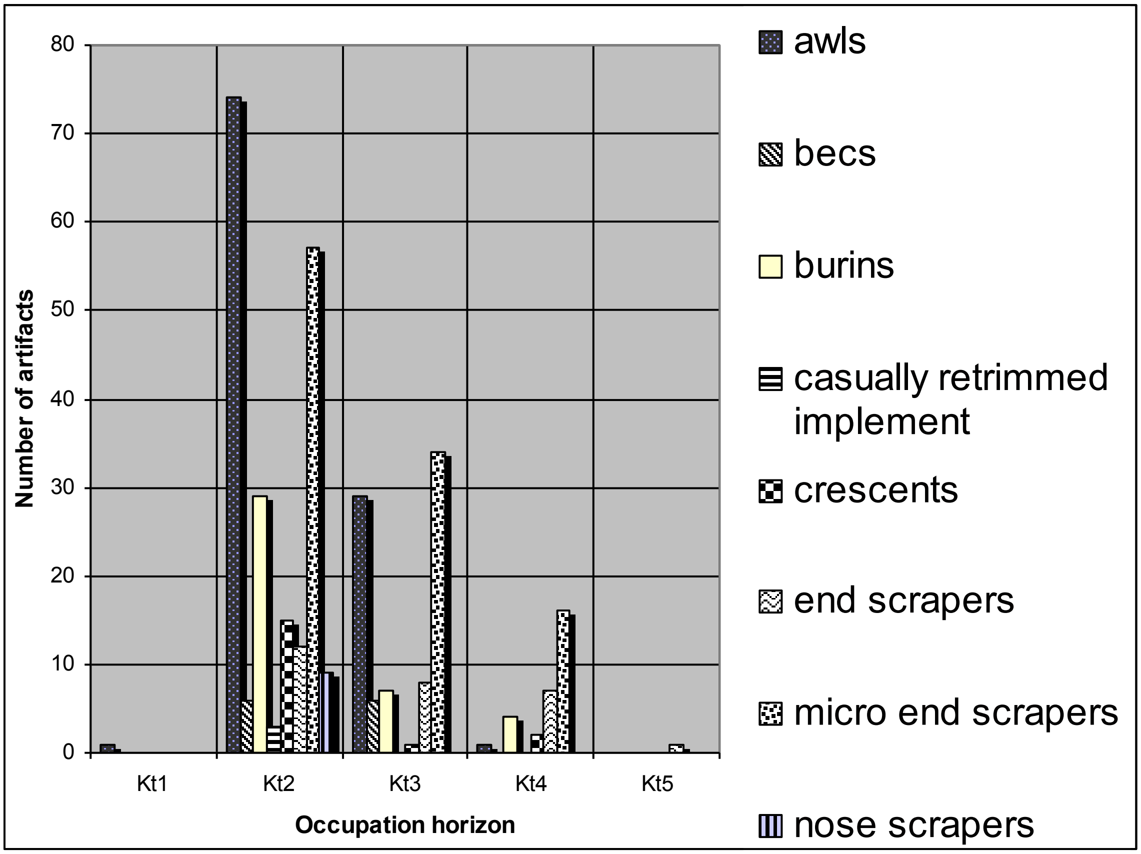

Figure 52. Numbers of shaped stone tools recovered and analyzed by occupation horizon at Kathuva 2001

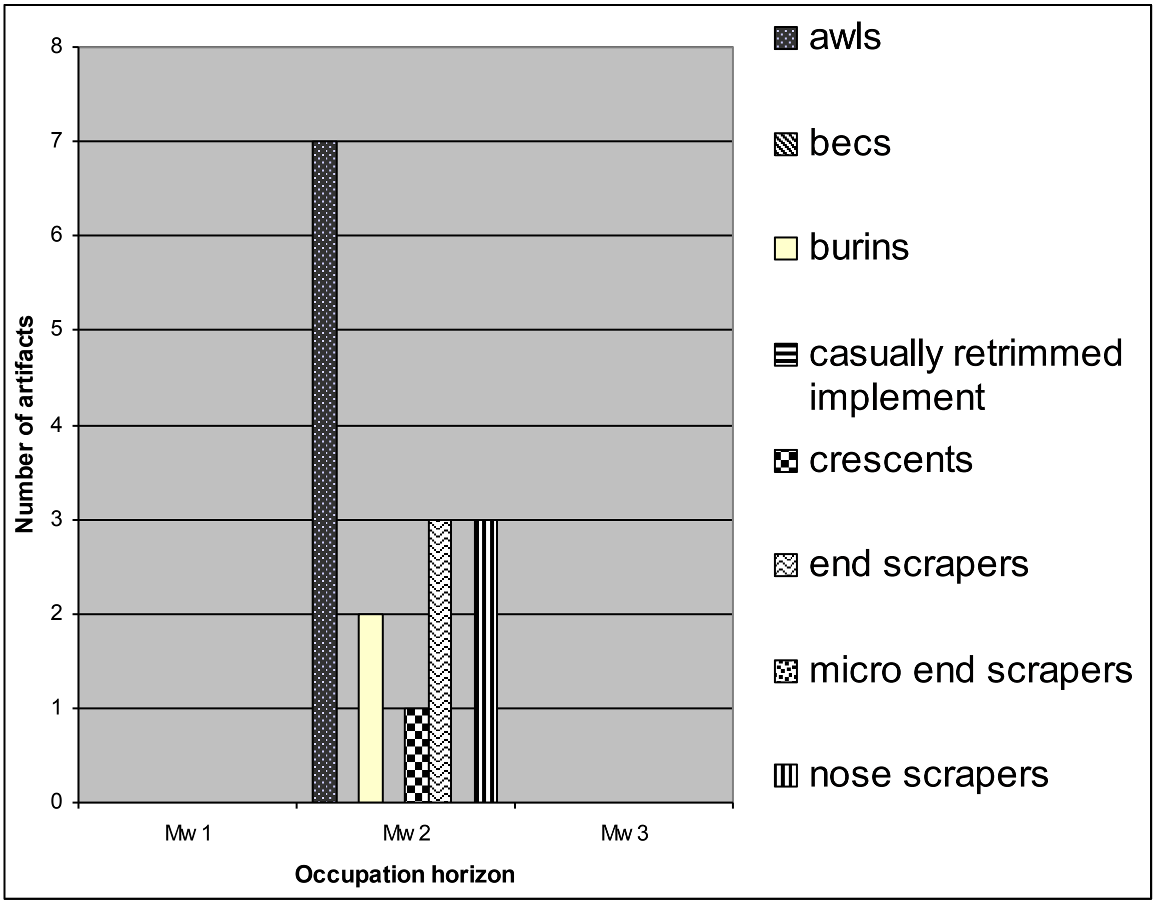

Figure 53. Numbers of shaped stone tools recovered and analyzed by occupation horizon at Mwiitu 2004

8.3.1 <u>Stone Tools of the Pastoral Neolithic of Kenya</u>

LSA assemblages are distinguished from their MSA predecessors by a higher frequency of flake as opposed to core technology (Phillipson 1993a). Microliths and scrapers represent a high percentage of LSA assemblages with earlier cultural occupations having a high relative proportion of scrapers and later assemblages possessing more microliths (Kusimba 2001). However, the Pastoral Neolithic stone tool assemblages are said to represent an autochthonous diversification of tools (Gifford-

Gonzalez 1998a: 124-7; Nelson 1973). The PN toolkit has been interpreted as functionally specific with implements being designed for use on a single task (Bower 1984b).[18] Lithics of PN sites are highly variable representing earlier industries at the locations at which they are found (Bower 1991).

Microliths represent almost 50% of shaped tools in the early pastoral site of Dongodien (Barthelme 1985). *Outils écaillés* and scrapers followed in frequency at the site (Barthelme 1985). Barbed bone harpoons are found around Lake Turkana and Lower Omo Basins, but not during pastoralist occupation levels (Barthelme 1985). This is an unexpected phenomenon because fishing is still occurring during these occupations, but there has been a shift in fishing technology. It is not yet known what new form of technology was adopted in place of harpoons (Barthelme 1985: 335), but ethnographic examples of alternative fishing procurement strategies include using nets, lines with hooks and weirs (Balikci 1970; Begossi 1992).

In open-air pastoral sites (SPN), obsidian accounts for over 80% of the stone tool assemblages while it is only 15 – 40% of the assemblage in rockshelter sites (Merrick and Brown 1984). However, there are changes in raw material types selected for at Gogo Falls over time. Earlier PN occupations preferred quartz as a raw material for making their lithics, while later Elmenteitan occupants preferred obsidian (Robertshaw 1991). A later post-Elmenteitan occupation at Gogo Falls shifts back to quartz as the raw material of choice (Robertshaw 1991).

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[18] However, it is worth noting that usewear analysis has not been successfully undertaken on East African LSA stone tool assemblages because of the high proportion of quartz. Quartz is a poor raw material for study of microwear patterns (Lawrence Keeley, personal communication, 1999) and any study of a PN assemblage that does not account for the quartz component would have a poor sampling bias.

Southern Naivasha obsidian is found on sites with Narosura ceramic tradition, while upper Eburru area obsidian is found on sites with Elmenteitan and unknown ceramic traditions (Merrick and Brown 1984: 147). Studies of raw material sources and distribution suggest that obtaining and exchange of obsidian was an important integrative mechanism *vis á vis* long distance exchange for later PN people (Barut-Kusimba 1999). Only during the PN does the exchange of obsidian exceed 50 kilometers (Barut-Kusimba 1999). The obsidian found at "Oltome" levels at Gogo Falls comes from as far away as 200 kilometers (Robertshaw 1991: 157). Robertshaw (1990b) believes that the distribution of obsidian during the PN was controlled by ascribed authorities such as lineage heads and/or ritual specialists.

Mehlman (1977) notes that at Masera Rock, Tanzania quartz constitutes 97% of the lithic assemblage. He reports that *outils écaillés* comprise the majority of the Later Stone Age diagnostic artifact assemblage while only "one or two" scrapers are present (Mehlman 1977: 116). Unfortunately, Mehlman (1977, 1989) does not present his findings in a clear geomorphic context with undisputable radiometric dating controls.[19] Therefore, it is impossible to know whether the inverted proportions of scrapers to *outils écaillés* at the two areas (which are only ~100 km distance from one another) is a function of geography or time.

The earliest documented appearance of iron in the Rift Valley is at 1,300 years B.P. (Bower 1991). When iron appears at Gogo Falls, manufacture and use of stone tools ends immediately (Robertshaw 1990b, 1991). At Enkapune ya Muto (EYM), stone use drastically decreases after the introduction of iron (1,300 – 1,100 years B.P.), but does not

[19] Mehlman (1989) primarily uses an archaeological assemblage excavated by L. Kohl-Larsen in 1934 that employed dubious horizontal controls and artifact proveniences.

disappear altogether (Ambrose 1984b). Furthermore, archaeological sites in Ufipa, Tanzania show evidence of the presence of iron-working technology long before the arrival of Bantu-speaking dialects to the region (Mapunda 2003). Therefore, the traditional model that argued that the diffusion of iron into East Africa piggybacked the spread of Bantu-speaking people (Fagan 1972; Guthrie 1963) has now been discredited (Ehret 2001; Flight 1980; Kense 1983, 1985; Mapunda 2003). This, wholesale replacement of stone tool technology in favor of iron implements now seems illogical and the new model of technological introduction into East Africa more comfortably fits the data recovered from the archaeological record in places like EYM. The acquisition of iron weapons is said to have given pastoralists a technological advantage over their foraging neighbors allowing them to expand their territory (Robertshaw 1990b: 300), but the transformation of East African people into an exclusively iron-using society took >1,000 years to complete.

8.3.2 Pastoral Neolithic Stone Tool from Tsavo Assemblages in Context

Thorbahn (1979) records that the lithic assemblage of LSA inhabitants of Tsavo resembles the Wilton Industry of southern Somalia. However, his test units were on rockshelters and open-air sites, which are probably later occupations than the sites situated along the Galana River. Radiocarbon ages also distinguish an historic and Iron Age occupation from Kisio Rockshelter in Tsavo West from ca. 100 and 1,000 years B.P. (Kusimba 2003: 215). The lithic assemblage of Kisio Rockshelter is similar to other LSA sites in the Tsavo region in that the vast majority of tools (97%) were made from locally available vein quartz (Kusimba 2003). In addition, most tools show little retouch and only 1.4% of the assemblage consists of shaped tools (Kusimba 2003). However, Kisio

Rockshelter is differentiated from other known LSA sites in Tsavo based on their use of iron tools during the later occupation of the site.

In general, later Pastoral Neolithic sites are characterized as having microlithic tool assemblages (Kusimba 2001; Mehlman 1989; Nelson 1973). Indeed this is the case Tsavo with the average awl weight of .61g (n=129), crescent weight of .90 g (n=28), burin weight of 1.54g (n=61) and blade weight of 1.67g (n=283). This number drops to 1.33g when basalts are not included in the count (n=278).

Keeping in mind the cautionary remarks made above, certain general trends of stone tool use and resource utilization in East Africa have been noted by other authors. Sites dominated by the presence of microliths are those in which hunting is the prevalent subsistence activity (Barut-Kusimba 1999). Conversely, sites with high percentages of scrapers relative to other types of tools are mostly oriented toward the processing of food and are thus associated with food production (Barut-Kusimba 1999). Pastoralists have higher frequencies of scrapers and fewer projectile points in their lithic assemblage than hunter-gatherers do (McDonald 1998). On the other hand, (Krzyzaniak 1980) argues that there is no implicit change in lithic tool types between foraging and pastoralist groups. At EYM, the ratio between domesticated and wild animals in the fauna changes drastically between 3,000 to 2,700 years B.P. but the stone tool assemblage remains virtually the same (Marean 1992).

The development of backed microliths in East Africa occurs in conjunction with a broadening of the availability of huntable game (Robertshaw 1988). Thus, microlithic technology provided the variety of tools necessary for exploitation of a greater range of resources than was previously attempted (Robertshaw 1988). Looking at the diagnostic faunal assemblage, the early Neolithic inhabitants of Tsavo are neither pure pastoralists nor are they pure foragers and needed a toolkit that allowed flexibility in its application. Gifford (1980: 97-98) proposes that exploitation of a wide range of wild in tandem with minimal domesticated resources is indicative of a restricted mobility pattern. Chapter 7 has addressed this issue in more detail, but the lithic assemblage recovered from the Tsavo 2001 field season is one more marker that a generalized subsistence and tethered mobility strategy was practiced throughout at least the last four horizons of occupation at both Kahinju and Kathuva.

8.4 Conclusion

The analysis of the lithic assemblage from Kahinju, Kathuva and Mwiitu has found that there is little evidence for change through time in the technology employed by the PN herders along the Galana River. More excavations are needed to confirm this hypothesis, but the preliminary results indicate that stone tools manufactured at these sites were designed to exploit a generalized range of faunal and plant remains. Ideally, microwear analyses could be performed to resolve how the tools were being used. However, given that the preferred raw material utilized at the Galana River PN sites was quartz, wear traces are not visible on the tools, even at the microscopic level.

Chapter 9. Ceramics

9.1 Introduction

In East Africa, taxonomies of Neolithic and Iron Age ceramics have been complicated by large geographical gaps in knowledge about prehistoric people and competing classification schema (Collett and Robertshaw 1983; Karega-Munene 2003; Soper 1989; Wandibba 1980). Understanding the movement and distribution of ceramic traditions through East Africa needs augmenting in order to be able to construct a classificatory database whereby archaeological sites can be reliably dated based on the ceramic assemblage. Relative dating of sites based on ceramics is a common phenomenon in many parts of the world where the sequences are well understood (Rice 1987). However, in East Africa more data is needed to fill in the gaps where prehistoric ceramic forms were produced and dispersed. This chapter will assemble published reports of ceramic finds in eastern Africa, provide a summary of the discipline's current understanding of the chronological and temporal distribution of ceramic traditions and facies and augment the database with new, dated ceramic finds from Tsavo National Park, Kenya.

9.2 Definitions

Prior to delving into the particulars of ceramic forms and functions in East Africa, it is first necessary to follow a set of definitions that can generally be agreed upon. The definitions below comply with classifications derived from Rice (1987), Orton et al. (1993) but especially Soper (1989: 9). From these definitions an evolving, but organized database of regional ceramic styles can be developed.

- **ASSEMBLAGE**: Pottery or other objects clearly associated together at one site.
- **PHASE**: A group of related assemblages that show no significant differences. Defined by Soper (1989) as a homogeneous unit of limited time and duration.
- **TRADITION**: Linked phases that show variation through time but are closely related.
- **FACIES**: A geographical, not chronological tradition.

One of the greatest obstacles in classifying East African ceramics is the presence of conflicting nomenclature for archaeological traditions of ceramic production and distribution. I have chosen to follow Wandibba's (1980) terminology as opposed to the derivative classification offered by Collett and Robertshaw (1983). The use of attribute analysis that is proposed by Collett and Robertshaw (1983) is recognized to be a useful contribution to the study of East African ceramics (cf. Mehlman 1989: 564-6) despite its incompleteness and association with quasi-Maasai names that carry ethnically loaded associations. Their critique that a site-type nomenclature obfuscates the geographical and temporal distribution of a facies or tradition is well-founded, but came at a point when the classification scheme for East African ceramics had been well-established (Karega-Munene 2003). Therefore, the typologies that follow will employ the attribute analysis distinctions of "assemblage," "phase," "tradition" and "facies," but will refer to these divisions using Wandibba's ware-based nomenclature.[20]

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[20] I owe a debt of gratitude to Simiyu Wandibba, who personally exmined all of the sherds from the 2001/2004 field seasons and helped me organize the finds into categories.

9.3 Understandings of East African Neolithic Ceramic Distribution Prior to 2001 and 2004 TARP Field Seasons

Knowledge of the distribution of early East African ceramics is limited by the geographical range of study that has taken place since the Leakeys began to identify Neolithic traditions in the 1930s (Leakey 1931; Leakey 1945). Archaeological investigations of the Rift Valley (including Lake Turkana), Central Kenyan Highlands, Lake Victoria and Indian Ocean coast have formed the basis of identifying the range and temporal framework for the distribution of ceramic traditions in East Africa. Other areas such as the arid northeastern regions of Kenya and much of the expanse between the Tana and Galana Rivers have not been very thoroughly investigated. Furthermore, poor geochronological controls on many sites have limited the context into which the ceramic finds from Kenya can be placed.

9.3.1 Early PN Ceramics

The earliest ceramic finds in East Africa have been identified in the Kansyore assemblage at Gogo Falls, Lake Victoria (Collett and Robertshaw 1980; Robertshaw 1991). The radiocarbon dates associated with the finds at this site are “variable,” but concretely identify a Kansyore assemblage at 4,000 years B.P. and the production of this ceramic tradition may extend back as far as 9,000 years B.P. (Robertshaw 1991). Mehlman (1989) has also recovered Kansyore tradition sherds in the Serengeti that date to 5,000 years B.P. Kansyore tradition sherds have also been located in southern Sudan dating to 4,000 to 2,000 B.P. (Robertshaw 1982) implying that Kansyore spread out of rather than into eastern Africa (Bower 1991). These vessels are characteristically wide bowls that are decorated by single impressions on the outside.

Another related phase to the early Pastoral Neolithic ceramic traditions is called the "Nderit" tradition. Nderit tradition ceramics are thought to have a slightly more limited geographical range than Kansyore, but they are roughly contemporaneous traditions. Distribution of Nderit tradition ceramics extends from Lake Turkana into the Rift Valley of Kenya (Soper 1989). A bone apatite fraction of 7,255 ± 225 years B.P. is reported for an early occupation containing Nderit tradition pottery at Salasun[21] (Bower and Nelson 1978 and Robbins, in Wandibba 1980). Other discoveries of the Nderit tradition include Hyrax Hill near Lake Naivasha (Leakey 1945) and Seronera in the Serengeti plains dated to 70 ± 115 B.C.[22] (Bower 1973). Ambrose (1998) also records the presence of pottery that resembles the Nderit tradition in a horizon that dates to 4,860 years B.P.—900 years prior to evidence for the presence of domestic stock at the site.

Nderit tradition ceramics are traditionally considered the earliest traditions associated with domesticated animal stock in the Rift Valley (Gifford-Gonzalez 1998a). The vessels are characterized as constricted bowls that have a red hue and tend to be decorated throughout the entire inside and outside. The outside is decorated with "weaving" impressions thought to imitate an actual basket and the inside is incised with indiscriminately placed lines (Soper 1989). Figure 54 shows the hypothesized distribution of the early PN wares.

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[21] Some scholars separate Salasun pottery as a separate tradition and facies because it is generally found in contexts dating to >5,000 years B.P., is aggregated in the regions near Lake Turkana and has some stylistic dissimilarities from other Nderit tradition ceramics.

[22] The use of "years B.P." is the preferred method of chronological reporting in this manuscript. However, when reporting radiocarbon ages reported by other authors, I have chosen to employ their ages, especially when the method of age calibration does not conform to standard protocols.

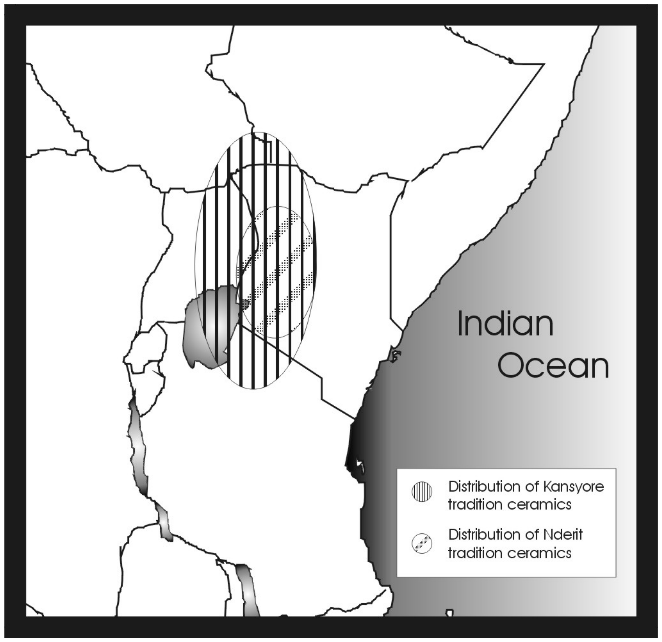

Figure 54. Distribution of Early PN traditions

9.3.2 Evolved PN Ceramics

The evolved phases of PN ceramics are more restricted in their overall geographic distribution, but have been found in higher quantities and are more securely dated. Narosura tradition ceramics (associated with Savanna Pastoral Neolithic occupations in the low-altitude grasslands of the Rift Valley and adjacent regions) have previously been reported after 3,000 years B.P. until 2,000 years B.P. (Bower et al. 1977; Marshall 1990c; Odner 1972). The tradition is defined by triangular-shaped comb stampings and line incisions executed on straight-sided bowls and gourd-shaped vessels (Bower et al. 1977; Wandibba 1980).

The distribution of Maringishu tradition ceramics is far less defined compared to Narosura tradition ceramics. The type-site is located near Solai and finds have been made at Hyrax Hill (Bower et al. 1977). However, Bower (1991: 70) believes that Maringishu tradition ceramics too closely resemble Narosura tradition ceramics in spatial, temporal and attribute characteristics to be classified as a separate form. The most distinguishable variety of these ceramics consists of straight-sided bowls with a slightly pointed base giving them an "ovoid beaker" shape and are decorated with a trellis motif around the rim (Bower et al. 1977; Karega-Munene 2003).

Remnant (a.k.a. Elmenteitan) ceramic traditions are largely limited to the western Rift Valley along the Mau Escarpment. This tradition is associated with the Elmenteitan lithic tradition identified by Ambrose (1984b), which is characterized by long blades with retouched platforms formed primarily from obsidian. The vessels are round-sided open to slightly constricted bowls often with small handles and rarely with decoration (Karega-Munene 2003; Soper 1989). Decorations that are associated with Remnant tradition ceramics include irregularly stabbed impressions within triangular incisions, and milling or nicking of the lip (Ambrose 1984a; Soper 1989). Small, shallow bowls with flat open spouts that resemble oil lamps have also been recovered and identified as part of the Remnant tradition (Soper 1989).

The distribution of the Remnant tradition overlaps with Narosura traditions in Lemek (in Maasai Mara, southwestern Kenya) (Marshall 1990c), but seems to have replaced the Narosura at Enkapune ya Muto in the Central Rift Valley (Marean 1992). The habitation zones of Elmenteitan people tend to be located >1,900 m in elevation on the fringes of the montane forest (Ambrose 1984c). However, seasonal grazing ranges in the low elevation grasslands are also found, but more ephemerally occupied (Ambrose 1985; Robertshaw 1988, 1991).

The common characteristic of the evolved PN traditions is that the assemblages are found in association with high proportions of domesticated animal bones as opposed to wild fauna (Bower 1991). The predecessors to evolved PN settlements have been found in single-component contexts with few domesticated animal remains (Bower 1991; Robertshaw and Collett 1983b). Most evolved PN sites are represented by >90% domesticated fauna and are deeply stratified leading some to conclude that they practiced a form of "tethered nomadism" as opposed to following seasonally dictated migration routes (Bower 1996; Marshall 1994). Even in areas where wild game was undoubtedly abundant, such as at Ngamuriak located in what is now designated the Maasai Mara Game Reserve in southwestern Kenya, there is little evidence of exploitation of wild resources (Marshall 1990a). However, this pattern can be viewed as regionally variable based on the large quantities of endoaquatic resources exploited at the Elmenteitan site of Gogo Falls near Lake Victoria (Marshall 1994; Robertshaw 1990b).

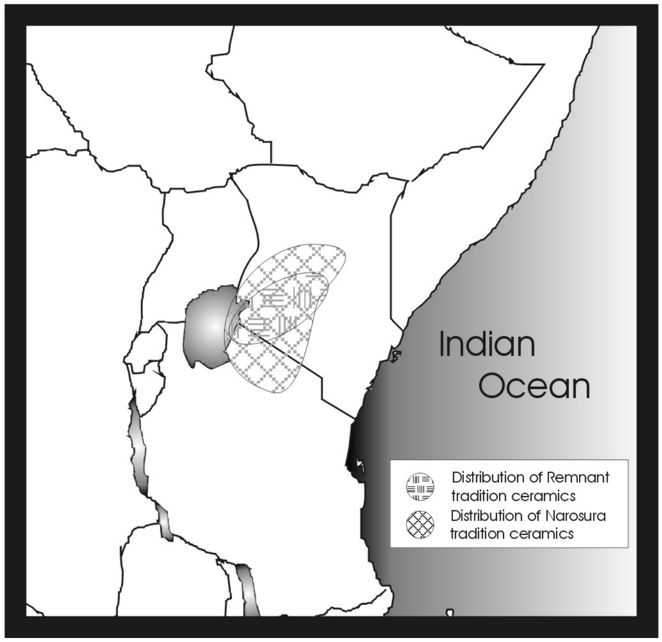

Figure 55. Distribution of Evolved PN Ceramic Traditions

9.3.3 Late PN Ceramics

Little is currently known about the later stages of the PN (Marshall 2000). The Akira ceramic tradition was first associated with the last known PN occupations at Lukenya Hill and Seronera dating to ~2,000 to 1,000 years B.P. (Wandibba 1980). Bower (1991) sees strong associations between incidences of Akira tradition ceramics and earlier forms such as Narosura and Maringishu, which also seem to persist until at least 2,000 years B.P. Akira ceramic assemblages have been found in the same archaeological contexts with Elmenteitan lithic industry tools (Bower et al. 1977). Furthermore, the decorative similarities between Narosura and Akira tradition ceramics are numerous including burnished exterior surfaces and many vessels that contain incised, hatched and cross-hatched ornamentation around the rim (Bower 1991; Bower et al. 1977). However, generally speaking, known Akira forms tend to be thinner and seemingly less utilitarian leading Soper (1989) to suggest that their function may be ceremonial.

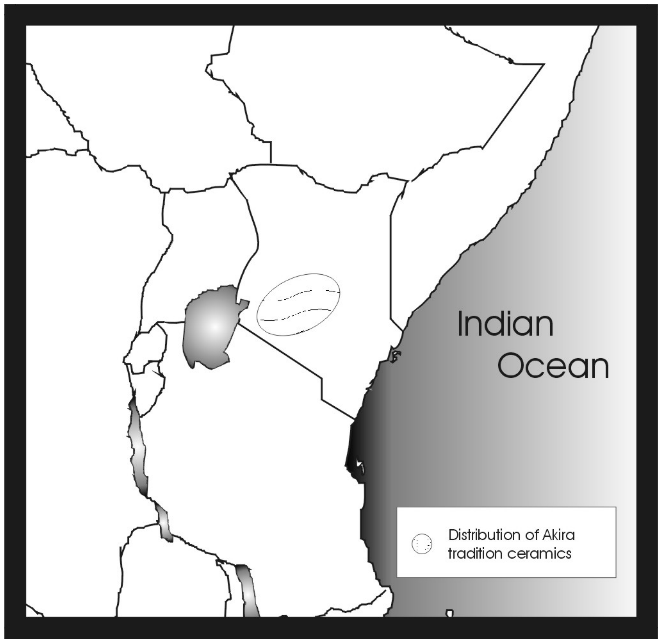

Figure 56. Distribution of Late PN Ceramic Traditions

9.3.4 Iron Age Ceramics

Prior to the 1980s, archaeologists did not classify Iron Age artifacts in the context of the development of Swahili civilization (Soper 1967a, b). Urban centers on the coast were believed to have arisen as a result of external (Arab) stimuli, not as autochthonous entities with roots in the continent in which it was situated (e.g. Braudel 1994; Chittick 1965, 1974, 1984; Kirkman 1964, 1975; Trimingham 1964, 1966). Presently, earlier archaeological data are being reinterpreted with a new assumption: early Swahili city-states were the result of long political and cultural evolutions that stemmed from migrations of people from the hinterlands to the coast (Abungu and Mutoro 1993; Allen 1993; Chami 1994, 1998; Connah 1987; Håland and Msuya 2000; Horton 1996; Kusimba 1999b; Pearson 1998; Pouwels 2000; Robertshaw 1990a). Economic transactions between various ethnic communities also affected the development of settlements to varying degrees.

Early manifestations of iron producing cultures are found on the shores of Lake Victoria as far back as 200 B.C. (Schmidt 1997). Iron working is found at the site of Limbo located 75 km south of Dar-es-Salaam dating between 100 and 250 A.D. (Chami 1992; Schmidt and Childs 1995). This is the earliest known site in the Swahili coast region that has direct evidence of iron production (Chami 1994). At Galu, C. Kusimba (1993: 243) has detected evidence of iron working dating from as early as 630 – 890 A.D. (see also Kusimba and Killick 2003). Likewise, Phillipson (1976) reports smelting from Zambia dated to between 210 and 650 A.D. By the second millennium A.D., exchange of iron tools is found throughout a diverse array of ecological zones in East Africa (Kense 1983, 1985; Kiriama 1993). However, the chronology of the adoption of iron smelting by hinterland communities and the degree to which this was an imported technological idea or physically carried and traded by Bantu people with their Nilotic and Cushitic-speaking neighbors remains somewhat controversial (Abungu 1994-1995; Allen 1993; Chami 1998; Huffman 1982; Kiriama 1993; Kusimba 1993; Kusimba and Killick 2003; Schmidt and Childs 1995).

In the Central Highlands, Rift Valley and Lake Victoria region of East Africa, Maringishu and Narosura Pastoral Neolithic ceramic forms are believed to have been replaced by Urewe tradition ceramics (Collett and Robertshaw 1983). There is little evidence of a geographical overlap between people using PN ceramics and those using Iron Age traditions (Soper 1989). Robertshaw and Collett (1983a: 74) argue that Iron Age agro-pastoralists preferred settling on good farmland while later PN people exclusively herded cattle and therefore sought open grassland environments. Collett (1985) argues that the earliest iron-producing communities show no evidence of evolving out of earlier PN traditions. However, sequential stratified deposits have been found at Gogo Falls, the type-site of Urewe, and on the Upper Tana that show Early Iron Age (EIA) ceramic traditions overlying cultural strata that contain Narosura traditions (Robertshaw 1991).

Urewe tradition ceramics are thought to be ancestral to the Early Iron Ware (EIW) tradition that appears later in the coastal hinterlands (Onyango-Abuje and Wandibba 1979: 32-2). The earliest traces of the tradition are found 2,600 years B.P. in Rwanda and Buhaya (Stewart 1993). After 2,000 years B.P., Urewe bearing sites can be found on the east side of Lake Victoria. The distribution of this tradition is mostly limited to areas that receive >100 cm of rainfall / yr (Stewart 1993).

There is a great deal of heterogeneity to Urewe pottery forms and there has been some criticism to lumping all forms dating to the last half of the last millennium B.C. into one category (Van Noten 1979). Necked pots with thick, beveled rims, beakers and shallow hemispherical bowls with a characteristic dimpled base are typical Urewe forms (Stewart 1993). Incised cross-hatching is also a common decorative feature as are grooved scrolls or rosettes on the body of the vessel (Soper 1989). Open bowls with parallel decorations running from the lip to the base are widespread, but individual motifs and interpretations of the style are more the rule than the exception.

Kwamboo ceramic traditions cover a much smaller geographic range than other Early Iron Age traditions. The first Kwamboo assemblages are detected later in the archaeological record than the first Urewe assemblages, but persist later in time. Sites in the Ithanga Hills of central Kenya place initial Iron Age occupations bearing evidence of the Kwamboo ceramic production tradition at ~1,700 years B.P. (Diblasi 1986). People using Kwamboo ceramics continued to flourish into the second millennium of the Common Era with the evolution of the tradition after 500 years B.P. being referred to as Gatung'ung'a (Soper 1989). The Kwamboo tradition is characterized with roughly fashioned bowls with comb stamping that covers the whole area between the rim and the neck of the vessel (Diblasi 1986; Soper 1989).

The earliest Iron Working ceramic sequences found on the East African coast and Taita Hills were recorded by Soper (1967a; 1967b) and later defined further by Odner (1972). Named after the site in which it was first found, Kwale Ware is characterized as having necked pots and bowls decorated with straight, cross-cutting incisions (Soper 1967a: 4-13). Kwale tradition ceramics are also found in the Taita and Shimba Hills into the highlands of Tanzania (Collett 1985; Håland and Msuya 2000; Soper 1989). Chami (1994; 1994-1995) has defined the same pottery as a subset of EIW ceramics based on attribute analysis rather than site location. EIW incorporates other derivations of Early Iron Age pottery such as Limbo and Mwangia traditions, which date to between A.D. 1 and 600 (Chami 1998: 209).

EIW sites are believed to be restricted geographically to the Tanzanian coast and adjacent islands (Chami 1998), although there are exceptions to this (Duarte 1993: 27; Horton 1996; Mutoro 1998: 191; Sinclair et al. 1993: 417). Sites with the later tradition of Triangular Incised Ware (TIW) found between A.D. 600-1000 are more widespread, especially after A.D. 700 (Chami 1998). Collett (1985: 96) and Chami (1998) argue that Pastoral Neolithic ceramic forms are not ancestral to EIW, strongly suggesting that a migration occurred of early iron using people into East Africa rather than a technological diffusion.

However, Chami and Kweksason (2003) revise earlier understandings of cultural and ceramic traditions in light of new evidence unearthed from four Neolithic sites on the coast of Tanzania and one from the inland Rufiji River. Evidence for early farming communities from the Rufiji River in addition to temporally correlating ceramic evidence convinces Chami and Kweksason (2003) to correct the notion that beveled/fluted pottery traditions accompanied iron-using Bantu agriculturalists spreading into East Africa after the advent of the Common Era. Agriculture and pottery are recovered in archaeologically contemporaneous strata from the Tanzanian coast and interior south to the Mozambiquan border prior to 5,000 years B.P. (Chami and Kweksason 2003). Thus, solid cultural connections existed between early Neolithic communities and later periurban, iron-using settlements on the coast of East Africa.

9.4 Ceramic Finds of the 2001 and 2004 TARP Field Seasons

Excavations during the 2001 field season recovered ceramic sherds that had not been previously identified in other archaeological contexts as well as several that conform to known traditions. The finds expand the geographic and temporal range of both Narosura and Maringishu traditions and cast serious doubt on the notion that the producers of PN and Iron Age ceramic traditions bear no cultural affiliation with one another.

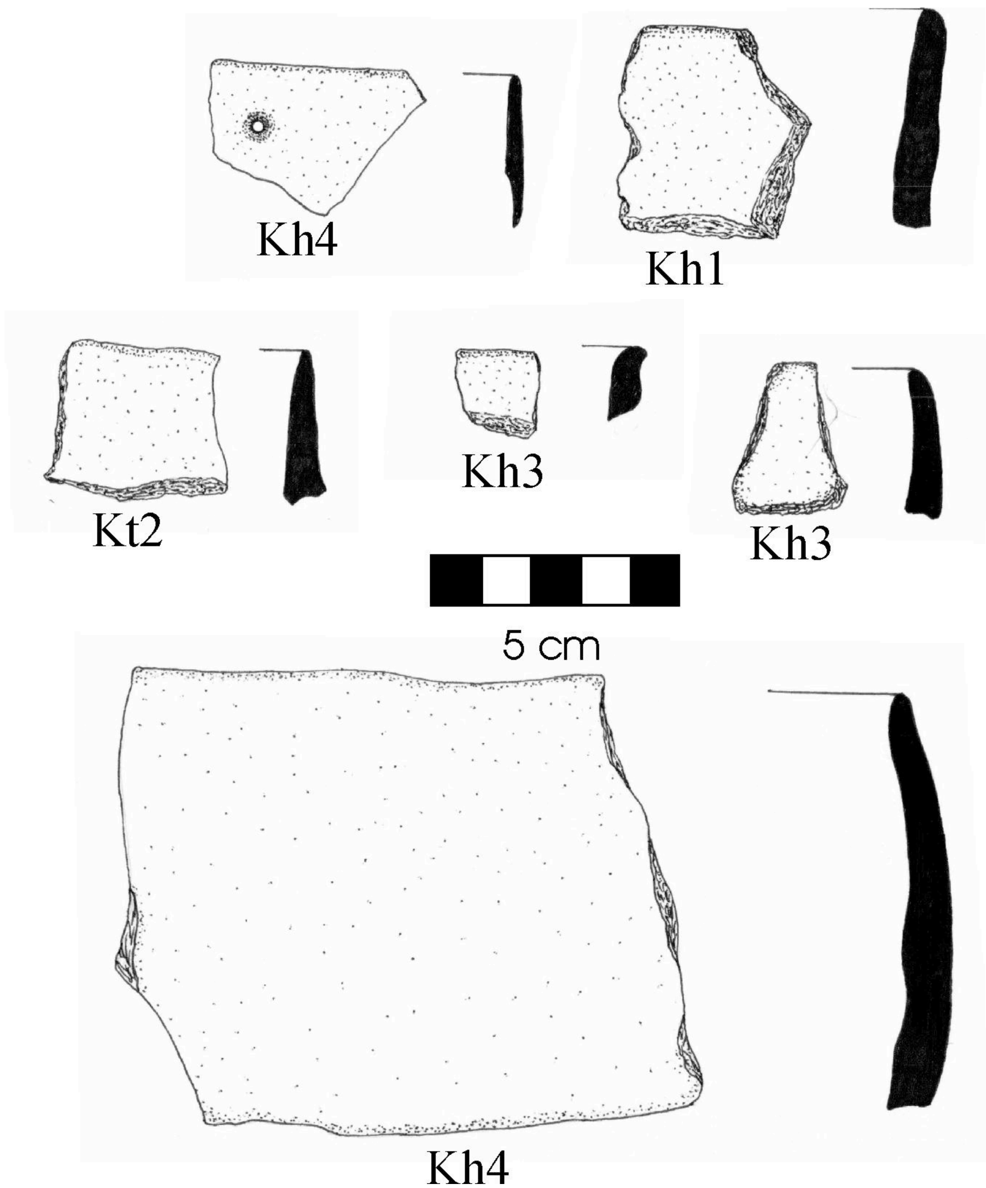

Figure 57. Representative depiction of undecorated ceramics recovered from Tsavo during the 2001 field season with occupation horizons

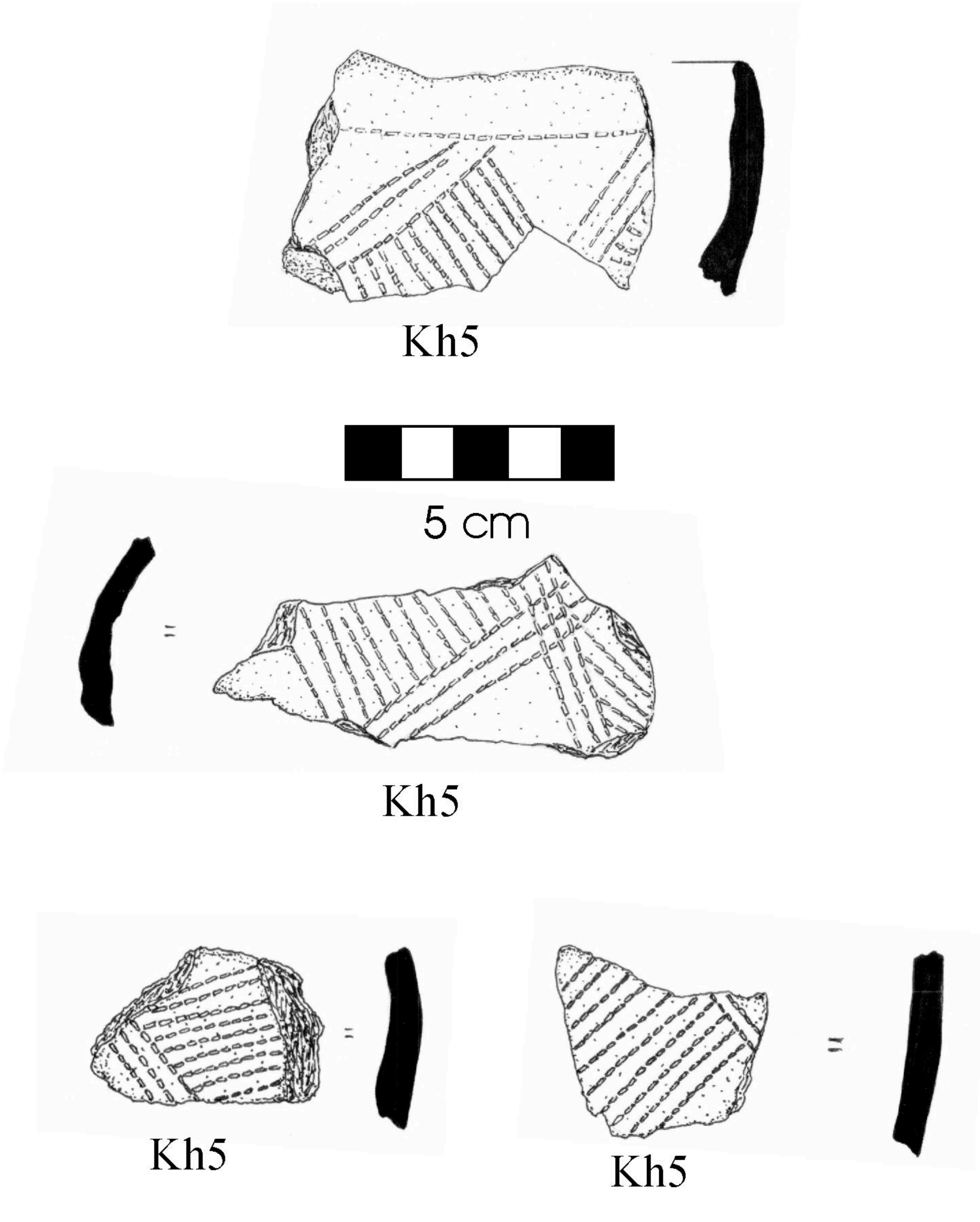

Figure 58. Representative depiction of Narosura tradition ceramics recovered from Tsavo during the 2001 field season with occupation horizons

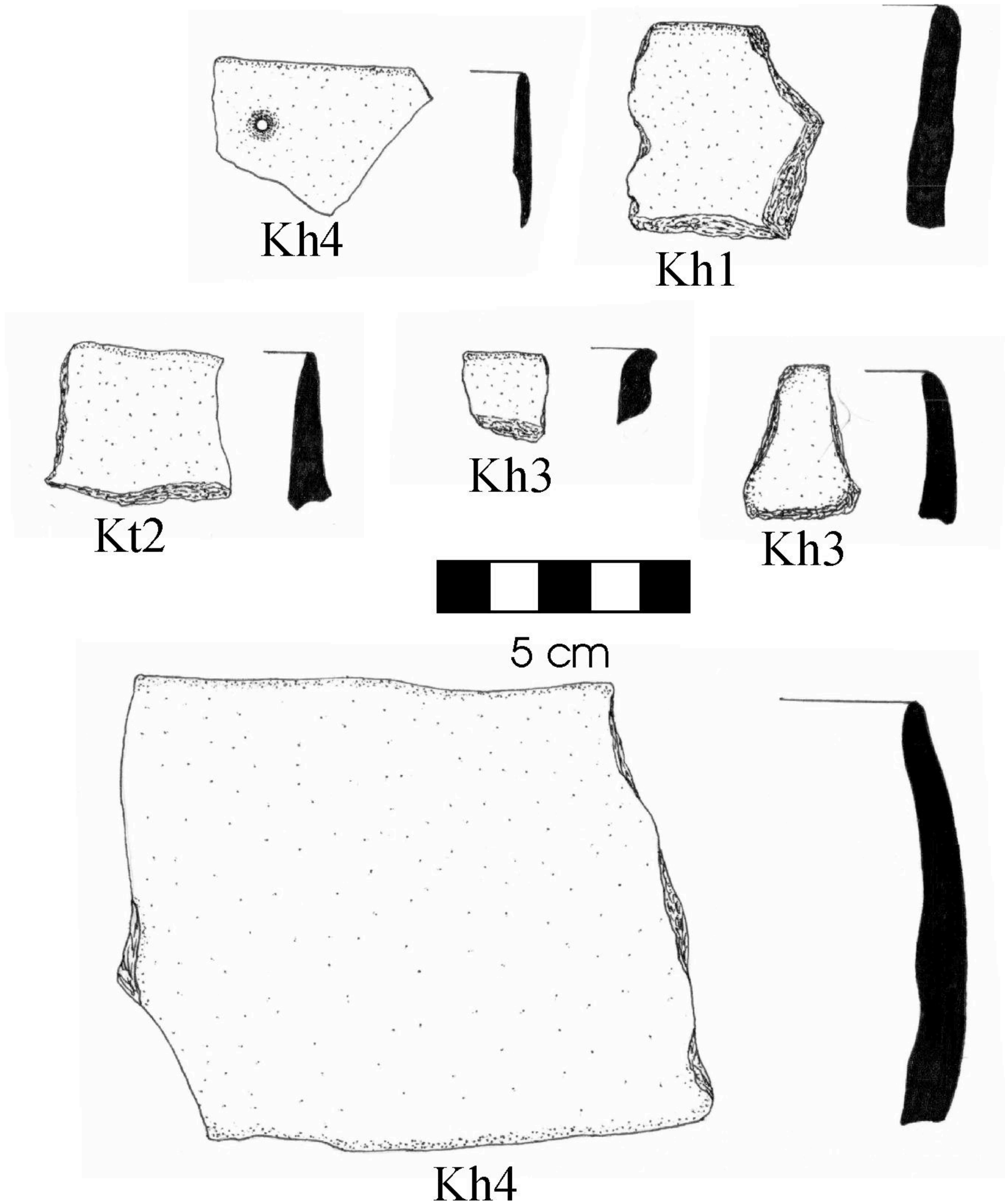

Figure 59. Representative depiction of Maringishu/Narosura tradition ceramics recovered from Tsavo during the 2001 field season with occupation horizons

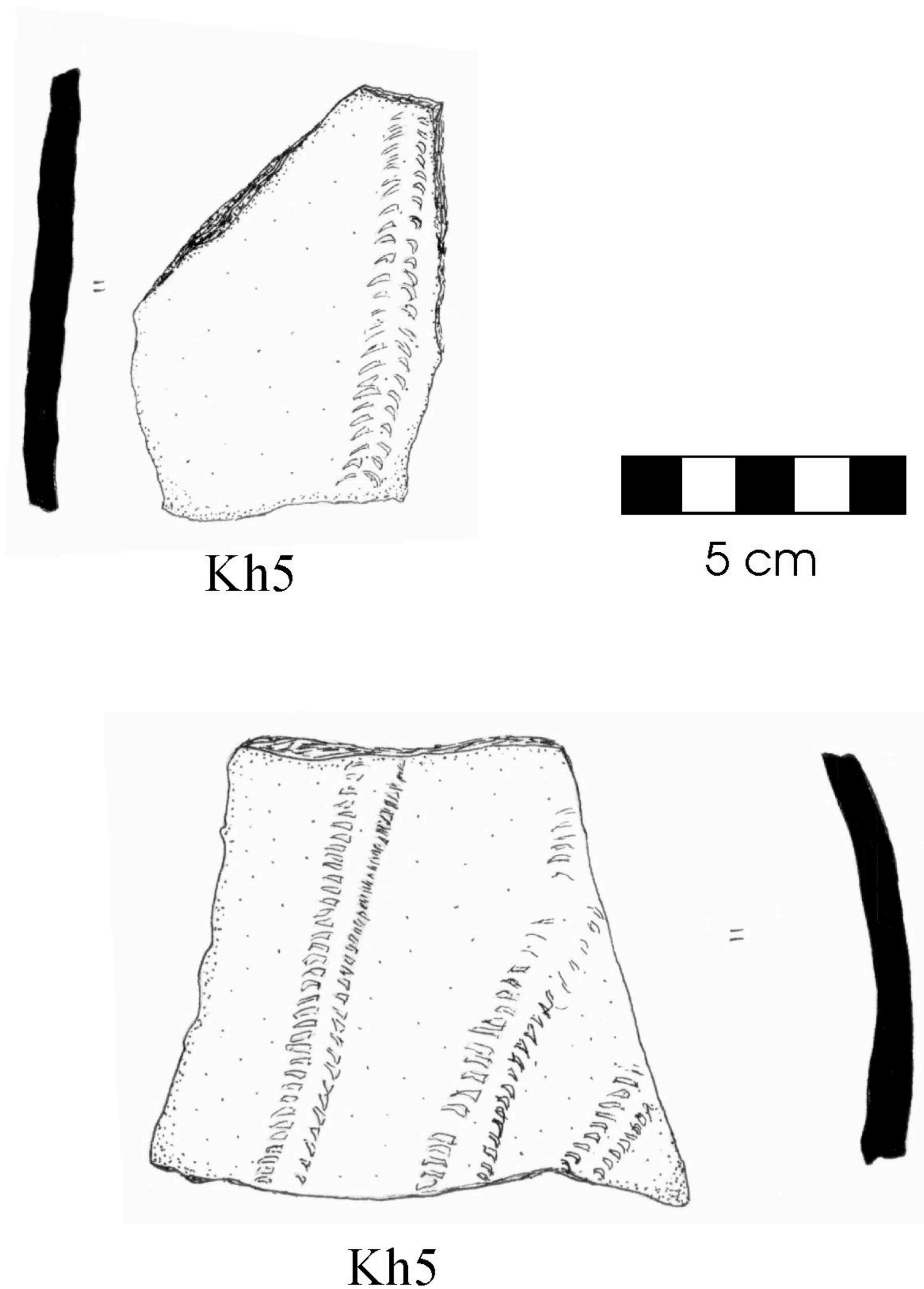

Figure 60. Representative depiction of Narosura ceramics recovered from Tsavo during 2001 field season with occupation horizons

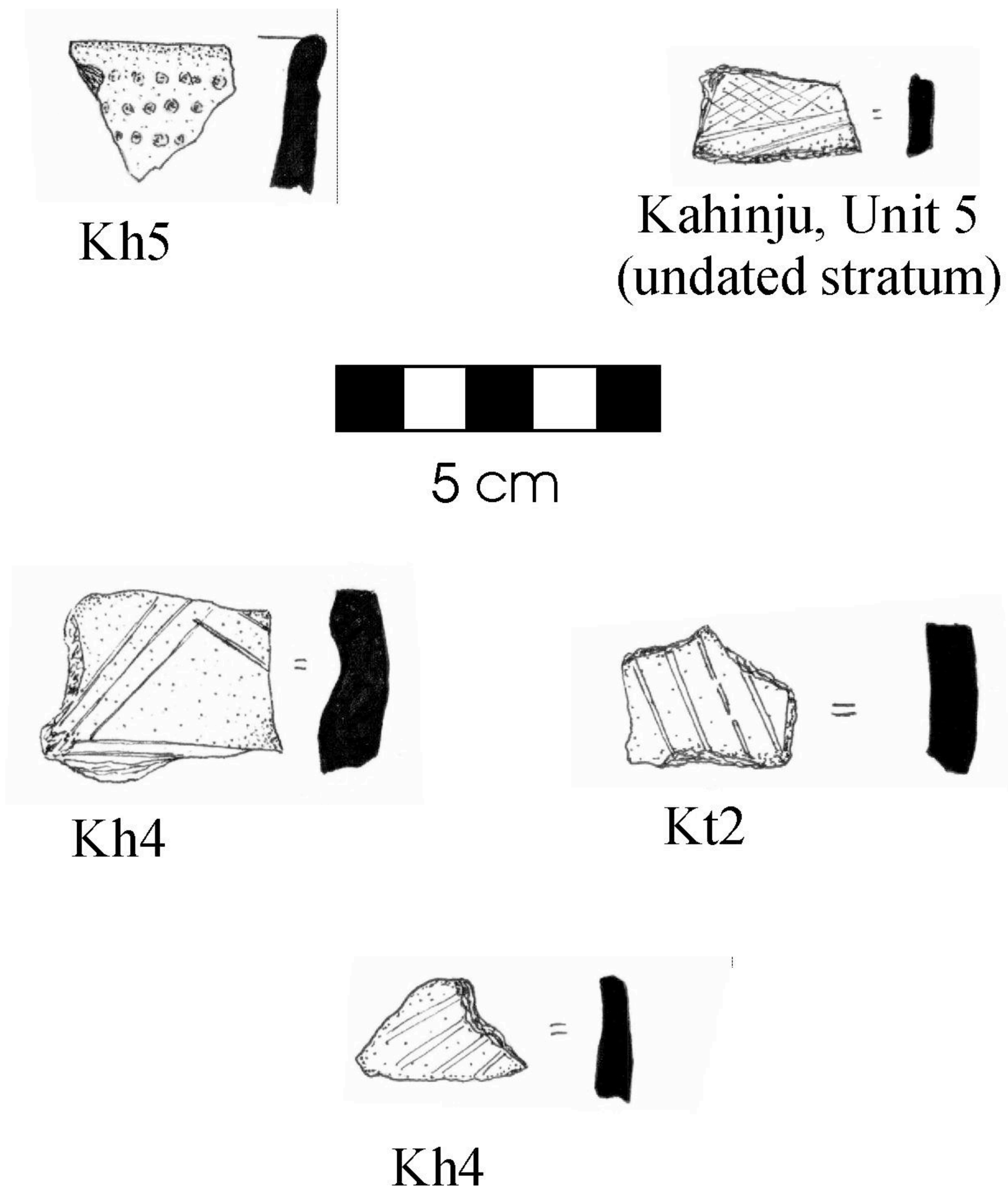

Figure 61. Representative depiction of Maringishu/Narosura/Iron Age ceramics recovered from Tsavo during the 2001 field season with occupation horizons

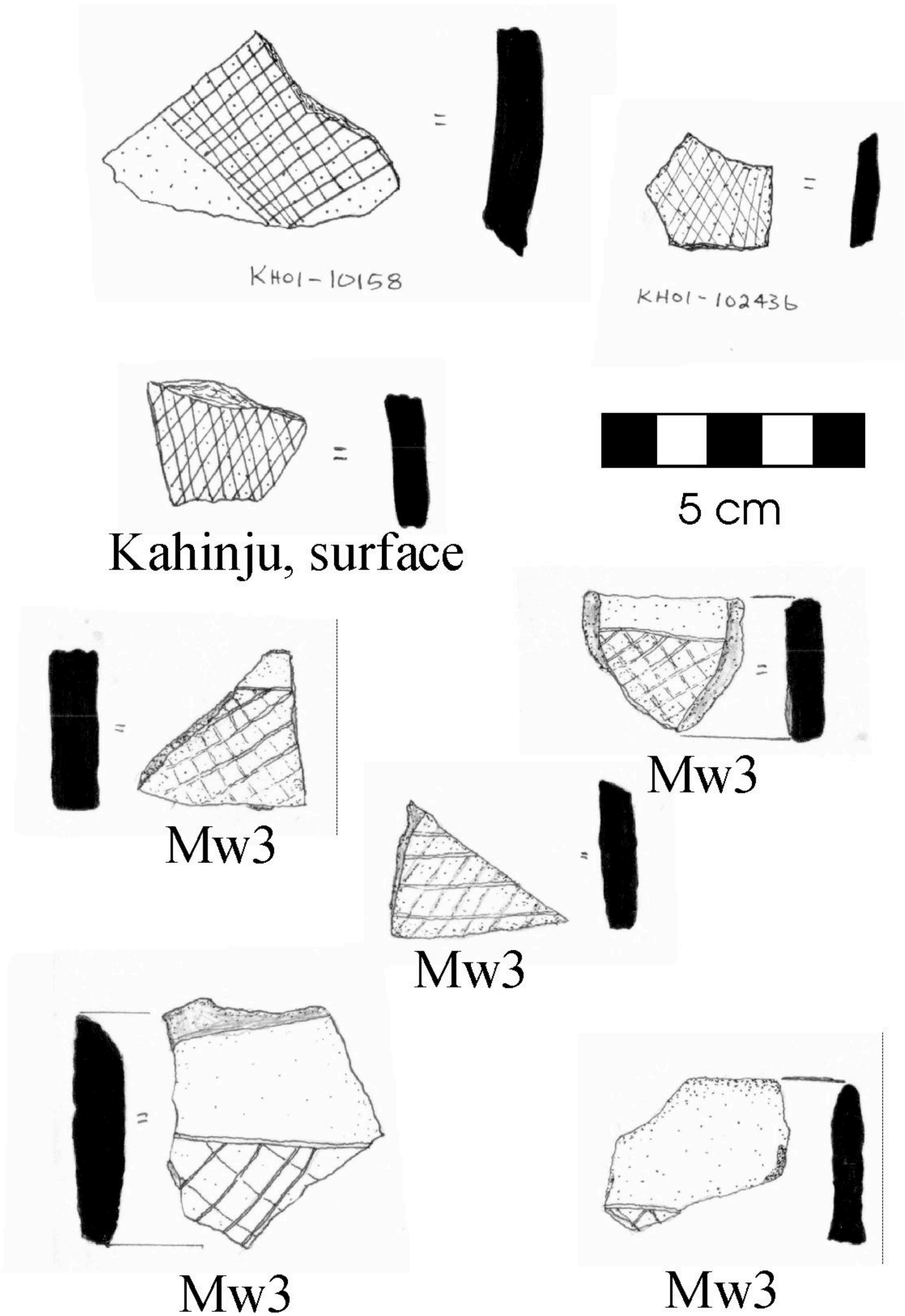

Figure 62. Representative depiction of Narosura tradition ceramics recovered from Tsavo during the 2001 and 2004 field seasons with occupation horizons

9.5 Analysis of the Assemblages in Enhancing Understandings of PN Ceramic Tradition Distribution

The earliest dated ceramic find from Kahinju dates to 3,820 – 3,590 years B.P. (AA51444, UIC1068). The find is too small to place convincingly within a regional facies, but has several diagnostic features that would be expected from the Kansyore tradition. This provisional diagnosis is made based on the fact that the sherd broadly conforms to the timeframe from which other Kansyore finds have been made, is thick and not burnished. However, this sherd could just as easily represent a more localized facies that is not connected to any known typology. The discovery of a similar sherd at Kathuva from an undated context suggests that the distribution of this ceramic type exceeds a site-specific assemblage.

The discovery of Narosura and Maringishu ceramics in sequential cultural levels does not help to resolve Bower's (1991) question of whether the two facies are related traditions. The initial interpretation that Maringishu is an antecedent to Narosura tradition ceramics (Wandibba 1980) is substantiated by the separation of these assemblages in sequential deposits. Based on the evidence at hand, occupation of the site by people using Maringishu phase ceramics occurred between ~3,300 and 3,000 years B.P. (AA51443, AA51445, UIC944, UIC1035). A previously unrecorded ceramic form (Figure 59) was also unearthed in this assemblage and is therefore assigned as a regional facies to the Maringishu tradition[23].

[23] Simiyu Wandibba has looked at sherds from this facies and believes that they may be Narosura tradition ceramics based primarily on vessel thickness. Therefore, assigning these sherds to the Maringishu facies is not conclusive. A more detailed analysis of the ceramic assemblage is necessary before the final verdict can be rendered.

Sherds diagnostic to the Narosura tradition have been recovered from a stratigraphic level securely dated to 2,750 to 2,470 years B.P. at Kahinju (Figures 58 – 62; AA51442, UIC943) and between ca. 1,000 – 3,000 years B.P. at Mwiitu. These finds are also associated with a variant of Narosura decoration that has not been reported in other publications but bears striking physical and stylistic similarities to known Narosura tradition ceramics (Figures 58 – 62). In addition, large burnished cylindrical vessels have also been recovered from this level (Figure 57, 63). The undecorated rimsherd comes from a pot whose diameter measures 36 cm. The sheer size of these vessels reinforces the hypothesis that the occupants of the site during this occupation phase (Kh5) were low-mobility pastoralists (e.g. "tethered nomads").

Figure 63. Large pot excavated from Kahinju, Unit 1

TABLE XIV. RIMSHERD DIAMETERS

Artifact #	diameter (cm)
Kh10015	Indeterminate
Kh10111/10112	36
Kh10113	22
Kh10068/10074	22
Kh10073/10070	26
Kh10279	34
Kh10297	Indeterminate
Mb20010	Indeterminate

The most evocative ceramic find of the 2001 field season is the rim sherd depicted in the upper left hand corner of Figure 61 dating to ca. 2,700 years B.P. (Kh5). The most diagnostic feature of the artifact is the presence of snail shell impressions as a decorative element, which is typical of Kwale Wares and later Swahili pottery recovered elsewhere (Soper 1967a, b, 1989; Wilson and Lali Omar 1997). There is no known tradition of PN ceramics that has this form of decoration. It is therefore possible that this find links the presence of PN and EIW ceramic traditions together in one clear stratigraphic context for the first time. The *in situ* association of the two previously unconnected traditions now forces the question as to how related the early iron producing settlements were with PN communities.

It has been suggested that kinship ties were crucial for the creation of long-distance trade networks between the coast and interior (Abungu 1994-1995; Abungu and Mutoro 1993; Horton 1984, 1990, 1996). Ceramic finds at Kahinju suggest that early ties between inland pastoral communities and later Swahili people may exist. Figure 64 shows decorative motifs from ceramic sherds recovered *in situ* at Kahinju and Mwiitu dating to before 3,000 years B.P. in comparison to decorative motifs found on EIW ceramics in other parts of East Africa. EIW wares reported by Posnansky (1961: 181, 184), Wilson and Lali Omar (1997: 40-41), Soper (1989: 21) and Chami (1998: 202) bear striking decorative and attribute similarities to Pastoral Neolithic-era Maringishu and Narosura Wares (Figure 64).

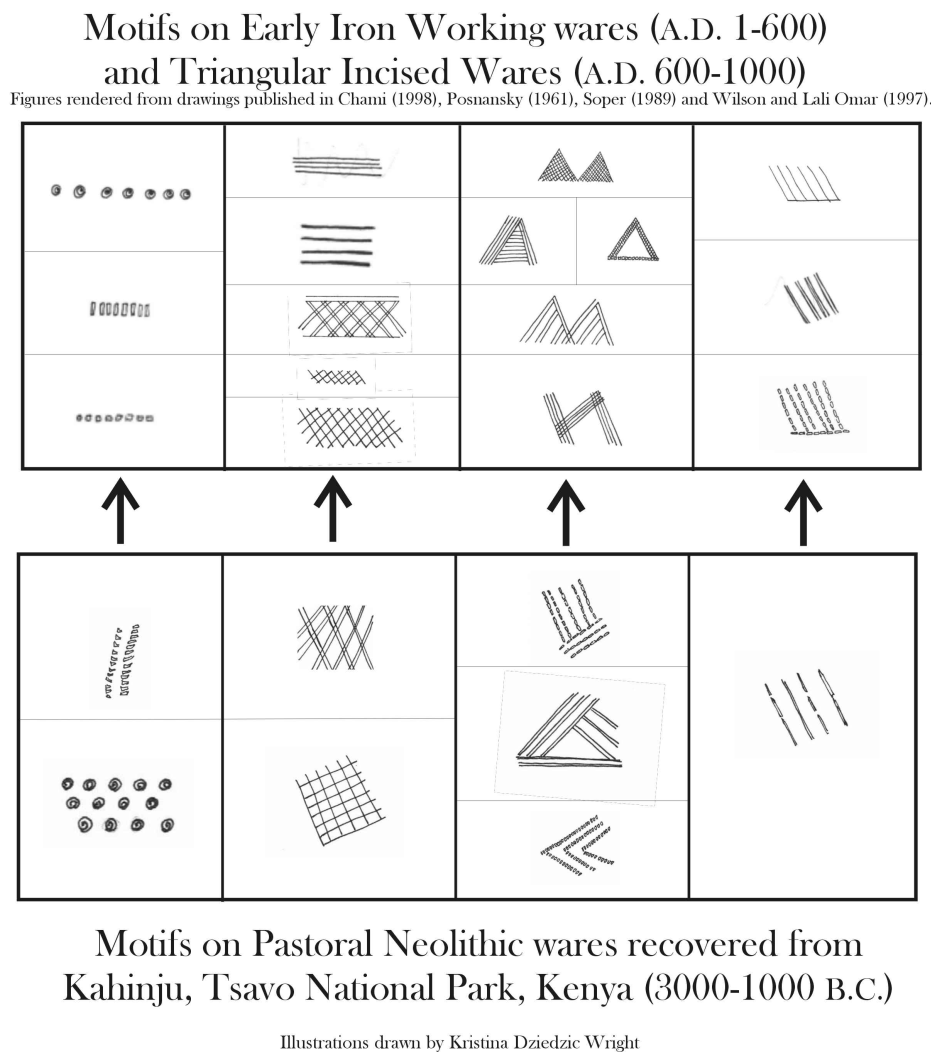

Figure 64. Motifs of recovered assemblages from Tsavo 2001 and 2004 compared to regional typologies developed by Chami (1998), Posnansky (1961), Soper (1989) and Wilson and Lali Omar (1997)

Horton (1996) makes similar observations in his analysis of EIW pottery from Shanga. Although the distribution of ceramics does not necessarily correlate directly to the movement of people (e.g. Hodder 1977), the replication of decorative features on ceramics throughout a 1,000+ year time period suggests that there is continuity of material reproduction in the community-at-large. I am suggesting that such continuity was largely perpetuated by interactions based on the notion of kinship, which is supported by lexicostatistical data and solid evidence of the existence of long distance trading networks in the early centuries of the Common Era (Ehret 1998, 2001). This issue will be addressed in more detail in Chapter 10.

9.6 Mobility/Population

The quantity of sherds recovered from the sites of Kahinju and Kathuva are indicative of sustained, intensive settlements. PN Archaeological sites in East Africa are generally characterized as having low-density ceramic assemblages due to the high mobility of early herding cultures (see for example Ambrose 1984b: Table 7.1). New investigations of Kansyore sites near Lake Victoria have demonstrated that some late Eburran-phase people accumulated and discarded copious amounts of ceramics, which have been interpreted as markers of delayed-return foraging strategies (Dale 2000).

As opposed to "immediate-return foraging," delayed-return foraging strategies involve storage and the development of socially stratified networks to manage and redistribute gathered resources (Woodburn 1982). In addition, limited management of the landscape is implied *vis á vis* keeping beehives, weirs, traps, boats, etc. in a delayed-return foraging economy (Woodburn 1982). Woodburn (1982) contrasts these societies with immediate return foragers (examples he cites are !Kung, Hadza, Mbuti and Batelk) in which resources are consumed at the point of procurement and little or no management or forethought is given to perpetuation of resources (Woodburn 1982). Although this position has been criticized for being overly simplistic and untenable in the real world (Bird-David 1992; Flanagan 1989; Kelly 1992; Terrell et al. 2003), it represents a means for scaling sedentism and degree of investment a group makes into a particular landscape (Layton et al. 1991). After 6,000 years B.P., LSA sites in East Africa demonstrate increasing reliance domesticated plants and animals, which correlates to ever growing use of ceramics and eventually metal products. Ceramic production is generally understood to occur among groups with restricted mobility ranges in East Africa (Bower 1997), generally because of the difficulty associated with transportation of pots over long distances (Arnold 1985).

Similar interpretations have been advanced regarding late foraging sites in the Sudanese Sahara. During the MHCO, semi-sedentary, non-specialized waterfront foragers inhabited Dotted-Wavy Line (c. 6,000 ^{14}C years B.P.) and Laqiya (c. 5,500 ^{14}C years B.P.) pottery sites and deeply stratified deposits of ceramics prior to abandonment of the sites (Hoelzmann et al. 2001). These sites stand in drastic opposition to later known ephemeral pastoral occupations in the area when the environment was desiccating (Hoelzmann et al. 2001; Hoelzmann et al. 2000). The pastoral Leiterband (c. 4,800 ^{14}C years B.P.) and Halbmond-Leiterband (c. 4,200 ^{14}C years B.P.) pottery distributions were comparatively light relative to earlier archaeological deposits in the region.

These observations have been further corroborated in a study conducted in the Great Basin of the northwestern Utah that used X-Ray Diffraction (XRD) to show correlations between residential mobility patterns and ceramic production (Simms et al. 1997). This study demonstrates that the greater the investment a group makes into ceramic production (time, materials, decorative features), the less mobile that population is (Simms et al. 1997). Similar accounts have been made in the ethnographic record of the Great Basin where until the late 19th century, largely semi-mobile populations were the primary inhabitants of the region, and of these only 40% manufactured ceramics (Arnold 1985: 124).

Wilkinson (1989) sees a strong correlation between high human populations and the number of ceramic sherds that are collected in pedestrian reconnaissance of several sites worldwide. At many archaeological sites, the number of archaeological occupations at one site is commonly separated by latitudinal and longitudinal (x, y) distance. However, in the study set elucidated for this thesis, all sites had evidence of multiple occupations that were separated by vertical (z) distances (Chapter 6). Thus, the surface collections from the Galana River sites are ambiguous in their ability to shine light on relative population densities of archaeological occupations.

The total excavated ceramic sherd count for Kahinju was 290, for Kathuva was 228 and Mwiitu was 130. Counts corresponding to occupation horizons can be found in Tables XV, XVI, XVII. Rimsherd diameters are provided in Table XIV. These finds suggest that storage, rather than mobility was of primary concern to the users of these wares. Because of the difficulties associated with transporting them, large ceramics at an archaeological site are commonly regarded as an indicator that the inhabitants of the site were not highly mobile (Arnold 1985; Close 1995; Eerkens 2003; Sassaman 1993; Simms and Russell 1997; Sullivan III 1995; Wills 1996). Taken in tandem with other lines of evidence, the PN inhabitants of the Galana River known to this point do not seem to have prioritized mobility in the face of alternative food procurement and storage opportunities.

TABLE XV. SHERD COUNTS BY OCCUPATION HORIZON AT KAHINJU

Sherd Counts	Occupation Horizon
7	Kh1
17	Kh2
58	Kh3
121	Kh4
66	Kh5

TABLE XVI. SHERD COUNTS BY OCCUPATION HORIZON AT KATHUVA

Sherd Counts	Occupation Horizon
0	Kt1
115	Kt2
41	Kt3
69	Kt4
2	Kt5

TABLE XVII. SHERD COUNTS BY OCCUPATION HORIZON AT MWIITU

Sherd Counts	Occupation Horizon
8	Mw1
121	Mw2
1	Mw3

At Lubbub Creek site, a 23 ha (9.31 acre) Mississippian occupation along the Tombigbee River in west-central Alabama, Blitz (1993) finds a strong correlation between the use of large cooking vessels and emphasis on storage and communal feasting activities. A strong correlation between vessel frequency and size has been detected from another Mississippian site on the Onconee River in north-central Georgia (Shapiro 1984).

His data is contrasted with a number of sites in the region that show evidence for high mobility patterns among prehistoric people who possess few ceramics and the vessels that are found tend to be small in size (Shapiro 1984). In these examples, low residential mobility patterns are found at sites where ceramic pots are large in size and frequent in number.

Likewise, production of large ceramic storage vessels intensifies during the first millennium A.D. in western Texas corresponding to the Pueblo Period when there is strong evidence for a heavy dependence on cultigens and low residential mobility (Whalen 1998). This pattern contrasts the earlier Pithouse Period, marked by El Paso Plain Brown ceramics that are smaller in size and less frequent in numbers than the later period ceramics. Pithouse Period archaeological occupations are characterized as having evidence for high residential mobility geared toward the emphasis of procurement of seasonally available wild resources (Matson 1991; Wills 1988). Evidence for permanent settlements with inferred low residential mobility patterns during the Pueblo Period corresponds to increasing numbers of sherds and also the production of proportionally more vessels with orifices >40 cm in diameter compared with the earlier periods (Whalen 1998). Ceramics are a form of community infrastructure investment that are indicative of restricted group mobility because their function is closely tied to storage—an activity that is generally understood to constrain mobility rather than facilitate it.

9.7 Conclusion

This chapter has detailed arguments pertaining to an expansion in the known timeframe and geographic distribution of prehistoric ceramics. These findings agree with contemporary scholars that the cultural milieu in East African prehistory was far more dynamic than initial ceramic typologies suggested. Furthermore, these data detect the presence of large volumes of bulky ceramics, which indicate a restricted range of mobility for the occupants of these sites. Chapter 10 will continue to explain the significance of the ceramic assemblages of Kahinju, Kathuva and Mwiitu in the context of a growing corpus of evidence that PN sites were closely knit to their regional antecedents and predecessors in terms of technology and material culture.

Chapter 10. Exchange Items

"Urban centers never exist in isolation—they are always articulated with a regional hinterland" (McIntosh 1997: 463).

10.1 Introduction

Africanist archaeology has long held the notion that early iron using people in East Africa were both socially and materially distinct from Later Stone Age (LSA) Neolithic pastoralists. However, current revisions to our understanding of the historical past coupled with recent discoveries made in Tsavo National Park are challenging such an anachronistic view. Historical sources indicate that people living on the coast of the Indian Ocean in the first half of the first millennium A.D. were perhaps pastoralists, possessing technology similar to what hinterland communities employed (Casson 1989; see also Horton 1990). Ceramic evidence recovered from proto-Swahili levels at the site of Shanga located on the island of Pate on the northern Kenyan coast also indicates that stylistic attributes of Early Iron Working (EIW) pottery are strikingly similar to late Pastoral Neolithic (PN) traditions (Horton 1996). Recent archaeological investigations from the Tanzanian coast have also produced evidence of a Neolithic antecedent to Early Iron Age (EIA) beveled/fluted pottery traditions suggesting that a cultural continuum existed between mixed foraging/pastoral economies and settled, agricultural communities (Chami and Kweksason 2003). Furthermore, proposed revisions of the lexicostatistical evidence of the Bantu expansion into eastern and southern Africa challenge the notion that iron-using Bantu agriculturalists pushed out LSA Cushitic and Nilotic pastoralists in one rapid sweep across the subcontinent (Ehret 2001).

Some of the decorated ceramics recovered from the site of Kahinju bear a striking resemblance to motifs found on later EIW wares. A later phase found at the site of Kathuva dates to between 1,410 and 1,310 years B.P. The discovery of a cowry shell *in* *situ* dating to this time period confirms that early exchange involving preciosities had begun which was a prequel to the later documented florescence of trade between urbanized coastal communities and rural pastoral people dating to between 1,000 and 500 years B.P. (Kusimba 1999b; Kusimba et al. in press). However, there is no evidence that this trade resulted in a drastic reorganization of technology, subsistence or mobility strategies of the herders living along the Galana River. This chapter will discuss recent finds along the Galana River, Tsavo, Kenya and how these discoveries pertain to perspectives on precolonial exchange of commodities and technological innovations in East Africa. The broader impacts of this research will also be applied to the general theoretical discourse in order to augment the discipline's understanding of the development of social and material distinctions between prehistoric societies.

10.2 Review of the Ecology of the East African Coastal Plains

The Swahili coast as it is defined today lies on the East African littoral plain of the Indian Ocean extending about 3,000 kilometers from present-day Mogadishu, Somalia to Cape Delgado, Mozambique (Figure 65). The coastal plain extends as far as 300 kilometers inland in some areas of Tanzania and Mozambique, but can be as narrow as 20 kilometers toward the north (Orme 1996: 258). It is dotted with numerous small islands and coves, but there are very few natural harbors in which large ships can be docked. The diverse climate of the coast supports a variety of vegetation and wildlife, which has created zones of resource specialization that likely contributed to the success of competing trading polities. Some areas of the coast receive as little rainfall as 80 mm, while others receive around 2,000 mm (Areola 1996). As would be expected, these extreme imbalances in rainfall also produce differing conditions for subsistence.

Transhumant pastoralists have traditionally occupied arid areas, while areas that receive high amounts of rainfall are well suited for agriculturalists who cultivate fruits and vegetables. Until recent times, foraging and mixed subsistence groups could also be found occupying the full range of ecozones along the coast (Kusimba 2003; Ominde 1979).

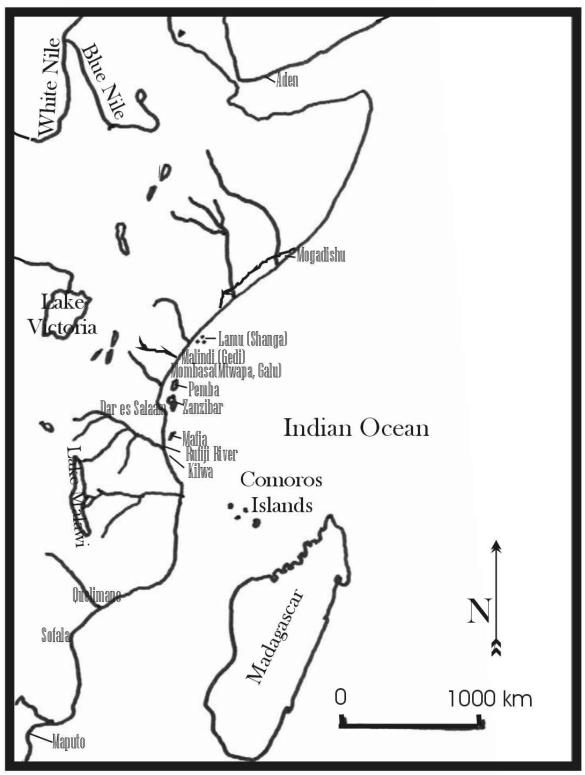

Figure 65. The Swahili Coast

The coast is crosscut with numerous major rivers and creeks that drain lakes and mountains from the interior. Only a few of these rivers are navigable for any great distance (Osei and Aryeetey-Attoh 1997: 9). Because of this, there is little doubt that journeys between the interior and the coast were difficult, but there is also documentary evidence it was a journey that people were willing to make because of the potential rewards (e.g. Burton 1872; Freeman-Grenville 1962a; Krapf 1858; Stanley 1890; Thompson 1968 [1885]). It is a central hypothesis of this dissertation that rivers were essential for supporting life in the hinterlands where pastoralists and some agriculturalists depended on permanent water for their survival.

Generally speaking, the climate and vegetation regime of East Africa grows increasingly arid the further one travels from the coast (Hamilton 1982; Leroux 2001, see also chapter 5). The topography adjacent to the coastal plains consists of gently rolling sedimentary hills that have been severely eroded over time. The soils are thin, and irrigation or terracing is necessary to sustain long-term agriculture in most areas (Wijngaarden and Engelen 1985). Rainfall is controlled by seasonal monsoons forced by alternating low and high pressure convection cells over the Indian Ocean and South Asia, and is strongly correlated to the El Niño cycle through Walker Cell teleconnections (see Chapter 3). Thus, the interannual variability in rainfall is high, making predictions of resource availability a very precarious endeavor (Semazzi and Indeje 1999).

The inhabitants of the interior have had to adjust their lives to the uncertainty of the environment they inhabit. This chapter will argue that the fabric of interactions between rural and urban East Africans was established long before the florescence of Swahili city-states. Patterns of exchange visible in the archaeological record were developed in prehistoric times to buffer against the uncertainties inherent to the environment, but indigenous technologies still flourished in some regions where local economies could not or did not want to support allochthonous inventions.

10.3 Early Iron Working (EIW) Settlement of the Coast

10.3.1 Archaeology

A detailed summary of the archaeology of the EIW communities is provided in Chapter 9. Therefore, the reader is urged to review the previous chapter for archaeological information on incipient iron-using communities.

10.3.2 Linguistics

It is believed that some of the earliest known modern humans to inhabit this region were Khoisan speakers (Nurse and Spear 1985: 33). The early Khoisan of East Africa were hunter-gatherers who collected wild plants and fruits, and utilized a broad range of stone technologies to prey on savanna and montane-dwelling ungulates (Kusimba 2003). Somewhere from around 2000 to 3000 B.C., the Khoisan people were squeezed southward in wake of a sudden and large movement of Southern Cushitic pastoralists originating from southern Ethiopia and Nilotic pastoralists from Sudan (Ehret 1998:7; Nurse and Spear 1985: 34-6). The Cushites were probably seeking new pasture in response to the desiccation of savanna ecosystems in the southern Sahara and Sudan regions (Gasse 2000; Hoelzmann et al. 2001; Prentice and Jolly 2000). The assumption has been that the eventual effect of this movement after 500 B.C. was the displacement of the indigenous hunter-gatherers by people who were primarily oriented toward the production of food (Bower 1991). However, hunting and gathering continued to be an important component of the subsistence base in East Africa even into the historic era (Kusimba 2003: 214-238).

Sometime after 1000 B.C., Bantu-speaking people entered East Africa from the Congo basin and began to move into the Western Rift Valley (Ehret 1998, 2001; Nurse and Spear 1985). Subsequent to that event, Eastern Cushitic people such as the Oromo (pejoratively, but commonly referred to as "Galla") and Somali began to immigrate from the north settling along the east coast of what is now Kenya (Nurse and Spear 1985: 36). Around 2,000 years ago, Bantu dialects were spoken by many coastal people and their hinterland neighbors (Ehret 1998, 2001; Phillipson 1993a). Iron working technology and artifacts have been recovered from archaeological deposits in East African within centuries of the advent of the Common Era, but cannot be explicitly associated with "Bantu-speaking" or "farming" cultures (Kense 1983, 1985).

Thus, in the early years of the first millennium A.D., the east coast of Africa was culturally eclectic. This phenomenon created a mosaic of subsistence and settlement strategies that connected the inhabitants of this region to one another. It is likely that all groups practiced some or all of the various forms of subsistence available to them in their environment and traded with their neighbors to obtain what they could not get in their own home range (Abungu and Mutoro 1993; Kusimba 1999b; Roscoe 1966). Perhaps because of this, the archaeological record shows great continuity between the cultural material produced and exchanged between different social groups in East Africa.

10.4 Early Swahili Civilization

Shortly after the beginning of the Common Era, Greek and Roman merchant vessels had minimal contact with some of the groups on the coast (Casson 1989). Muslim merchants first began to arrive on the Swahili coast by the eighth and ninth centuries (Levtzion and Pouwels 2000). Periurban and eventually urban cultures supported by subsistence and exportable trade items brought in from their hinterlands developed on the coast at this time. Swahili merchants were trading the goods procured from the interior with the distant locales of China, India and Arabia. The northern coastal settlement of Shanga had public structures fashioned from coral stone and a thriving urban center by the tenth century (Horton 1996).

Horton (1984; 1990; 1996), Wilding (1980) and Abungu (1994-1995) contend that the earliest ceramic sequences of some of the Swahili settlements may represent ethnically Cushitic people. The most recent translation of a first century A.D. Greek manuscript has played a large role in the construction of Horton's argument. The *Periplus of the Erythrean Sea* is a Greek maritime navigation document that tells of a port called "Rhapta" along the Azanian (a.k.a. Swahili) coast (Casson 1989). It details the distances and routes sailors were required to sail in order to arrive at ports in the Indian Ocean littoral where trade items could be acquired. Horton (1990) believes that the people of the *Periplus of the Erythrean Sea* must have been Southern Cushites based on the descriptions of the social structure and material culture provided in the text. In addition, he looks at what he calls the "cattle corral" pattern of the early coastal sites to argue that the early first millennium inhabitants of the coast must have been Cushites who are known for their enclosed kraal settlement patterns (Horton 1987).

Many scholars take issue with using the term *Swahili* to describe anyone who is non-Bantu in origin (Chami 1998; Middleton 1992; Pouwels 1999). Modern Swahili retains 44% proto-Bantu cognates while additional vocabulary has been contributed from the various languages with which the Swahili people have had contact including Arabic, Hindi, Turkish, Portuguese, and English (Kusimba 1999a). It is indeed likely that at the time of the writing of the *Periplus of the Erythrean Sea* there were Cushitic inhabitants on the coast who may have aggregated into a trading settlement in response to demographic and social pressures placed on them by the Bantu newcomers (Pouwels 1999). Some have argued that based on the vestiges of Cushitic loan words left in the modern Swahili language, their contribution to the development of Swahili society was probably very minimal although some cultural intermingling is likely to have occurred (Nurse and Hinnebusch 1993: 21, 490-1).

However, Chami and Kweksason (2003) refute the assertion that the people recorded in the *Periplus* necessarily spoke Cushitic dialects. Instead, they claim that early Bantu-speaking people penetrated to the coastal areas much earlier than has been previously asserted. This contention is sustained in new revisions to lexico-historical understandings of the prehistoric spread of African languages and language families (Ehret 2001). Although specifics regarding the introduction of language and technology into East Africa remain ambiguous, new understandings of the prehistoric milieu agree that complex cultural interactions have occurred since Neolithic times throughout the region and greatly influenced the evolution of later exchange systems between urban communities and the rural hinterlands.

10.5 Swahili Civilization in a Regional Context

Little data from the hinterlands of East Africa have been found delineating trade routes during the period of early Swahili settlement of the coast. Prior to European colonization of the coast, there is scant documentation of the actual nature of the coast/hinterland interactions. The first Arab and Chinese travelers and seasonal inhabitants arrived on the coast in the first millennium A.D. In the middle of the ninth century, the Chinese visitor Tuan Ch'eng-shih records that natives subsist on primarily pastoral products and byproducts and engage in trade of ivory, ambergris, and slaves with Persian merchants (Freeman-Grenville 1962b: 8). Arabian traveler, al-Mas'udi, describes the inhabitants of the coast as iron-working people living in stratified settlements with "kings" who dictate the law that people are obligated to follow (Freeman-Grenville 1962b: 16). Additionally, Sassanian-Islamic and Early Sgrafiatto pottery has been recovered from proto-Islamic levels at Shanga that date to before A.D. 1000 (Horton 1996: 274-7). This has led Horton (1996: 421) to conclude that Muslim merchants were active on the coast as early as the eighth century A.D. It is likely that these were mostly indigenous Muslims who had converted in maritime expeditions to Arabia.

The early historic-era record plays a crucial role in augmenting understandings of how precolonial exchange networks operated. The afore mentioned *Periplus of the Erythrean Sea* advises circum-Mediterranean merchants that a variety of wild animal products including cat skins, rhinoceros horns and elephant tusks are obtainable from the port of Rhapta (Casson 1989). The Chinese traveler Tuan Ch'eng-shih (died A.D. 863) writes of a thriving trade in ivory, slaves and ambergris made available for Persian and Arab merchants by local merchants (Freeman-Grenville 1962a: 8). Arab explorer al-Mas'udi (ca. A.D. 915) also acknowledges the importance of East African trade of ivory, leopard skins and tortoise shell within the Muslim Indian Ocean network (Freeman-Grenville 1962a: 14-17).

Minerals were also sought from the East African interior for export abroad. Hematite and quartz found at Manda and Shanga were used for iron and bead production and originated from the interior (Mutoro 1998). Quartz used in the manufacture of beads during Fatimid Egypt (10^{th} to 11^{th} Centuries A.D.) is believed to have come from East Africa (Allen 1993). The hematite found at Shanga must have come from as far away as Mount Kenya (Allen 1993). The closest quartz source to the Lamu archipelago is found at Kitui—a distance of 220 miles inland (Allen 1993), and the closest sedimentary system to the Swahili coast that would bear quartz and rock crystal is found in the Tsavo region (Sanders 1959, 1963).

The historical records are vague as to what the provenance of the ivory sources were prior to A.D. 1500, yet some documents suggest that by the mid-1500s, ivory was being transported from far inland to the Swahili coast for trade due to depletion of the elephant population along the coast resulting from overhunting (Pearson 1998: 86-87). The existence of long-distance trade networks that date back to the Neolithic have been suggested by finds of cowries from archaeological middens made by Leakey (1966) at Ngorongoro Crater, Tanzania and Nelson (1993) at Jarigole (near Koobi Fora). Ambrose (personal communication, 2000) also found small amounts of marine shell at Lukenya Hill and Enkapune ya Muto in Eburran phase horizons (LSA) that date to 4,860 ± 70 years B.P. One cowry shell has also been recovered from the northern Upemba Depression in Congo dating to between the tenth and twelfth centuries A.D. (de Maret 1999). These finds are significant to the extent that they corroborate ambiguous historical data that suggests long-distance contact between the Indian Ocean coast and interior was established prior to the establishment of Swahili city-states.

The lack of centralized political control of the East African interior has led to the assumption that down-the-line trading networks would have been in operation in precolonial East Africa (Pearson 1998; Spear 1981). In this method of exchange, there is a two-way flow of merchandise that changes hands many times before the items reach their final destinations. Swahili coast polities were incapable of militarily conquering any portion of the interior, which meant that they were forced to develop integrative mechanisms to solidify relationships with tribes in the interior (Middleton 1953: 76; Mutoro 1998; Pearson 1998). Such models of interaction are commonly documented in Africa, where population densities have always been generally low and elites' ability to exert influence relied on their persuasiveness and ability to accommodate a wide range of economic and political interests (Coquery-Vidrovitch 1988, 1991; McIntosh 1999).

C. Kusimba (1999b) argues that kin-based alliances formed between urban elites and rural pastoral communities facilitated the development of stratified city-states along the East African coast. Reciprocal exchange networks based on kinship associations developed between communities that live in precarious environments are well-documented in the ethnographic record (e.g. Behnke 1980; Bollig 1998; Galaty 1993; Gulliver 1955; Hopen 1958; Irons 1972; Stenning 1959). In order to forge alliances with both foreign merchants and the hinterland neighbors from whom they procured the items they traded abroad, Swahili merchants maintained dual identities that they could switch between as the situation warranted (Mazrui and Shariff 1994).

By way of ethnographic analogy, some Yörük tribesmen in southeastern Turkey have been documented as shifting between rural mobile and urban sedentary existences based on their "self-interests at the moment" (Bates 1972). In order to do so, the Yörük depend on kin based in both areas to provide housing, livestock and access to pasture when it is needed. Furthermore, Galaty (1993) contends that the key to the success of the Maasai expansion in the late 19th century was their ability to assimilate the people they conquered into a fictive kin network that turned their foes into allies (see also Spear 1981). Thus, the status of "kin" does not necessarily need to be premised on actual genetic affinity between two groups of people, but could be largely perpetuated out of a mutual interest for preserving close economic and political connections through time and space.

10.6 New Data on the Origins of Coastal Trade

Chapter 6 provides a detailed geoarchaeological interpretation of the settlements dating to the PN along the Galana River. However, a brief review will be undertaken in this section that highlights relevant geographical and chronological concerns to the discussion of commodities exchange.

The archaeological survey of 2001 along the Galana River in Tsavo National Park, Kenya identified three large settlements eroding from river terraces with evidence of multiple cultural occupations. Excavations and subsequent analyses have proven that these sites were originally settled by herding communities over 3,500 years ago. The site of Kathuva had occupations that covered a 2,500-year time span. The latest occupation of this site contained evidence that trade with the coast was occurring as far back as the pre-Islamic phase of Swahili state florescence.

The site of Kathuva lies approximately 100 km west of the port city of Malindi. The site is situated on the banks of the Galana River and is well situated for the exploitation of endoaquatic resources. In 2001, excavation and analysis of scarps that cut into the prehistorically settled river terraces showed that occupation of this site extends back to ~2000 B.C. (UIC1071). Later occupations occur between 1600 and 1100 B.C.

(ages reported in Chapter 6), A.D. 263 and 427 (AA51449) and A.D. 439 and 635 (AA51447, AA51448, UIC1153).

The site of Kahinju is also located on a terrace of the Galana River inside Tsavo East National Park. Cultural occupations extend as far back as ~4000 B.C. and all ages generated from this site fit into the early to middle PN time period. Decorated ceramics include several previously unidentified wares as well as Narosura and Maringishu tradition ceramics that are found at other sites in East Africa (Chapter 9). Horton (1996) sees a strong stylistic connection between Maringishu tradition ceramics and various types of EIW wares found later on the coast. Figure 64 shows similarities between ceramics discovered *in situ* at Kahinju and later vessels previously recorded by other authors.

There is little change in material technology between the various occupations of the site of Kathuva (Chapters 7, 8, 9). Domesticated cattle are found during the second (1600 – 1100 B.C.) and fourth (A.D. 263 – 427) occupations of the site. Pastoral Neolithic stone tools and ceramics were recovered from all occupied terraces. The last two known occupations of the site did not contain any evidence of iron working or use of iron technology, despite the fact that iron working technology is established in other parts of East Africa at this time (Schmidt 1997). Economically, the inhabitants of Kathuva engaged in mixed pastoralism and foraging, and wild animal bones were recovered from all occupied levels.

The discovery of a cowry shell dating to the last known settlement of the site (A.D. 439 – 665) shows that although there is little change in the material technology of the inhabitants of this site, connections to coastal people were established by the time period traditionally recognized as the age of incipient Swahili civilization on the coast (Horton 1984, 1996; Kusimba 1999b). A cowry shell could have originated from only one place—the coast of the Indian Ocean. In order to obtain this item, goods or services would have been exchanged either directly or through trade networks established between different communities on the way to the coast. Alternatively, cowry shells may have been collected directly by herders who could have grazed their animals in far flung regions during especially dry periods in Tsavo. Given the preponderance of indirect evidence assembled suggesting that trade between the coast and the hinterland was blossoming at this time, the former scenario seems more likely than the latter.

Figure 66. Obsidian flakes from Mwiitu

The discovery of obsidian flakes in the Mw2 occupation horizon (<3,020 ± 270, >1,020 ± 80 years) indicates that there were interregional interactions extending westward from Tsavo that can be traced from Neolithic archaeological contexts. The closest sources of obsidian are found in the Great Rift Valley, which is over 200 km west of the sites' locations (e.g. S. Kusimba 2001). S. Kusimba (1999; 2001) argues that the presence of obsidian in later LSA occupation horizons at Lukenya (LH2, ca. 15,000 years B.P.) indicate high residential mobility patterns and broadened interregional exchange patterns than in earlier LSA contexts (LH1, ca. 20,000 years B.P.). Although the majority of the data support low residential mobility patterns among the inhabitants of the Galana River sites, trade artifacts indicate that at least some members of the community were moving great distances.

The development of long-distance trade networks did not seem to affect the community's economic or subsistence activities to any great extent. The arrival of iron technology encouraged a rapid adoption of metal production and limited use of agriculture in many areas of Africa (Alexander 1980; Chami 1994; Collett 1985: 96, 177; de Barros 1997; Onyango-Abuje and Wandibba 1979; Schmidt 1996, 1997; Schmidt and Avery 1996; Schmidt and Childs 1985; Soper 1967b; Wadley 1996). In other areas, such as Gogo Falls on the shores of Lake Victoria, replacement of stone with iron technology was gradual and there is no evidence that agriculture was practiced (Robertshaw 1991). Kathuva represents a site where contact with iron-using people was established (either directly or indirectly), but there is no indication that any aspect of Iron Age technology was adopted.

10.7 Discussion of Cultural Exchange in Holocene East Africa

Anthropologists have long been interested in understanding whether the existence of social and political boundaries occurs in relation to the presence of ecological zones of exploitation. Steward (1955) proposes the concept of a "culture core," an area where human cultural behavior is limited and shaped in part by the innovative capacity of a group adapting to particular environmental constraints. In order to maximize economic return, humans will also establish cooperative relationships with each other when the environment necessitates (Steward 1955). Similarly, Barth (1956, 1969) argues that symbiotic relationships develop between subsistence groups that inhabit different ecological niches even if they are practicing the same types of subsistence. His analysis concentrates on social and economic interactions between Pathan agriculturalists, Kohistani agropastoralists and Gujar nomadic pastoralists in the Swat state of northern Pakistan. He argues that if groups are in direct competition with each other for access to resources, the stronger group will eliminate the weak (Barth 1969). However, in Swat state, stable co-residence and peaceful interactions are sought and maintained because the groups occupy complimentary ecological niches (Barth 1956).

Numerous studies in West Africa have shown that symbiotic relationships between fishers, pastoralists and agriculturalists formed the basis for long distance exchanges of exotic trade items across the Sahara and throughout the West African forests and savannas (Casey 1998; Connah 1987; Holl 1986; McIntosh 1993; McIntosh 1998; McIntosh 1999; Munson 1971; Saenz 1991; Sellnow 1981). The precarious nature of living in the Intertropical Convergence Zone (ITCZ) with shifting seasonal arid and wet zones has been interpreted as the foundation for the development of cooperative subsistence interactions in the region (Casey 1998).

The discovery of a cowry shell *in situ* from excavations in Tsavo National Park, Kenya dating to 439 – 665 A.D. (AA51448; UIC1153) is further evidence that coastal exchange networks extended at least 100 km into the interior during the period of development of early Swahili civilization. However, the recovery of over 10,000 individual artifacts at Kathuva failed to yield either direct or indirect evidence of the use of metal. In a recent review of the means and timeframe by which metal production spread through sub-Saharan Africa, Holl (2000) argues that people using traditional technologies do not readily accept new technological achievements, such as iron working, just because they are available (see also Trigger 1993). Utilitarian goods are difficult to obtain in the early phases of their development because of their value as tools to the producers of the items (Holl 2000: 20-21). It may also be that herding people occupying the fluvial ecosystems of Tsavo did not seek iron technology even when it was more readily available. The acquisition of non-utilitarian luxury items, such as cowry shells, could have fulfilled the herders' esoteric desires to obtain exotic goods at a lesser cost than over-valued iron products (e.g. Helms 1988, 1993). Stone tools appear to have been adequate to meet the subsistence needs of the East African pastoralists and foragers for several thousand years.

Typically, diverse subsistence bases characterize Early PN sites where exploitation of a wide range of resources was both possible and preferable (Bower 1991). After 1300 B.C., a shift to more specialized forms of pastoralism is found throughout East Africa until A.D. 700, when little else is known about PN people (Ambrose 1984b; Marshall 1990c). However, the faunal material recovered from the site of Kathuva reflects that the diet of its inhabitants remained diverse throughout all occupations of the site. Subsistence revolved around exploitation of endoaquatic resources as well as limited culling of domesticated stock. There is no evidence of a dramatic shift to domesticated animal exploitation or limited use of horticulture in the later phases of occupation of the site as has been found at other locations in East Africa. This pattern is further reflected in the tool kit, which contains numerous microliths that show little variability from assemblages found at early Pastoral Neolithic occupations in other parts of East Africa.

It has been suggested that the development of trade of exotic luxury items between the East African coast and interior was largely spawned by the desire of urban merchants to obtain food products from their hinterland neighbors (Kusimba 1999b; Mutoro 1998; Pearson 1998). In exchange for agricultural and pastoral products as well as non-perishable trade items such as honey wax, elephant tusks, rhinoceros horns and cat skins, Swahili merchants would provide glass beads, iron and copper commodities, bracelets, cloth, bangles and coastal shells (Kusimba 1999b). Shell provided the only solid evidence that trade was occurring between the coast and Tsavo before A.D. 665. The discovery of obsidian artifacts <3,020 ± 270 years but >1,020 ± 80 years at Mwiitu indicate that contact with communities in the Rift Valley was likely established, or at least selected members of the community engaged in long distance mobility for grazing or resource procurement. It is plausible that down-the-line exchange between well-acquainted communities was the basis for this trade. I propose that early trade routes established between the Swahili coast and the interior were based on symbiotic interactions between communities with distant kin relationships that were not competing for access to ecological niches. This scenario likely extended westward from Tsavo and included large areas of East Africa, where a growing body of evidence indicates that Neolithic communities maintained at least indirect contact with groups hundreds of kilometers away from their home ranges. Similar to the early trans-Saharan trade networks, complimenting biotones that exist between the Tsavo region and coast produced circumstances that were ideal for the development of symbiotic exchange networks (Kusimba et al. in press).

It has also been suggested that kinship ties were crucial for the creation of long-distance trade networks between the coast and interior (Abungu 1994-1995; Abungu and Mutoro 1993; Horton 1984, 1990, 1996). Although finds at Kathuva do not substantiate or refute this claim, artifacts recovered from the site of Kahinju suggest that early ties between inland pastoral communities and later Swahili people may exist. Figure 60 shows ceramic sherds recovered *in situ* from Kahinju dating to before 1000 B.C. in comparison to decorative motifs found on EIW ceramics in other parts of East Africa. EIW wares reported by Posnansky (1961: 181, 184), Wilson and Lali Omar (1997: 40-41), Soper (1989: 21) and Chami (1998: 202) bear striking decorative and attribute similarities to Pastoral Neolithic-era Maringishu and Narosura tradition ceramics (Figure 64). Horton (1996) makes similar observations in his analysis of EIW pottery from Shanga. Although the distribution of ceramics does not necessarily correlate directly to the movement of people (e.g. Hodder 1977), the replication of decorative features on ceramics throughout a 1,000+ year time period suggests that there is continuity of material reproduction in the community-at-large. I am suggesting that such continuity was largely perpetuated by interactions based on the notion of kinship, which is supported by lexicostatistical data and solid evidence of the existence of long distance trading networks in the early centuries of the Common Era.

Some East Africanist archaeologists have resisted the notion that continuity can be found between LSA pastoralists and EIW sedentary agro-pastoralists. Chami (1994;

1994-1995; 1998) contends that autochthonous development of EIW can be traced to early Bantu immigrants and bears little stylistic similarity to Pastoral Neolithic wares. However, a recent revision of the understanding of how Bantu language and technology spread through sub-Saharan Africa casts doubt on the notion that Bantu culture flourished in isolation of indigenous communities (Chami and Kweksason 2003; Ehret 2001). In the new view of the Bantu expansion, admixture of language and culture likely occurred frequently between eastward migrating iron-using communities and LSA pastoralists and foragers who were the primary inhabitants of the East African savannas at 1000 B.C. (Ehret 1998, 2001).

The idea that the spread of Bantu languages throughout eastern and southern Africa occurred as a single-event *vis á vis* a steamrolling cultural juggernaut replacing indigenous cultures lying in the way (Guthrie 1962, 1963; Oliver 1966) has now been discredited (Ehret 2001). Continuity between groups of people in Africa, as elsewhere, has allowed people occupying specific ecological niches to pick and choose the aspects of their neighbors' material culture that likewise suits their own needs. It now seems appropriate to revise our views of early East African trade and technological development in light of these new understandings and forge a new model toward understanding trajectories of social complexity in general (Figure 67).

Old Model New Model

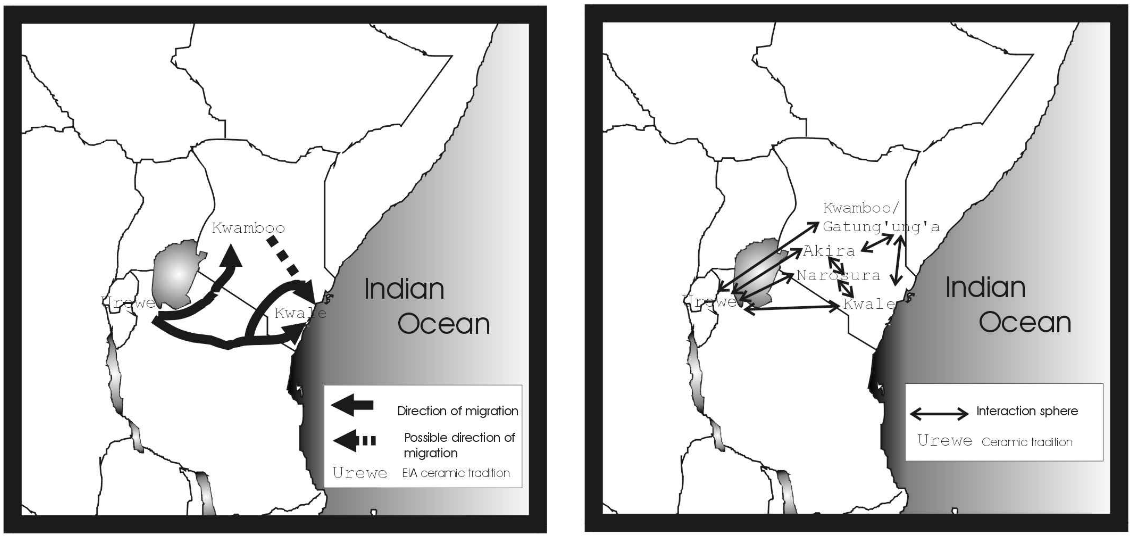

Figure 67. Old and new models explaining the evolution of late prehistoric East African ceramic traditions

Finally, the notion that diffusion of ideas and technologies associated with "advanced" or "exotic" societies (Adams 1966; Helms 1988, 1992, 1993; Wolf 1982) transforming "lesser-developed" economies is not borne out in the archaeological data presented in this thesis. Contact between periurban, iron-using coastal communities and the rural inhabitants of Tsavo had an undetectable influence on both the social fabric and technologies employed by PN people living in Tsavo. Stone tool technology continues to be employed with no detectable decrease in frequency and no evidence of iron production or use is found in the archaeological record along the Galana River.

Furthermore, there is no archaeological evidence for the development of political stratification in response to participation in the long-distance exchange network. Markers of such a process typically include differential accumulation of prestige items, construction of monumental architecture and specialized craft production (Fried 1967; Service 1975). Schneider (1977) posits that the trade of exotic, non-commodity goods (preciosities) brings about large-scale reorganizations of technology, class structure, leadership and ideologies of all participating parties. However, Stein (1999) finds that among the interaction sphere of Late Chalcolithic Uruk (ca. 4000 B.C.), whether or not the development of social complexity amongst the urban center's rural trading partners occurred was a function of distance and degree of sustained contact maintained. The "distance-parity model" can be used to argue that a rural response to trade is not necessarily linear and depends on the success in which the urban society has in subordinating their rural trading partners (Stein 1999).

In precolonial East Africa, urban elites were never able to exert enormous influence on the internal affairs of their rural neighbors (Kusimba 1999b; Kusimba and Kusimba 2001). The relative technological parity between coastal and hinterland people and the perceived hostility that rural people maintained against coastal people medalling with established trade networks or their internal affairs did not allow for the Swahili to gain direct influence over communities in the interior (Pearson 1998). From the present analysis of the data excavated during the 2001 and 2004 field seasons, it seems that trade did not likewise represent sufficient stimulus to replace autochthonous technology or political systems of the late PN occupants of the Galana River (see also Abungu 1989; Abungu and Mutoro 1993; Mutoro 1987). This mirrors the historically and archaeologically documented response of Ituri Pygmy participation in 16th century trade with the Portuguese whereby social stratification existed only on a local level and was not very pronounced (Coquery-Vidrovitch 1971: 13). In these cases, indigenous adaptations to landscape exploitation were preferable to externally derived political or technological solutions.

10.8 Conclusion

Evidence of early long-distance trade between coastal and hinterland people in East Africa indicates that the exchange of commodities and cultural ideas spans great distances in response to ecological differentiation of the landscape. Connections forged between inhabitants occupying complementary ecological niches formed the basis for the later development of interregional and international exchange in the Indian Ocean littoral. Ceramic attributes found in early Neolithic finds from Tsavo, Kenya and later wares credited to coastal EIW and Swahili people suggest that there is some degree of cultural continuity between LSA and EIW inhabitants of the region. As Ehret (2001), Horton (1996), Allen (1993) and C. Kusimba (1996; 1999b) suggest, the cultural setting of East Africa in the early part of the Common Era is indeed a very diverse scene in which language and material culture is fluid and overlapping. Wholesale adoption of all forms of technological innovation, such as agriculture or iron forging and usage, did not occur in the early phases of East African long distance exchange despite evidence that many of the inhabitants of the region had kinship ties to one another.

The inhabitants of the Tsavo stretch of the Galana River made a conscious decision to participate in the long-distance exchange network of the first millennium A.D. as evidenced by archaeological discoveries made in 2001. It is likely that the networks in which they operated revolved around long-standing kinship ties with town and city-dwelling coastal people. The retention of certain aspects of local technology in spite of contact with people who possessed innovations that would improve the efficiency of hunting practices suggests that such innovations were perceived as unnecessary to a subsistence system that worked well-enough. Certainly the effort devoted to acquiring prestige goods (such as cowry shells) could have been focused on acquiring iron tools. However, the value of the different goods was assessed on their seeming necessity by the acquirers of the objects. The fact that family members in other regions with whom they were in contact were employing iron technology did not impress the pastoralists of Tsavo enough to warrant a restructuring of their own technological foundations.

Thus, on examining the theoretical implications of the diffusion of technology and differentiation of social groups, it can be problematic to assume that genetic or social ties correlate directly to a complete overhaul of material culture once these bonds are formed. Exchange of ideas and technology occurs on many levels between contiguous social groups, but not necessarily all levels. Instead, local strategies that are believed to maximize the best potential economic return for energy expended are more important to technological choices than what ones' family in a neighboring region are doing.

Chapter 11. Conclusion

This thesis has presented data and interpretation of field seasons that were undertaken in Tsavo National Park, Kenya in 2001 and 2004. The data and interpretations offered here represent the first detailed exploration of Late Eburran/Early to Late Pastoral Neolithic occupations inside Tsavo National Park. In this position, one has the unarguable handicap of being unable to critique or build upon previous studies conducted within the project area. On the other hand, being the first manuscript in an interesting study area opens the door to future work and provides some direction on what a future archaeologist should expect to encounter when undertaking a project in this area.

I have limited the scope of my interpretations to solely what was documented in the archaeological record during the 2001 and 2004 field seasons and subsequent analyses. Interpretations of the data set are limited by the non-randomness of the excavation strategy, which has been discussed in preceding pages. Future studies may disprove some or all of the interpretations that I have presented in this thesis, but I have attempted to present a coherent set of testable hypotheses that should form the framework for the debate on the transition from Middle to Late Holocene occupations within the Tsavo region and perhaps beyond.

The questions addressed in this work are fundamental issues within the broader discourse of the anthropology of past peoples. These specifically revolve around when, how and under what environmental conditions incipient food production techniques spread into a new geographical area. The data show that the first domesticated animals in Tsavo appear roughly contemporaneously to those found near Lake Turkana and at Enkapune ya Muto after c. 4,000 years B.P. Previous studies of the spread of cattle into

East Africa during the mid Holocene have been restricted to the Rift Valley and the Central Kenya Highlands, thus geographically skewing our understandings of the dispersion routes of early domesticates in the region. This study shows that the range of the earliest domesticated ruminants in East Africa also extends to the coastal plains. Future studies may show that domesticated animals also grazed east of Tsavo and in the Taita Hills from the earliest periods of their introduction into East Africa.

Similar to other East African locations, the first domesticates in Tsavo appear in faunal assemblages that are disproportionately skewed in representing wild taxa. The data available clearly show that non-domesticated endoaquatic resources remained an important component of subsistence throughout the successive occupations that span ~4,700 years along the banks of the Galana River. This discussion has been framed in the context of a domesticated landscape (Terrell et al. 2003), which expands our concept of how people inhabiting a rapidly changing ecosystem can manage available resources in the face of environmental and demographic pressures.

Early adoption of domesticated animals in East Africa occurred during a period of extreme aridity, but the shift toward complete reliance on them as a food source generally occurs when climatic periodicity is at its highest frequency in the Holocene. However, the pattern in Tsavo bears a different marker. The trend toward increased reliance on domesticated animals through the later Holocene among PN herders is not witnessed in Tsavo. Rather, the data shows that settlements found along the Galana date to periods when the climate is at its most unpredictable. As Chapter 6 has shown, aggregation along the margins of the riverbank and exploitation of riverine resources occurs during phases of highest periodicity in the El Niño/La Niña cycle in the Middle to Late Holocene.

Cattle appear to have been kept in limited numbers, but represented a small minority of the total number of faunal material collected. This hypothesis does not exclude local dependence on pastoral byproducts (e.g. milk, blood), but bears a pattern that differs from other East African faunal assemblages during the Late Holocene.

Four primary theories on the nature of Middle to Late Holocene occupations in Tsavo have been advanced in this work.

1. *Site occupations correlate to periods when proxy data indicate that the climate either highly unpredictable or arid.* High-resolution radiometric ages have been presented (Chapter 6) along with recently published paleoclimatological proxies (Chapter 3) that corroborate this hypothesis. Aggregation proximal to a permanent water source is a mitigating strategy to buffer a group's access to resources during otherwise unpredictable resource availability.
2. *Mobility of the sites' inhabitants was generally low.* Artifact densities and site sizes indicate that high mobility was probably not an important survival strategy in these locations. The discovery of large, bulky ceramics (Chapter 9) and faunal elements that indicative of a delayed-return foraging strategy (Chapter 7) further serve to advance this theory. The theory that some pastoralists were semi-sedentary by 3,000 years B.P. has been proposed elsewhere (Bower 1997; Lamphear 1986). Further testing is needed on these sites in order to recover evidence of structures and other features that may

indicate the permanence of the settlements throughout the various occupation phases.

3. *There is little change in both the technology and subsistence strategies of the inhabitants of Kahinju and Kathuva over the ca. 4,700-year period that the sites are occupied.* Later Stone Age tools (Chapter 8) and ceramics (Chapter 9) were recovered from Kh1 and the same technology persists through the last occupation (Kt5). Evidence for the presence of domesticated cattle is found from 3,800 years B.P., but wild fauna continue to be exploited through later occupations of the sites (Chapter 7).
4. *Artifact assemblages analyzed from the Tsavo 2001 field season along with new lexico-statistical and ceramic analysis from Tanzania show continuity between PN occupations in the interior and later Iron Age civilizations along the Swahili Coast.* This argument is predicated on the recovery of an *in situ* cowry shell from Kt5 (Chapter 10) and the identification of ceramic decorative motifs from Kahinju that bear striking similarity to Iron Age traditions that have heretofore only been identified in coastal assemblages (Chapters 9 and 10).

The response of the early pastoral cultures detected in Tsavo to environmental perturbations represents a significant deviation from traditional models of resource scarcity and mobility (e.g. Binford 1991; Kelly 1983). However, the mitigating effect of having a permanent resource base available in the generally unpredictable middle to late Holocene ecosystem of Tsavo is clearly an important factor. Instead of allaying the effects of aridification or climatic periodicity with high residential mobility patterns, it is the conclusion of this thesis that the residents of these sites chose to remain tethered to the only predictable source of water and food available to them. Increasing reliance on domesticates during stressful environmental circumstances has been implied from other archaeological assemblages (Gifford-Gonzalez 1984; Marean 1992; Marshall 1989, 1990c, 1994, 2000), but is not detected from archaeological occupations in Tsavo. The persistence of foraging throughout the Holocene and types of fauna identified from the dataset indicate that predation on endoaquatic resources remained a crucial component of the subsistence strategies of the successive occupations of the PN sites tested along the Galana River. From these analyses, the Galana River is perhaps the single most important agent used by Neolithic people to buffer against resource scarcity and high climatic periodicity.

This thesis also shows that diffusion of new cultural innovations, such as iron technology, does not necessarily replace indigenous technologies upon first contact (c.f. Adams 1966; Helms 1988, 1992, 1993; Schneider 1977). Strong evidence has been presented that show interactions between iron-using coastal communities and the Neolithic inhabitants of Tsavo. No evidence of development of politically stratified economies or adoption of iron technologies at the expense of stone tool manufacture throughout the 4,700-year series of occupations of this region was detected. The evolution of long distance trade networks in this region reflects a continuum of interactions based primarily on kin-based networks (Kusimba 1999b) and a lack of direct control or interference of periurban and urban societies on the affairs of hinterland people (Pearson 1998).

Although much more works remains to be done in order to arrive at definitive conclusions regarding settlement duration and the material characteristics of site occupation, these preliminary conclusions are an important first step toward conducting further analyses of the PN in the Tsavo region. Future directions of research should focus on conducting randomly stratified excavations at these sites in order to ascertain statistically significant household-level tool/ceramic production and faunal consumption data (*sensu* Flannery 1976a). Furthermore, deep transect trenches should be dug to test the geographical extent of the sites behind the exposed scarp face of the terraces.

Archaeological sites along the Galana River have great potential to further elucidate the conditions under which the incipient adoption of domesticates in eastern African contexts occurred. Occupations span from the time period prior to the known introduction of domesticated animals into East Africa and continue through the late PN. The PN remains an important phase to understand of the spread of domestication techniques throughout the world to the extent that it was highly varied in the intensity, which the shift from reliance on wild to domesticated resources within a relatively confined geographical area occurred. Domesticated species of stock also begin to appear in East Africa during a particularly well-documented phase of global climatic aridity (Booth et al. in press; Dalfes et al. 1997; Johnson et al. 1991), followed by subdecadal-scale periodicity in ENSO (Moy et al. 2002b). Grasping the mechanisms at work during the transition from a foraging to a domesticated economy throughout all phases of the PN represents a prime opportunity to augment current models of the motives and means for the adoption of food production techniques. It is hoped that more research toward this end is forthcoming.

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APPENDICES

APPENDIX A

Partial Description of African Taxa and Antelope Classes (*sensu* Brain 1973)

Antelope Classes	**Weight Range (kg)**
Bovid Class 1	
Dik dik	4.5-5
Suni	4.5-7
Blue duiker	6-7
Cape grysbok	7-9
Sharpe's grysbok	7-9
Red duiker	9-14
Klipspringer	10-16
Steenbok	11-15
Common duiker	11-21
Oribi	14-19
Bovid Class 2	
Springbuck	18-52
Mountain reedbuck	23-27
Grey rhebuck	23-27
Bushbuck	23-83
Blesbok	32-81
Impala	36-69
Reedbuck	45-104
Puku	56-84
Goat	?
Bovid Class 3	
Lechwe	77-130
Nyala	91-114
Sitatunga	91-114
Tsesebe	117-158
Red hartebeest	106-172
Lichtenstein's hartebeest	146-205
Kudu	150-296
Black wildebeest	158-182
Defassa waterbuck	158-205
Waterbuck	158-272
Gemsbok	182-238
Sable	205-264
Blue wildebeest	205-274
Roan	223-299
Bovid Class 4	
Buffalo	367-837
Eland	396-943
Cattle	?

APPENDIX B

Minitab© results from rainfall correlation coefficient analysis[24]

Correlation (Pearson) of SOI index and Malindi precipitation anomalies (1962 – 1990)

```
Correlation of Malindi and SOI = 0.024, P-Value = 0.909
```

YEAR	SOI	Malindi
1961	-0.01	*
1962	0.39	-0.25839
1963	-0.32	0.188806
1964	0.54	0.00811
1965	-0.95	-0.26158
1966	-0.54	0.214566
1967	0.25	0.369407
1968	0.2	0.607806
1969	-0.66	-0.27001
1970	0.29	*
1971	1.07	-0.13446
1972	-0.83	0.122204
1973	0.64	0.038835
1974	0.96	*
1975	1.33	*
1976	0.06	-0.09699
1977	-1.14	-0.03048
1978	-0.29	0.219624
1979	-0.26	0.1578
1980	-0.43	-0.245
1981	0.07	-0.06027
1982	-1.45	0.603216
1983	-0.95	0.064689
1984	-0.14	0.143843
1985	-0.02	-0.14964
1986	-0.32	0.023004
1987	-1.48	-0.74352
1988	0.74	-0.29764
1989	0.62	-0.051
1990	-0.33	-0.16294

[24] * indicates that the data is not available or is excluded from this year.

APPENDIX B (continued)

Correlation (Pearson) of SOI index and Makindu precipitation anomalies (1961 – 1980)

```
Correlation of SOI2 and Makindu2 = -0.101, P-Value = 0.671
```

YEAR	SOI2	Makindu2
1961	-0.01	0.60073
1962	0.39	-0.03534
1963	-0.32	0.71234
1964	0.54	0.12208
1965	-0.95	-0.37113
1966	-0.54	-0.2052
1967	0.25	0.33825
1968	0.2	1.03945
1969	-0.66	-0.10243
1970	0.29	-0.4122
1971	1.07	-0.03387
1972	-0.83	-0.3168
1973	0.64	-0.35247
1974	0.96	-0.33889
1975	1.33	-0.43855
1976	0.06	-0.40369
1977	-1.14	0.18378
1978	-0.29	0.226
1979	-0.26	0.19736
1980	-0.43	-0.40942

Correlation (Pearson) of SOI index and Mombasa precipitation anomalies (1961 – 1978)

```
Correlation of SOI3 and Mombasa2 = -0.431, P-Value = 0.096
```

YEAR	SOI3	Mombasa2
1961	-0.01	0.275974
1962	0.39	-0.27686
1963	-0.32	0.275692
1964	0.54	-0.18996
1965	-0.95	-0.07849

APPENDIX B (continued)

1966	-0.54	0.134189
1967	0.25	0.490158
1968	0.2	0.679582
1969	-0.66	-0.30482
1970	0.29	-0.32421
1971	1.07	-0.48803
1972	-0.83	0.35261
1973	0.64	-0.04253
1974	0.96	-0.41045
1975	1.33	-0.24871
1976	0.06	*
1977	-1.14	*
1978	-0.29	0.155842

Correlations (Pearson) of correlation coefficient of rainfall at Makindu, Malindi and Mombasa (1961 – 1980)

```
       Makindu3 Malindi3
Malindi3  0.721
          0.002

Mombasa3  0.682    0.892
          0.004    0.000

Cell Contents: Correlation
               P-Value
```

YEAR	Makindu3	Malindi3	Mombasa3
1961	0.60073	*	0.275974
1962	-0.03534	-0.25839	-0.27686
1963	0.71234	0.188806	0.275692
1964	0.12208	0.00811	-0.18996
1965	*	*	*
1966	-0.2052	0.214566	0.134189
1967	0.33825	0.369407	0.490158
1968	1.03945	0.607806	0.679582
1969	-0.10243	-0.27001	-0.30482
1970	-0.4122	*	-0.32421
1971	*	*	*
1972	*	*	*
1973	-0.35247	0.038835	-0.04253
1974	*	*	*

APPENDIX B (continued)

1975	*	*	*
1976	-0.40369	-0.09699	*
1977	0.18378	-0.03048	*
1978	0.226	0.219624	0.155842
1979	0.19736	0.1578	*
1980	-0.40942	-0.245	*

Correlations (Pearson) of all SOI anomalies modeled against precipitation anomalies at Makindu, Malindi and Mombasa (1961 – 1990)

```
       Makindu4 Malindi4 Mombasa4
Malindi4  0.721
          0.002

Mombasa4  0.682    0.892
          0.004    0.000

SOI5     -0.101    0.081   -0.431
          0.671    0.721    0.096

Cell Contents: Correlation
               P-Value
```

YEAR	SOI5	Makindu	Malindi	Mombasa
1961	-0.01	0.60073	*	0.275974
1962	0.39	-0.03534	-0.25839	-0.27686
1963	-0.32	0.71234	0.188806	0.275692
1964	0.54	0.12208	0.00811	-0.18996
1965	-0.95	-0.37113	-0.26158	-0.07849
1966	-0.54	-0.2052	0.214566	0.134189
1967	0.25	0.33825	0.369407	0.490158
1968	0.2	1.03945	0.607806	0.679582
1969	-0.66	-0.10243	-0.27001	-0.30482
1970	0.29	-0.4122	*	-0.32421
1971	1.07	-0.03387	-0.13446	-0.48803
1972	-0.83	-0.3168	0.122204	0.35261
1973	0.64	-0.35247	0.038835	-0.04253
1974	0.96	-0.33889	*	-0.41045
1975	1.33	-0.43855	*	-0.24871
1976	0.06	-0.40369	-0.09699	*
1977	-1.14	0.18378	-0.03048	*
1978	-0.29	0.226	0.219624	0.155842

APPENDIX B (continued)

1979	-0.26	0.19736	0.1578	*
1980	-0.43	-0.40942	-0.245	*
1981	0.07	*	-0.06027	*
1982	-1.45	*	0.603216	*
1983	-0.95	*	0.064689	*
1984	-0.14	*	0.143843	*
1985	-0.02	*	-0.14964	*
1986	-0.32	*	0.023004	*
1987	-1.48	*	-0.74352	*
1988	0.74	*	-0.29764	*
1989	0.62	*	-0.051	*
1990	-0.33	*	-0.16294	*

Correlations (Pearson) of SOI anomalies beyond 1 σ not represented modeled against precipitation anomalies at Makindu, Malindi and Mombasa (1961 – 1990).

```
        Makindu4 Malindi4 Mombasa4
Malindi4   0.756
           0.004

Mombasa4   0.804    0.966
           0.003    0.000

SOI5      -0.003    0.096   -0.081
           0.991    0.704    0.814

Cell Contents: Correlation
               P-Value
```

YEAR	Makindu4	Malindi4	Mombasa4	SOI5
1961	0.60073	*	0.275974	-0.01
1962	-0.03534	-0.25839	-0.27686	0.39
1963	0.71234	0.188806	0.275692	-0.32
1964	0.12208	0.00811	-0.18996	0.54
1965	*	*	*	*
1966	-0.2052	0.214566	0.134189	-0.54
1967	0.33825	0.369407	0.490158	0.25
1968	1.03945	0.607806	0.679582	0.2
1969	-0.10243	-0.27001	-0.30482	-0.66
1970	-0.4122	*	-0.32421	0.29

APPENDIX B (continued)

1971	*	*	*	*
1972	*	*	*	*
1973	-0.35247	0.038835	-0.04253	0.64
1974	*	*	*	*
1975	*	*	*	*
1976	-0.40369	-0.09699	*	0.06
1977	0.18378	-0.03048	*	-1.14
1978	0.226	0.219624	0.155842	-0.29
1979	0.19736	0.1578	*	-0.26
1980	-0.40942	-0.245	*	-0.43
1981	*	-0.06027	*	0.07
1982	*	*	*	*
1983	*	*	*	*
1984	*	0.143843	*	-0.14
1985	*	-0.14964	*	-0.02
1986	*	0.023004	*	-0.32
1987	*	*	*	*
1988	*	*	*	*
1989	*	-0.051	*	0.62
1990	*	-0.16294	*	-0.33

APPENDIX C

Kahinju Sorted Faunal Data

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
10000	1a	1	tibia	Ds	L	syncerus caffer	4		
10001	1a	1	long bone shaft frag			indet			
10003	2	1	Astralagus		r	equid		cut mark	
10004	2	1	metapodial	ds		bovid	3	cut mark	Stone
10005	2	1	bone frag			indet			
10006	2	1	long bone frag			indet			
10007	2	1	long bone frag			indet			
10008	2	1	long bone frag			indet			
10012	2	2	long bone shaft frag			indet			
10013	2	2	long bone shaft frag			indet			
10014	2	2	long bone shaft frag			indet			
10022a	2	3	magnum		l	equid		carnivore punch mark	cut mark
10022b	2	3	astralagus frag		r	bovid	2	cut mark	
10022c	2	3	metapodial shaft frag			bovid	2		
10022d	2	3	tibia shaft frag			bovid	2		
10022e	2	3	tibia shaft frag			bovid	3		
10022f	2	3	femur shaft frag			indet		burnt	
10022g	2	3	femur shaft frag			indet		burnt	
10022h	2	3	lower molar frag			bovid	2		
10022i	2	3	tooth frag			bovid	2		
10022j	2	3	tooth frag			bovid	3		
10022k	2	3	rib frag			indet			
10022l	2	3	bone frag			indet		burnt	21

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
10022m	2	3	bone frag			indet			84
10053	1a	2	bone frag			indet			9
10057	1a	2	rib frag			indet			
10060	1a	2	thoracic vertebra			indet			
10061	1a	2	bone frag			indet			5
10062	1a	2	bone frag			indet			4
10063	1a	2	bone frag			indet			
10064	1a	2	thoracic vertebra			syncerus caffer			
10087	2	4	m2/		l	equid			
10088a	2	4	humerus shaft frag			indet		carnivore punch mark	
10088b	2	4	bone frag			indet		carnivore punch mark	
10088c	2	4	tibia shaft frag			bovid	2		
10088d	2	4	bone frag			indet		burnt	29
10088e	2	4	bone frag			indet			86
10089	2	4	radius shaft frag			bovid	2	cut mark	
10092a	3	2	rib shaft			indet		carnivore punch mark	
10092b	3	2	humerus shaft frag			bovid	2	burnt	
10092	3	2	bone frag			indet		burnt	12
10096a	2	5	incisor		r	bovid	2	burnt	
10096b	2	5	phalanx1	ds		bovid	2		
10096c	2	5	bone frag			indet		carnivore punch mark	
10096d	2	5	long bone shaft frag			indet		burnt	12
10096e	2	5	long bone shaft frag			indet			19
10100	3	3	long bone frag			indet			2 (joinable)
10107	1a	3	calcium carbonate						
10108	1a	3	bone frag			indet			7 (embeded in matrix)
10109	1a	4	ilium frag			indet			8 (embeded in matrix)
10115a	2	6	m1/,m2/,maxilla		r	syncerus caffer	4		juvenile
10115b	2	6	p3/ frags			bovid	4		5

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
10015c	2	6	skull frags			indet			
10116a	2	6	phalanx2			suidae			
10116b	2	6	metapodial			suidae			
10116c	2	6	mandible frag			bovid	4	cut mark	
10116d	2	6	humerus shaft frag			indet		carnivore punch mark	
10116	2	6	bone frag			indet			163
10123a	2	7	p4/		l	syncerus caffer	4		juvenile
10123b	2	7	m1/		l	syncerus caffer	4		juvenile
10123c	2	7	m2/		l	syncerus caffer	4		juvenile
10123d	2	7	teeth frag			bovid	2		8
10123e	2	7	metapodial shaft			bovid	2		
10123	2	7	bone frag			indet			13
10126	4	1	metacarpal			cercopithecus aethiops			
10128a	2	8	tibia	ds	r	grant's gazelle	2		
10128	2	8	bone frag			indet			15
10135	2	9	metapodial frag	ds		bovid	2		
10141	2	2	bone frag			indet			
10144a	2	3	external & mid cuneiform			bovid	3		
10144b	2	3	phalanx1 frag	ds		bovid	3		
10144	2	3	bone frag			indet			68
10150a	2	4	m/3		r	aepyceros melampus	2		
10150b	2	4	bone frag			indet		cut mark	stone
10150	2	4	bone frag			indet			26
10152	4	5	vertebra			lizard			
10153	5	1	radius frag			bovid	2		16
10156a	2	5	teeth frag			bovid	2		8
10156b	2	5	metapodial frag	px		bovid	3		
10156	2	5	bone frag			indet			19

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
10163a	2	6	navicular cuboid		l	bovid	2		
10163b	2	6	metapodial frag	ds		bovid	2		
10163	2	6	bone frag			indet			16
10170	5	4	bone frag			indet			2
10173	2	10	n/a			n/a			
10177a	5	5	phalanx1	ds		bovid	3		
10177	5	5	bone frag			indet			8
10178a	5	6	radius frag			bovid	2		6
10178	5	6	femur shaft frag			indet			
10182a	6a	1	astralagus		l	bovid	3		
10182	6a	1	bone frag			indet			4
10183a	6a	1	rib frag			indet		carnivore punch mark	
10183	6a	1	bone frag			indet		burnt	9
10187a	6	surface	tibia frag	ds	l	bovid	3	burnt	
10187b	6	surface	radius shaft frag			bovid	3	burnt	
10187c	6	surface	humerus head frag			indet		burnt	
10187	6	surface	bone frag			indet		burnt	9
10190	6c	1	m1/,m2/,m3/		r	bos taurus	4		
10193a	6c	1	m1/		l	bos taurus	4		
10193b	6c	1	p/3		l	bos taurus	4		
10193c	6c	1	p/2		l	bos taurus	4		
10194a	6c	1	metapodial frag	px		bovid	4		
10194b	6c	1	long bone shaft frag			bovid	4		
10194	6c	1	premolar frags			bovid	4		
10197a	6e	1	phalanx2			equid			
10197	6e	1	rib frag			indet			
10199	7c	1	humerus frag			bovid	3		
10201	4	10	incisor		l	bos taurus	4		
10202	4	10	incisor		l	bos taurus	4		

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
10204	4	10	radius shaft frag			bovid	2	carnivore punch mark	
10213	4	10	radius shaft frag			bovid	2	carnivore punch mark	
10214	4	10	rib shaft frag			indet	2		
10209	4	10	femur shaft frag			bovid	2		
10210	4	10	femur shaft frag			bovid	2		
10211	4	10	femur shaft frag			bovid	2		
10212	4	10	femur shaft frag			bovid	2		
10215-24	4	10	bone frag			indet			13
10225a	4	10	rib shaft frag			indet			
10225	4	10	rib frag			indet			8
10227a	6e	2	canine frag			hippopotamus amphibius			
10227b	6e	2	bone frag			indet		carnivore punch mark	
10227c	6e	2	bone frag			fish			
10227d	6e	2	rib frag			indet			2
10227	6e	2	long bone shaft frag			indet			21
10231a	4	10	canine frag			hippopotamus amphibius			
10231b	4	10	incisor frag			bovid	4		
10231c	4	10	rib frag			indet			3
10231	4	10	bone frag			indet			133
10232	6profile	215-235cm	phalanx1 frag	px		bovid	2		
10236	6profile	235-236cm	bone frag			indet		burnt	
10235a	6e	3	canine frag			hippopotamus amphibius			3
10235b	6e	3	vertebra frag			indet			5
10235	6e	3	bone frag			indet			19
10237a	6e	3	canine upper tooth			hippopotamus amphibius			
10238-40	6e	3	radius shaft frag			bovid	4		3
10242	6e	3	cervical vertebra			indet			
10245a	7c	2	p/4			bovid	2		
10245	7c	2	bone frag			indet			4

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
10249	6e	4	bone frag			indet			2
10251a	4	11	ilium frag		r	indet			
10251	4	11	bone frag			indet			19
10258	4	12	bone frag			indet			21
10259a	6f	2	metacarpal IV		r	Leo leo			
10259b	6f	2	phalanx3			bovid	2		
10259c	6f	2	metapodial frag	px		Dik dik			
10259	6f	2	bone frag			indet			12
10262	4	13	bone frag			indet			48
10266	1c	1	femur	ds	r	syncerus caffer			
10268a	1d	1	femur codyle			indet			
10268	1d	1	bone frag			indet			10
10269	1d	1	rib shaft			indet			
10271	2	profile	bone frag			indet			
10273	2	profile	bone frag			indet			20
10274a	2	profile	magnum		r	equid		burnt	
10274b	2	profile	metapodial frag	ds		bovid	2		3
10274c	2	profile	metapodial shaft frag			bovid	2		
10274d	2	profile	humerus shaft frag			bovid	3	carnivore punch mark	
10274e	2	profile	tibia shaft frag			bovid	2	cut mark	
10274f	2	profile	humerus shaft frag			bovid	2	cut mark	
10274g	2	profile	navicular cuboid frag			bovid	2	burnt	
10274	2	profile	bone frag			indet			112
10276a	2	profile	cervical vertebra frag			indet		burnt	
10276b	2	profile	lumbar vertebra frag			indet		burnt	
10276c	2	profile	phalanx1 frag			bovid	2	burnt	
10276	2	profile	bone frag			indet		burnt	85
10277a	2	profile	p/4		r	bos taurus	4		
10277	2	profile	bone frag			indet			

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
10278	7b	2	n/a			n/a			
10281a	7c	3	humerus shaft frag			bovid	2	cut mark	
10281	7c	3	bone frag			indet			6
10287	7e	2	bone frag			indet		burnt	37
10288	1d	1	long bone shaft frag			indet			
10289	1d	1	long bone shaft frag			indet			
10290	1d	1	metatarsal	ds		giraffidae			
10291a	1d	1	tibia	px	r	syncerus caffer	4		
10291	1d	1	bone frag			indet			13
10304a	7e	3	tibia	ds	r	bovid	2		
10304b	7e	3	metapodial shaft frag			bovid	2		
10304c	7e	3	radius frag	px	l	bovid	2	burnt	
10304d	7e	3	metapodial	px		bovid	2	burnt	
10304e	7e	3	scapula frag		l	bovid	2	burnt	
10304f	7e	3	femur frag			bovid	2	burnt	6
10304g	7e	3	bone frag			indet		burnt	221
10314a	7e	4	axis			bovid	2	burnt	
10314b	7e	4	metatarsal	px		bovid	2	burnt	
10314c	7e	4	radius frag			bovid	2	burnt	
10314d	7e	4	patella			bovid	2	burnt	
10314e	7e	4	phalanx3			bovid	2	burnt	
10314f	7e	4	fibula		r	bovid	2	burnt	
10314g	7e	4	pubic bone			bovid	2	burnt	
10314h	7e	4	zygomatic			bovid	2	burnt	
10314i	7e	4	metapodial frag	ds		bovid	2	burnt	
10314	7e	4	bone frag			indet		burnt	91
10317	7e	5	bone frag			indet		burnt	8
10320	7e	7	bone frag			indet		burnt	6
10325	7e	8	bone frag			indet			2

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
10327a	7e	9	premolar crown		r	bovid	4		very worn
10327b	7e	9	molar tooth frag			bovid	4		very worn
10327	7e	9	bone frag			indet			34
10329a	1d	1	radius frag	px	l	bovid	4	burnt	
10329b	1d	1	tibia frag	ds	r	bovid	4	burnt	
10329c	1d	1	radius frag	px	r	bovid	4	burnt	
10329d	1d	1	unciform		l	syncerus caffer	4	burnt	
10329e	1d	1	bone frag			bovid	4	burnt	carnivore punch mark
10329f	1d	1	radius frag	px	l	Dik dik	1	burnt	
10329g	1d	1	bone frag			indet		burnt	111
10329	1d	1	vertebra frag			snake		burnt	
10333	7d	2	bone frag			indet		burnt	4
10335	7d	3	metapodial shaft	ds		Dik dik		burnt	epiphysis not fused
10336	7e	10	calcaneum frag		r	bovid	4	burnt	cut mark
10342	7e	10	calcaneum frag		l	bovid	4	burnt	
10343	7e	10	tibia shaft frag		l	bovid	4	burnt	
10341	7e	10	humerus shaft frag			bovid	4	burnt	
10346	7e	10	radius	ds	l	bovid	4		epiphysis not fused
10347	7e	10	femur codyle	ds		bovid	4	burnt	
10337-40	7e	10	bone frag			bovid	4	burnt	
10344-5	7e	10	tibia shaft frag			bovid	4	burnt	
10348a	7e	10	calcaneum frag		l	bovid	4	burnt	
10348b	7e	10	femur head frag			bovid	4	burnt	
10348c	7e	10	humerus head			bovid	4		
10348	7e	10	bone frag			indet		burnt	170

APPENDIX D

Kathuva Sorted Faunal Data

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
20003a	3a	1	incisor frag			bovid	2		
20003	3a	1	bone frag			indet			4
20004	1b	2	scapula			indet		carnivore punch mark	
20005	1b	2	rib frag			indet			17
20006	1b	2	bone frag			indet			35
20015	1b	3	bone frag			indet			21
20019	1b	5	metapodial frag	ds		dik dik			
20020	1b	5	astralagus		r	dik dik			
20021	1b	5	phalanx 1 frag	ds		bovid	3	burnt	
20022	1b	5	bone frag			indet		burnt	
20023	1b	5	phalanx 1			bovid	3	burnt	
20024	1b	5	bone frag			indet		burnt	
20025a	1b	5	calcaneum frag			bovid	2	burnt	
20025b	1b	5	phalanx 1 frag	ds		bovid	2	burnt	
20025c	1b	5	mandible frag			bovid	2	burnt	
20025d	1b	5	petrosal frag			indet		burnt	
20025e	1b	5	astralagus		r	dik dik		burnt	
20025	1b	5	bone frag			indet		burnt	225
20028	1b	6	bone frag			indet		burnt	8
20037	3a	3	bone frag			indet		burnt	17
20045	1a	2	bone frag			indet		burnt	4
20048a	1a	3	astralagus frag		l	dik dik	1	burnt	
20048	1a	3	bone frag			indet		burnt	3

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
20051	1a	4	sessamoid frag			indet		burnt	
20054	3a	4	mandible frag		r	bovid	2	burnt	
20055	3a	4	tibia shaft frag			bovid	2	burnt	
20056	3a	4	tooth frag			bovid	2		
20057	3a	4	tooth frag			bovid	2		
20058	3a	4	radias frag	px	r	bovid	2	burnt	
20059	3a	4	metapodial frag	ds		dik dik	1	burnt	
20060	3a	4	incisor frag			bovid	2		
20061	3a	4	phalanx 2 frag	px		bovid	2	burnt	
20062	3a	4	skull frag			indet		burnt	
20063	3a	4	tooth frag			bovid	2	burnt	
20064	3a	4	petrosal frag			indet		burnt	
20065	3a	4	phalanx 2 frag	ds		bovid	2	burnt	
20068a	3a	4	bone frag			indet		carnivore punch mark	2
20068b	3a	4	phalanx frag	ds		bovid	2	burnt	4
20068c	3a	4	tooth frag			bovid	2		1
20068	3a	4	bone frag			indet		burnt	207
20072	1a	6	bone frag			indet		burnt	5
20075	1a	5	bone frag			indet		burnt	14
20080a	3a	5	rib frag			indet		cut mark	1
20080b	3a	5	bone frag			indet		burnt	125
20081	3a	5	bone frag			indet			1
20082	3a	5	calcaneum frag		r	dik dik		burnt	1
20083	3a	5	phalanx 2	px		bovid	2	burnt	1
20084	3a	5	rib frag			indet		carnivore punch mark	1
20085	3a	5	rib frag			indet		carnivore punch mark	1
20086	3a	5	rib frag			indet			1

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
20087	3a	5	phalanx 1 frag	ds		bovid	3	burnt	1
20088	3a	5	rib frag			indet			1
20089	3a	5	rib frag			indet			1
20090	3a	5	phalanx 1	px		bovid	2		1
20094	1a	7	concretion						
20097	2	1	bone frag			indet			1
20102a	3a	6	mandible frag		l	bovid	2	burnt	1
20102b	3a	6	rib frag			indet		cut mark	1
20102c	3a	6	phalanx 3 frag			bovid	2	burnt	1
20102d	3a	6	mandible frag			bovid	2	burnt	2
20102e	3a	6	scapula frag		r	dik dik	1	burnt	1
20102	3a	6	bone frag			indet		burnt	283
20103	3a	6	m3/		l	aepyceros melampus	2		
20104	3a	6	m2/		l	aepyceros melampus	2		
20106	3a	6	m/3		l	aepyceros melampus	2		joins w/ 20127
20127	3a	6	m/3		l	aepyceros melampus	2		joins w/ 20106
20128	3a	6	m2/		r	aepyceros melampus	2		
20109a	3a	6	m/2		l	aepyceros melampus	2		
20113	3a	6	m3/		l	dik dik	1		
20110	3a	6	m2/		l	dik dik	1		
20111	3a	6	m3/		r	dik dik	1		
20123	3a	6	m1/		l	dik dik	1		
20108	3a	6	m/2 frag		r	aepyceros melampus	2		
20109b	3a	6	m1/ frag		l	aepyceros	2		

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
						melampus			
20125	3a	6	p/3, p/4		l	aepyceros melampus	2		
20115	3a	6	p/2		l	aepyceros melampus	2		
20126	3a	6	molar frag			bovid	2		
20121	3a	6	molar frag			bovid	2		
20124	3a	6	molar frag			bovid	2		
20122	3a	6	incisor root			bovid	2		
20118	3a	6	incisor			bovid	2		
20114	3a	6	p/2		r	aepyceros melampus	2		
20112	3a	6	molar frag			bovid	2		
20119	3a	6	incisor frag			bovid	2		
20132	3a	6	scapnoid		l	bovid	2	burnt	
20130	3a	6	calcaneum		l	bovid	2	burnt	cut mark
20129	3a	6	skull frag			bovid	2		
20131	3a	6	bone frag			indet			
20120	3a	6	tibia		l	avian (cf. Francolin)			quail
20134	3a	7	bone frag			indet			45
20140	2	2	tibia		r	dik dik	1	cut mark	
20141	2	2	phalanx 2			bovid	2		
20142	2	2	metapodial	ds		dik dik	1		
20143	2	2	radius	px	l	dik dik	1		
20144	2	2	metacarpal	px	l	dik dik	1		
20145	2	2	metacarpal	px	r	dik dik	1		joins w/ 20175
20175	2	2	metacarpal	px	r	dik dik	1		joins w/ 20145
20146	2	2	astralagus		l	bovid	2		
20147	2	2	phalanx 1			dik dik	1		
20148	2	2	patella		l	dik dik	1		

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
20149									
20150	2	2	radius	px	l	dik dik	1		
20151	2	2	astralagus		l	dik dik	1		
20152	2	2	centrum			bovid	2		
20153	2	2	navicular cuboid		r	bovid	2		
20154	2	2	phalanx 1			bovid	2		
20155	2	2	phalanx 1			dik dik	1		
20156									
20157	2	2	metatarsal frag	px		dik dik	1		
20158	2	2	metatarsal frag	px	r	dik dik	1		
20159	2	2	humerus	ds	l	dik dik	1		
20160	2	2	humerus shaft frag			indet			
20161	2	2	metapodial	ds		dik dik	1		
20162	2	2	humerus shaft frag			indet			
20163	2	2	astralagus frag			bovid	2		
20164	2	2	phalanx 3			bovid	2		
20165	2	2	molar frag			bos taurus	4		
20166a	2	2	bone frag			indet			
20167	2	2	navicular cuboid	l		bovid	2		
20166b	2	2	metapodial frag	px		dik dik	1		
20168	2	2	astralagus		r	dik dik	1		
20169	2	2	metapodial frag	ds		dik dik	1		
20170	2	2	m/3		r	dik dik	1		
20171	2	2	metapodial frag	px		dik dik	1		
20172	2	2	navicular cuboid		r	dik dik	1		
20173	2	2	metapodial frag	px		dik dik	1		
20174	2	2	petrosal			indet			
20175	2	2	metapodial frag	px		dik dik	1		

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
20176	2	2	navicular cuboid frag	l		bovid	2		
20177	2	2	pubic bone			indet			
20178	2	2	vertebra frag			indet			
20179	2	2	femur head		l	dik dik	1		
20180	2	2	metapodial frag			dik dik	1		
20181									
20182	2	2	vertebra frag			indet			
20183	2	2	phalanx 3			bovid	1		
20184	2	2	bone frag			indet			
20185	2	2	long bone shaft frag			indet			
20186	2	2	bone frag			indet			
20187	2	2	radius frag			bovid	2		
20188	2	2	phalanx 3			bovid	2		
20189	2	2	long bone shaft frag			indet			
20190	2	2	vertebra frag			indet			
20191	2	2	metapodial shaft frag			dik dik	1		
20192	2	2	calcaneum		r	dik dik	1		
20193a	2	2	external cuneiform		r	bovid	2		
20193b	2	2	tooth frag			bovid	3		
20193c	2	2	calcaneum frag			bovid	2		
20193d	2	2	patella		r	dik dik	1		
20193e	2	2	patella		l	dik dik	1		
20193f	2	2	navicular cuboid		l	dik dik	1		
20193g	2	2	phalanx 3			dik dik	1		
20193h	2	2	radia/ulna frag			bovid	2		
20193i	2	2	femur shaft			dik dik	1		
20193j	2	2	metapodial frag	ds		dik dik	1		
20193k	2	2	metapodial shaft			dik dik	1		

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
20193l	2	2	hyoid frag			bovid	2		
20193m	2	2	patella		l	dik dik	1		
20193n	2	2	phalanx 3			dik dik	1		
20193	2	2	bone frag			indet			388
20196	3a	8				indet			36
20198	1a	8	bone frag			indet			
20280	3b	2	n/a						
20202	3b	3	bone frag			indet			1
20210	1d	1	bone frag			indet			1
20211	1d	1	bone frag			indet			
20212	1d	1	phalanx 2 frag			bovid	2		
20213	1d	1	bone frag			tortoise		burnt	
20214a	1d	1	sessamoid	px		bovid	2	burnt	
20214	1d	1	bone frag			indet		burnt	134
20222a	3b	4	sessamoid			bovid	2		
20222	3b	4	bone frag			indet			122
20223	3b	4	bone frag			indet			1
20230a	1d	2	phalanx 1 frag	px		bovid	2	burnt	
20230b	1d	2	phalanx 2 frag	ds		bovid	2	burnt	
20230c	1d	2	astralagus frag		r	dik dik	1	burnt	
20230d	1d	2	sessamoid	?		bovid	2	burnt	
20230e	1d	2	phalanx 2	px		bovid	2	burnt	
20230	1d	2	bone frag			indet		burnt	125
20231	1d	2	phalanx 1	ds		bovid	2	burnt	
20232			n/a						
20233	1d	2	metapodial frag	ds		bovid	2	burnt	
20234	1d	2	bone frag			indet		burnt	
20235	1d	2	phalanx 1	ds		bovid	2	burnt	
20238	2	3	phalanx 2			bovid	2		

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
20239	2	3	tibia	ds	r	dik dik	1		
20240	2	3	metapodial frag	px		dik dik	1		
20241	2	3	p4/		l	dik dik	1		
20242	2	3	phalanx 1			dik dik	1		
20243	2	3	tooth frag			bovid	2		
20244	2	3	phalanx 3			bovid	2		
20245	2	3	bone frag			indet			
20246	2	3	metapodial	ds		dik dik	1		
20247a	2	3	phalanx 3			bovid	2		
20247	2	3	bone frag			indet			41
20255a	3b	5	bone frag			indet		burnt	cut mark
20255b	3b	5	bone frag			indet		carnivore punch mark	1
20255	3b	5	bone frag			indet		burnt	411
20256	3b	5	humerus shaft frag			bovid	4	cut mark	burnt
20257	3b	5	cervical vertebra			indet			
20258	3b	5	mandible frag		l	bovid	2	burnt	
20259	3b	5	tibia shaft frag			bovid	2	burnt	
20260	3b	5	cervical vertebra			bovid	2	burnt	
20261	3b	5	phalanx 1 frag			dik dik	1	burnt	
20262	3b	5	humerus shaft frag			bovid	4	burnt	
20263	3b	5	bone frag			indet		burnt	
20264	3b	5	metacarpal frag	px		bovid	4	burnt	
20265	3b	5	ilium frag			bovid	2	burnt	
20266	3b	5	vertebra frag			indet			
20267	3b	5	bone frag			indet		burnt	
20268	3b	5	tooth root			bovid	3		
20269	3b	5	metapodial frag			bovid	3	burnt	
20270	3b	5	vertebra frag			indet		burnt	

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
20271	3b	5	bone frag			indet		burnt	
20272	3b	5	lower molar frag		r	bos taurus			
20273	3b	5	tibia shaft frag			bovid	3		
20274	3b	5	phalanx 1 frag	ds		bovid	2		
20275	3b	5	tooth		r	crocodylus niloticus			
20276	3b	5	tibia shaft frag			bovid	3	burnt	
20277	3b	5	phalanx 1	ds		bovid	3	burnt	
20278	3b	5	magnum frag		l	bovid	2	burnt	
20279	3b	5	rib frag			indet		burnt	
20280	3b	5	vertebra frag			indet		burnt	
20281	3b	5	femur frag	px	l	avian (cf. Francolin)		burnt	
20284a	1e	3	phalanx 1	ds		bovid	3	burnt	
20284	1e	3	bone frag			indet		burnt	29
20286	3b	6	tibia shaft frag			bovid	2	burnt	
20287	3b	6	pubic bone			bovid	2	burnt	
20288	3b	6	femur head			bovid	2	burnt	
20289	3b	6	bone frag			indet		burnt	
20290+94	3b	6	tarsometatarsus			avian (cf. Francolin)			joined up
20291	3b	6	femur head		r	avian (cf. Francolin)			
20292	3b	6	tarsometatarsus			avian (cf. Francolin)			
20293	3b	6	mandible, p/2,p/3,p/4		l	dik dik	1	burnt	
20295	3b	6	p3/			bovid	4		
20296	3b	6	p/4		r	bovid	2		
20297	3b	6	cervical vertebra			indet		burnt	
20298	3b	6	magnum frag		l	bovid	3	burnt	
20299	3b	6	phalanx 1			avian (cf. Francolin)			
20300	3b	6	centrum			indet		burnt	
20301	3b	6	spine			fish		burnt	
20302	3b	6	phalanx 1			avian (cf. Francolin)		burnt	

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
20303	3b	6	bone frag			indet		burnt	
20304	3b	6	metatarsal		l	syncerus caffer		burnt	
20305	3b	6	femur	ds		avian (cf. Francolin)		burnt	
20306	3b	6	bone frag			indet		burnt	
20307	3b	6	pisiform		r	bovid	3	burnt	
20308	3b	6	tibia	ds	r	avian (cf. Francolin)		burnt	
20309	3b	6	vertebra frag			indet		burnt	
20310	3b	6	lumbar vertebra			bovid	2	burnt	
20311	3b	6	astralagus frag		r	dik dik	1	burnt	
20312a	3b	6	humerus shaft frag			bovid	4	burnt	cut mark
20312b	3b	6	sessamoid	px		bovid	4	burnt	
20312c	3b	6	phalanx 1	ds		bovid	4		
20312d	3b	6	radius frag	px		bovid	2	burnt	cut mark
20312e	3b	6	rib frag			indet		burnt	2
20312f	3b	6	tibia frag			bovid	4	burnt	5
20312g	3b	6	phalanx 2	px		bovid	2	burnt	
20312h	3b	6	vertebra frag			indet		burnt	
20312i	3b	6	mandible frag			bovid	3	burnt	
20312	3b	6	bone frag			indet		burnt	571
20317	1e	4	bone frag			indet			6
20320	2	4	humerus frag		l	bovid	4		6
20231+32	2	4	tooth frag			bovid	2		
20325	2	4	bone frag			indet			46
20340	3b	7	bone frag			indet		burnt	163
20341	3b	7	p3/		l	dik dik	1		
20342	3b	7	premolar frag			bos taurus	4		
20343	3b	7	vertebra frag			indet			
20344+50	3b	7	m1/		l	alcelaphinae	3		
20345	3b	7	phalanx 1	ds		bovid	3	burnt	

Cat #	Location	Depth	Element	Px/Ds	R/L	Taxon ID	Size	Mod	Comments
20346	3b	7	calcaneum frag		r	bovid	2	burnt	
20347	3b	7	lumbar vertebra			indet		burnt	
20348	3b	7	tibia shaft		r	dik dik	1	burnt	
20349	3b	7	tooth frag			bovid	3		
20350	3b	7	bone frag			indet			
20351	3b	7	med cuneiform		l	bovid	2	burnt	
20352	3b	7	bone frag			fish		burnt	
20353	3b	7	sessamoid	px		bovid	2	burnt	
20354	3b	7	tooth frag			bovid	2		
20355	3b	7	phalanx 2	ds		bovid	4	burnt	
20358	1e	5	ilium		r	dik dik	1	burnt	
20359	1e	5	phalanx 3			bovid	2		
20360	1e	5	pubic bone frag			dik dik			
20361	1e	5	bone frag			indet			21
20366	1e	6	bone frag			indet			
20367	1e	6	spine			fish			
20368	1e	6	radius frag	px		bovid	1	burnt	
20369	1e	6	incisor			monkey			vervet or colobus
20371	1e	6	sessamoid			bovid	4	burnt	
20272	1e	6	bone frag			tortoise			
20273	1e	6	bone frag			indet		burnt	114
20373	2	5	bone frag			indet			13
20374	1e	7	bone frag			indet		burnt	25
20377	1e	7	radius frag	px	r	bovid	4	burnt	cut mark
20378	1e	7	radius shaft frag			bovid	4		4
20381	1e	10	bone frag			indet			32
20007	Surface	art cluster 2	cervical vertebra			indet			

VITA

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University of Illinois at Chicago, Chicago, IL (1997–2004)
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University of Arizona, Tucson, AZ (July–Aug. 1998)
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Wayne State University, Detroit, MI (1993–1997)
Bachelor of Arts, German and English, summa cum laude
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University of Illinois at Chicago, Geography Department (Jan 99–April 99; Jan 98–April 98): Teaching Assistant for Introduction to Cultural Geography (GEOG 102)

Professional Experience:

Public Service Archaeology Program, University of Illinois at Urbana (May 04–present; June 03–Sept 03): Crew Supervisor

Tsavo Archaeological Research Program (Dec 03–May 04; Dec 00–Dec 01): Project Director

Public Service Archaeology Program, University of Illinois at Urbana (Jan 03–June 03; May 02–Aug 02; June 00–Dec 00): CRM Field Aide

University of Illinois at Chicago, Department of Earth and Environmental Sciences, Luminescence Dating Research Laboratory (Jan 02–May 03): Laboratory Technician

Field Museum of Natural History, African Archaeology and Ethnography (Sept 99–Dec 00): Research Assistant

Honors:

2003	National Science Foundation Dissertation Research Grant ($11,909)
2002	University of Illinois Provost's Graduate Research Award ($3,000)
2001	Fulbright IIE research fellowship ($30,000)
1997	Inducted into Phi Beta Kappa National Honor Society Certificate of Achievement from Wayne State University, College of Liberal Arts for outstanding undergraduate scholarship USAA All-American Scholar
1996	Inducted into Delta Phi Alpha National German Honor Society Received a scholarship to study the philosophy of Spinoza at the Instituto Italiano Per Gli Studi Filosofici, Naples, Italy ($1,500) Dean's List (winter, summer and fall)
1995	Received Uwe K. Faulhaber Endowed Scholarship ($2,000) German Department Book Award for outstanding scholasticism Dean's List (winter, summer and fall)

1994 Received a scholarship to take summer courses at Albert-Ludwigs Universität, Freiburg, Germany ($3,000 travel, tuition, fees, housing, board)
German Department Book Award for outstanding scholasticism
Dean's List (winter and fall)
1993 Dean's List (winter and fall)

Papers Read at Professional Meetings:

2003 The relevance of new understandings of early pastoralism from Tsavo, Kenya to pastoralists today. *African Studies Association Meetings*. Boston, MA
2002 Filling in the gaps: The Pastoral Neolithic of Tsavo. *Society of Africanist Archaeologists*. Tucson, AZ

Academic Publications:

(In Review) New perspectives on early East African trade: A view from Tsavo National Park, Kenya. Under review at the *African Archaeological Review*.

(In Review) Understanding pastoralism as a risk management strategy: An archaeological perspective. In *Ecology, Economy and Culture: Human Adaptation in Tsavo, Kenya*. C. Kusimba, ed. Trenton, NJ: Africa World Press.

2004 Results of recent archaeological work in Tsavo East National Park, Kenya. *Nyame Akuma*, 61, 39-42.

2003a Archaeological investigations of three Pastoral Neolithic sites in Tsavo National Park, Kenya. *Azania* 38, 183-188.

2003b Survey, excavation and preliminary analysis of Pastoral Neolithic sites, Tsavo, Kenya. *Nyame Akuma* 59, 54-61.

Co-Authored Academic Publications:

Chapurukha M. Kusimba, Sibel B. Kusimba and David K. Wright
(in press) The development and collapse of precolonial ethnic mosaics in Tsavo, Kenya. In press at the *Journal of African Archaeology*.

Robert K. Booth, Stephen T. Jackson, Steven L. Forman, John E. Kutzbach, E. A. Bettis, III, Joseph Kreig and David K. Wright
2005 A severe centennial-scale drought in continental North America 4,200 years ago and apparent global linkages. *The Holocene* 15 (3), 321-328.

Selected Cultural Resource Management Publications:

David K. Wright and Kevin P. McGowan

2004a Phase Ia archaeological reconnaissance for a proposed telecommunications system at 300 West Avenue B in Griffith, Lake County, Indiana. Public Service Archaeology Program Archaeological Survey Full Report submitted to Indiana Historic Preservation Agency, Indianapolis.

2004b Phase Ia archaeological reconnaissance of a 2.8-acre Lake Hills Country Club property addition in Lake County, Indiana. Public Service Archaeology Program Archaeological Survey Full Report submitted to Indiana Historic Preservation Agency, Indianapolis.

Kevin P. McGowan and David K. Wright

2004a Archaeological reconnaissance of the proposed Graham property development in Kendall and Lake Counties, Illinois. Archaeological Survey Short Report submitted to Illinois Historic Preservation Agency, Springfield.

2004b Archaeological reconnaissance of Vogelei Park in Cook County, Illinois. Public Service Archaeology Program. Archaeological Survey Short Report submitted to Illinois Historic Preservation Agency, Springfield.

2003a Archaeological reconnaissance of a 101.5-acre Glenwood Property in Kane County, Illinois. Public Service Archaeology Program. Archaeological Survey Short Report submitted to Illinois Historic Preservation Agency, Springfield.

2003b Archaeological reconnaissance of a 70-acre Glenwood property in Kane County, Illinois. Public Service Archaeology Program. Archaeological Survey Short Report submitted to the Illinois Historic Preservation Agency, Springfield.

2003c Phase Ia archaeological reconnaissance and architectural review for a proposed telecommunications tower (Trileaf #9095), in Cedar Creek Township, Lake County, Indiana. Archaeological Survey Full Report submitted to the Indiana Historic Preservation Agency, Indianapolis.

Gregory R. Walz and David K. Wright

2003 Archaeological reconnaissance of a proposed telecommunications tower (Trileaf No. 9078) in Lake County, Indiana. Public Service Archaeology Program. Archaeological Survey Full Report submitted to the Indiana Historic Preservation Agency, Indianapolis.

David K. Wright and Gregory R. Walz
2003 Archaeological reconnaissance of a proposed telecommunications tower (Trileaf No. 8230) in Jo Daviess County, Illinois. Public Service Archaeology Program. Archaeological Survey Short Report submitted to the Illinois Historic Preservation Agency, Springfield.