BONE HARPOONS FROM SELECTED SITES IN THE LAKE TURKANA BASIN.

by

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To my parents, sister and brother.

ABSTRACT

This work concern barbed bone harpoons from four Holocene fishing settlement sites in the Lake Turkana Basin. The harpoons are a component of the assemblages recovered by excavation. The study has been undertaken to find the significance of these tools in the assemblages and the relationship between harpoons from different fishing settlements.

The first chapter present the project and hypothesis being tested. Second chapter discuss the palaeoenvironmental history of East and North Africa and the Lake Turkana Basin since the close of the pleistocene to the present. The third chapter discuss the Holocene archaeology of East and North Africa and Lake Turkana Basin. The fourth chapter present the geo-environmental setting, dating and artifactual contexts of the four studied sites. The studied sites are Lothagam, Lowasera, GaJi 11 and GaJi 12.

Chapter five concern the methods employed in analysing bone harpoons from the four sites. Chapter six is the analysis where description, comparison of harpoons and cultural reconstruction of harpoon culture dispersal into lake Turkana Basin are done. In chapter seven, the procedure and results of experimental work undertaken are presented. Finally, in chapter eight summary and conclusions are made.

The harpoon culture reached the Lake Turkana Basin from Ethiopia where it had reached from Zaire. In manufacturing harpoons there was need to select big straight fresh bones. The harpoons were made by the same people who were in close contact. The people used the same technology of manufacturing. The semi-sedentary life shows there was intersite movement in the Turkana Basin.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Excavations of the Lake Turkana Holocene fishing settlement have recovered artifacts and faunal remains. Among the artifacts are lithic and bone tools. Though bones were used to make various types of tools as the archaeology of the basin shows, it was predominantly used to make barbed bone harpoons. These barbed bone harpoons are represented in all excavated fishing settlements. This is a manifestation that they were a vital component of the well known aquatic culture. This means that the understanding of the overall culture of the Holocene fishermen in the lake Turkana Basin is incomplete without a full knowledge of barbed bone harpoons.

The work that has been done on fishing sites in the Lake Turkana Basin in an effort to understand Holocene culture lacks a contribution on harpoons. The fact that harpoons are a component of the culture, their detailed study is required in order to harmonise the results of all the studies which create a base of answering some of the following questions: What was the technology of making harpoons? What is the possible direction of origin of the harpoon culture? Who were the fishermen? Were they the same or different groups of people who occupied the fishing settlement sites scattered along the shore of lake Turkana? What factors led to settlement pattern portrayed by faunal remains and artifacts recovered from excavation, semi-sedentary life?

Detailed studies have been done on lithic tools, pottery, fish and animal remains and the role of environment in shaping the settlement pattern and its relation to resource exploitation. But such study has not been extended to the barbed bone harpoons. There has been an inclination to studying single Holocene fishing sites (e.g. Phillipson 1977) or a number of them but in the same geographical region (e.g. Barthelmé, 1981). This makes it impossible to make a good conclusion and leaves the question of the relationship between the spatially scattered fishing sites still unanswered.

This work studies harpoons from four sites in the lake Turkana Basin. The harpoons studied are from the sites of: Lothagam, Lowasera, GaJi 11 and GaJi 12. The study is focussed on different sites located at different areas of the basin and the whole perimeter of the lake has been covered. Over 500 bone harpoons from the four sites have been analysed to accomplish this project.

This work has been divided into eight chapters. The second chapter present the palaeoenvironmental history of the lake Turkana Basin and its environs, east and north Africa during the late pleistocene and Holocene pluvial period. The transition from pleistocene to Holocene is believed to have effected a systematic change of people from hunter-gatherers to a semi or permanent settled way of life. Therefore, this transition is emphasized in this chapter. This change is seen in the form of the appearance of fishing settlement sites whose inhabitants predominantly relied on aquatic resources. The geological evolution of the Turkana Basin is discussed, the historical evolution of the Turkana Basin is discussed, its historical evolution has remarkably affected the life of the people on its shore. The Holocene deposits which are the Galana Boi and Kibish Formations are discussed to review their deposition and relevance to the chronology of the Holocene artifact-baring horizons. Lake Turkana's high water stands which characterised the Holocene and present lake's environments are also presented.

The past archaeology of the lake Turkana Basin Holocene fishing settlement sites and that of East and North Africa is reviewed in chapter three. The conclusions drawn form the past research are presented. Diverse views of past researchers as to the origin, spread and extent of the prehistoric cultures are critically reviewed. Bone harpoons and their affinities are discussed in chapter three. The main aim of incorporating the palaeoenvironmental history and past archaeology is to open a way of understanding harpoons as a cultural element of the widespread Holocene aquatic culture (see Figure 1).

Chapter four present the geo-environmental settings chronology and the artifactual contexts of the four sites studied.

Chapter five presents the methods used to study harpoons from the four different sites.

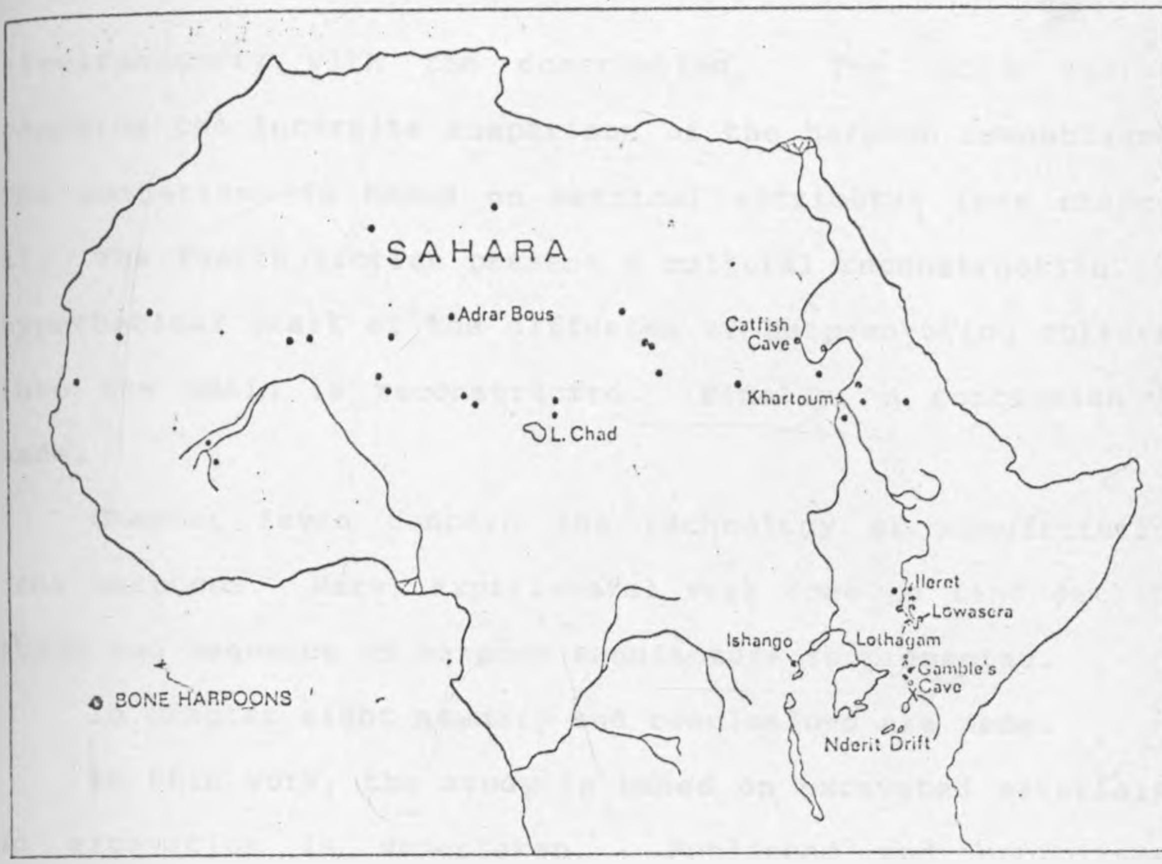


Figure 1. Location of selected Holocene archaeological sites with associated banbed bone harpoone (After Barthelme 1981 cited in Sutton, 1974)

Chapter six is the analysis. The chapter is sub-divided into five sections. One section describe the harpoon assemlages from the four sites studied. Data collected are presented in summarised form in this section. Intrasite comparison is done simultaneously with the description. The third section concerns the intersite comparison of the harpoon assemblages. The comparison is based on metrical attributes (see chapter 5). The fourth section present a cultural reconstruction. A hypothetical trail of the diffusion of harpoon-using cultures into the basin is reconstructed. Finaliy, a conclusion is made.

Chapter seven concern the technology of manufacturing bone harpoons. Here, experimental work done to find out the style and sequence of harpoon manufacture is presented.

In chapter eight summary and conclusions are made.

In this work, the study is based on excavated materials. No excavation is undertaken. Published and unpublished information has been utilized to accomplish the project. All the above has been done to test the hypothesis that: harpoons from different sites within the Lake Turkana Basin portray temporal-spatial variations in styles and sequence of manufacture. These variations are seen as attesting to individual craftsmanship, group of people or culture. The results drawn from this study are used to reconstruct the possible source, medium of and spread of the culture into the lake Turkana Basin.

CHAPTER II

PALAEOENVIRONMENTAL HISTORY

INTRODUCTION

This chapter opens with the palaeoenvironmental history of East and North Africa from the early to late Holocene. Brief attention is given to terminal pleistocene conditions and transition to the Holocene which is a period distinct from the former. Features associated with Holocene increasing pluviality are discussed, such as, high and low lake stands, pollen and sediments analysis.

The geological evolution of the lake Turkana basin is discussed, focussing on sedimentological changes the basin has undergone. These are a prelude to the present geological features of the basin. Holocene environments in the basin and associated deposits, mainly the Kibish and Galana Boi Formations, are described. The relevance of the two Formations to chronology of the Holocene high water stands is shown. Finally, a description of modern Lake Turkana is presented stressing the environent and the lake biochemisty.

HOLOCENE ENVIRONMENTS IN EAST AND NORTH AFRICA

Past East African environments have largely been interpreted in terms of pluvial theory (Leakey, 1931, Wayland, 1934). The theory correlated stratigraphic deposits with pluvial and interpluvial periods. The analysis of beach and river levels and sendiments were interpreted according to glacial and interglacial sequences in Europe (e.g. Leakey, 1931). The start of C14 dating showed that African pluvial periods could not be correlatted with European periods (See Hamilton, 1982:44). consequently, reconstruction of palaeoenvironments have been done regionally (Stewart, 1989).

In the past two decades, pollen profiles and sediments analysis present a picture of environmental change. The late pleistocene in eastern Africa was hyper-arid and cooler. Pollen and sediments are indicators of high rainfall experienced by east and north africa during the Holocene. It is not my wish to discuss the terminal pleistocene in this section but to understand the transition from the pleistocene to the Holocene it is necessary. Absence of evidence for lakes, rivers or human habitation in the Western desert of Egypt between Circa 22,000 - 12,000 B.p. attest to aridity. Analysis of lake levels in the Ethiopian highlands show that, lake Abhe started drying up at Circa 20,000 B.p. and was almost completely dry at 17000 B.p.(Gasse and Street, 1978; Williamson and Adamson, 1980, From Stewart,1989). Analysis of fish fauna from eastern Lake Turkana deposits in this period shows a preponderance of ciclids. Schwartz (1983) suggest that they may tolerate high alkalinity values. Cores from Lake Naivasha suggest low lake levels from at least 28,000 - 12,500 B.p. (Richardson and Richardson, 1972) While those from lake Victoria show a low or non-existent water standing from *Circa* 14,500 -12,000 B.p.(Kendall, 1969). Lake Kivu is also very low from 13,700 - 11,200 B.p. (Hecky and Degens, 1973, Stoffers and Hecky, 1978) and Lake Mobutu is low from 25,000 - 12,500 B.p. (a brief rise is recorded at *Circa* 18,000 B.p.(See Harvey *in* Hamilton 1982).

Pollen profiles show a widespread drier habitat with open vegetation taxa prior to 11,000 - 12,000 B.p.profiles from Muchoya Swamp in Southwest Uganda show a peak of Graminaeae pollen with bush taxa (e.g.*Erica Phillipia*) from 17,000 - 11,000 B.p. (Morrison, 1969). Open vegetation is recorded at Mahoma Lake in the Ruwenzori Mountains at *Circa* 18,000 - 12,700 B.p. (Livingstone, 1967).A profile dominated by Graminaeae is seen at Laboot Swamp on Mount Elgon, from *Circa* 23,000 - 13,000 B.p. until 7,000 B.p. (Hamilton 1982:13). All these profiles indicate dry conditions.

The climate was also apparently cooler. Pollen analysis from Muchoya Swamp in Southwestern Uganda (Morrison, 1968) suggest the presence of *Stoebe* indicating temperatures were 5-8 degrees centigrade lower than today for a duration of 17,000 -11,000 B.p. This is supported further by pollen data from Sacred Lake on Mt. Kenya where the taxa present suggests that temperatures were 5 degrees centigrade lower than today (Van Zinderen Bakker and Coetzee, 1972: *From* Stewart, 1989). Hamilton (1982) has noted that moisture-loving forest taxa were present in some localities on Mt Kenya through this dry period. These, he suggests might have been a refuge for human habitaion. Evidence of change to more pluvial conditions in Eastern Africa is indicated in a variety of palaeoenvironmental indicators and dates between Circa 12,500 and 10,000 B.p. (Stewart, 1989). The terminal pleistocene studies on cores and pollen indicate a generalised trend to extreme aridity prior to the start of the Holocene.

A change from drier to moisture-loving vegetation types occurred ealier in the wetter areas of the Ruwenzori mountains and Lake Victoria than in the drier areas such as Central Rift Valley. At Muhoma lake at 12,700 B.p. a sudden change is noted from profiles dominated by grasses and heliophytic trees to closed montane forest taxa indicating the earliest dated pluvial period (Livingstone, 1967, see Stewart, 1989). At Northern Lake Victoria, Circa 12,000 B.p., pollen profiles indicate dominance of semi-deciduous and evergreen forest taxa indicating accelerating humid conditions. Supplementary evidence of moister conditions is evident from sediment analysis at Lakes Victoria and Kivu at 12,000 B.p., indicating increased stability of the diatom populations, lack of carbonates, increase in water depth, suggesting fresher water and rising lake levels. Lake Victoria overflows its outlet at this time (Kendall, 1969; Stoffers and Hecky, 1978). Sediments from Lake Kivu found in the core at Circa 13,700 B.p. are interpreted as representing a highly concentrated closed lake (Stoffers and Hencky, 1987).

At 10.500 B.p., there is evidence for regression of Lakes

Kivu and Victoria. Lake Victoria lost its outlet between *Circa* (10,400 - 9,500 B.p.) (see Stewart, 1989 *cited* in Kendall, 1969). Aragomite deposition between *Circa* 11,000 to 10,000 B.p. at Lake Kivu a fall in Lake level which concides with the Lake Victoria decline. At the same time, there is a noted decline in mesic forest taxa at Pilkington Bay, suggesting a fall in precipitation as the cause. Montane forest taxa recovers at 9,500 B.p. and continues until about 6,000 B.p. (Kendall, 1969).

Water rose again in Lakes Kivu and Victoria after 10,000 B.p. and Lake Victoria had an outlet to the Nile. Between 9,000 and 5,000 B.p. diatoms changes suggest a warming trend. At Lake Kivu at *Circa* 5,000 B.p., volcanic activity, drier climate or both, result in a Lake level fall, loss of outlet and termination of stable stratification of the lake (Stoffers and Hecky, 1978).

Similar data are lacking from Lake Runtanzige (formerly Edward). Volcanic activity occurred at 5,600 B.p. (Hamilton, 1982). High lake levels are known at 12m above the present lake (de Heinzelin, 1957) but dating is controversial (See stewart's footnote 1 1989:248). High level at this volcanically active time are seen as the cause of the disappearance of some fish species de Heinzelin, 1957, 1957: Greenwood 1959). There is evidence of high level and overflow at 12,500 B.p. (Hecky, 1978 *in* Hamilton 1982). Pollen profiles from Lake Victoria and Muchoya Swamp indicate a change to a drier semi-deciduous forest taxa at about 6,000 B.p. Podocarpus, a drier montane genus, appears in greater frequency throughout the area.

In the Central Rift Valley, a change from a pollen profile dominated by grasses to one dominated by moist-loving montane forest taxa is seen at Lake Kimilili on Mt. Elgon at 10,500 B.p.(Hamiliton, 1982) and at Circa 10,600 B.p. at Sacred Lake on Mt. Kenya (Coetzee, 1967). There is evidence of lake level rising at Lake Nakuru at Circa 12,000 B.p. (Butzer et.al. There is no evidence of increasing moisture at Mt. Kenya until after 11,000 B.p. First evidence of moisture conditions in the Central Rift Valley lakes is found at 9,200 B.p. at Lake Naivasha. Richardson and Richardson, 1972, From Stewart, 1989), at Circa 8,740 B.p. at Lake Elmentaita (Butzer et.al,1972)and at 9.650 B.p. at Lake Nakuru (Washbourn - Kamau, 1971). Dates of Circa 10,500, B.p. from Lake Bogoria (Formerly Lake Hannington) and 9120 B.p. from Lake Magadi confirm the high water conditions throughout the Central Rift at this time.

Lakes Nakuru and Elmentaita were combined into one basin which covered an area over 10 times the size of present day Lake Nakuru, and a depth of up to 180m above the present day level of the lake (Butzer et.al, 1972). Presence of fish remains at Gambles' cave and Lion Hills Cave (Leakey, 1931) indicates a fresher lake than today.

The upper catchment of the Ethiopian Highlands are environmentally important due to their nearness to the catchment of the Omo River which provides over 98% of the Lake Turkana water (Beadle, 1981:Fromtewart 1989: 23). Lakes in Ziway - Shala basin - Ziway, Langono, Abi Yata and Shala are fed by run-off from the highlands. The first evidence of refilling is at Circa 12,000 B.p. (Street and Gassee, 1981). The lakes rose until they formed a single continuous watermass at Circa 9,400 to 8,500 B.p. The lakes remained high until 4,000 B.p. with interrupting regressions from 8,400 to 6,500 B.p. and briefly at 5,800 B.p. Those dates correlates well with pollen data from nearby mount Badda which shows moist condition at Circa 10,000 B.p. (Hamilton, 1982).

In the Sahara, pluvial conditions are attested in the Southern Sahara at 11,000 B.p. in high lake levels at Lake Chad (servant and servant-vildary 1980, From Stewart, 1989). Aridity is seen at about 10,500 to 9,500 B.p. (Legine and Casanova, 1987. After 9,500 B.p., scatters of fossil bones of aquatic animals associated with cultural remains and old beach ridges dating from this period are common. Palynology indicates moister savanna grassland from 9,500 B.p. (Ritchie and Haynes, 1987). Lake Chad's levels are high between 9,000 and 8,000 B.p. and again 6,000 B.p. (servants and servant - vildrary, 1980) Regression is evident between 8,000 and 7,000 B.p. (Street and Gasse, 1981).

Increased downwash is interpreted as a sign of increasing aridity from about 8,000 to 7,000 B.p. and abandonement of archaelogical sites between *Circa* 8,000 and 7,000 B.p. as at Adrar Bous at 7310 B.p. (Clark *et.al*, 1973. Smith (1984) suggests the Air mountains may have been a refuge for human habitation. Presence of bones of *Lates niloticus* (Nile perch) in now arid areas indicates deep, well-oxygenated water (Fish, 1955). Remains of elephant, hippopotamus, crocodile, turtle and pollen of mediterranean - type flora confirm moister conditions northeast of Lake Chad (Daget, 1949;*From* Stewart, 1989). The rainfall regime changed to more seasonal one about 7,500 B.p. (casanova, 1987 also mark and sadr 1988).

Pollen studies from Lake Chad suggest first pluvial period was cooler dominated by sudano-guinean pollen during the second period reflecting more humid conditions (Maley, 1977 *in* Stewart, 1989). Petit-maire and Riser(1981) suggest presence of Lakes Erg Ine Sakine in 6,500 to 7,500 B.p. implying humid conditions in the Sahara. In north western Sudan, there is evidence of deciduous Savanna vegetation from 8,500 to 6,000 B.p. thereafter replaced by *Acacia* Savanna and shrub grassland (Ritchie, 1985). In the second pluvial phase, there is evidence of seasonal precipitation (street and Gasse, 1981). After 4,500 B.p. escalated dessication followed with short pluvial period at *Circa* 3,500 B.p. Smith (1984) suggest a southerly migration. A widespread lacustrine episode took place from 9,000 to 4,500, 9,500 to 4,500 and 9,500 to 3,500 B.p. between 24 degrees 22 degrees N, 20 degrees N and 22 degrees N and 18 degrees N and 20 degrees N respectively.

(Petit-Maire,1988) in the Taoudeni Basin (Mali) lake and swamp deposits are widespread implying variation in precipitation South -northerwards. After 7,000 B.p., climate deteriorated and fluctuations in lake level were frequent resulting in saline deposits or mud cracks (Petit-maine 1986, 1988). Those data correlate well with those from Ethiopia and Sudan, Atlantic Saoura to the Ghana Lakes (Petit-maire,1988). Increased rainfall induced growth of Graminaeae Steppe to the north of area and of a Sudanese Savanna South of the twentieth parallel (Petit-maire, 1988:23).

Foraminifera, Ostracods, Molluscs, rhinoceros, Large fish, crocodiles, turtles, hippopotamus, warthog, elephants and large antelopes remains were recovered. The large antelopes fauna had disappeared by 5,000 B.p. At 3,500 B.p., the saharan basins were desert (Petit -Maire, 1988).

In the Nile area, the highest Holocene lake level in the Fayum is placed at 9,000 B.p. which is succeeded by a series of lakes called Palaeomoeris depth 12m, premoeris 15-19m deep, protomoeris 19-24m deep, and Moeris lakes (Hassan, 1988). Deposits associated with these lakes dating to early Holocene are represented by Lacustrine sand and diatomite. Deposits of middle Holocene lake (Predynastic/Neolithic) and of late Holocene (Lake Moeris) are also represented.

At about 11,500 B.p Nile sediments suggest high river level branded "Wild Nile" by Butzer (1980). Low stands are indicated at 7,700 and 6,000 B.p. Fayum Lake Birket Qarun was low between Circa 7,000 and 6,000 B.p. .(Brewer, 1986 From Stewart, 1989). Butzer dates this decline at Circa 7,300 to 7,700 B.p. (1980), therefore earlier. Continuous falling river levels throughout the Holocene until about 5,000 B.p. are recorded (Butzer, 1980). Blue and White Niles are high at 7,500 and again 5,500 B.p. (Adamson and Williams, 1980).

In summary, a generalised trend of rise in Lake/river levels is observed immediately after the end of terminal Pleistocene aridity. The onset of high Lake level during the Holocene is localised as indicated by different dates obtained from different regions of East and North Africa. Again, aridity reset in many areas after 5,000 B.p. and Holocene pluviality ended.

LAKE TURKANA BASIN:-

Geological Evolution.

The geological context of the Lake Turkana Basin and evolutionary history, though within the East African Rift Valley System, are poorly understood (Feibel, 1988). The basin is composed of a series of Structural entities among others, the Turkana Rift proper, the Kibish Rift, Omo Rift and Usno Rift. (Davidson and Rex, 1980; From Feibel, 1988). The basin is Cenozoic in origin and developed on precambrian basement rocks (Hopson, 1982). These structures are believed to have been fully formed by 5 million years ago. The structures are half-grabens. Faults around the basin postdate the Plio-Pleistocene sediments leading to a suggestion that the present basin is of pleistocene age (Feibel; 1988).

Development of the Plio-Pleistocene basin was most likely complete by 4 million years ago. Efforts to interprete the stratigraphic sequence using seismic studies of rocks beneath the lake have failed. Rocks exposed around the basin are tentatively assigned to three groups, Metamorphic basement rocks of the Mozambique Belt, Cenozoic Volcanic Mantle and the Gomba Group.

The evolution of the Turkana Basin has been explained in models. Those models are aimed at reconstructing the past history of the basin which is long. The first model was discredited as it showed the existance of a permanent lake in Turkana basin, South of River Omo and east of the Koobi Fora region. The lack of continous sedimentologic evidence made the model questionable (Feibel and Brown, 1989). The sedimentation rate of Cerling (see Feibel and Brown, 1989), shows that it is not possible for a permanent lake to exist in the basin. This led to the theory of sedimentation by a meandering river, ancestral Omo? Lakes form when there is no outlet either to the east or north. During the past 4-2 million years,a permanent lake could not develop as the water could flow into the Indian Ocean or Mediterranean through the Omo River or Nile System as it was not bound by escarpment except to the South.

However, between 4 to 3.9 million years ago, a stable lake existed in the basin represented by Muruongori Formation at Lothagam extending into the Kerio Valley. To the eastern lake, the deposits of 4-3.9 million years are marked by the Lonyumum member of the Koobi Fora Formation. The Lonyumum member lake lasted for 100,000 years (Feibel, 1988). Volcanic ouflows are suggested to have dammed the basin outlet leading to formation of the lake aided by a slight upwarp along the eastern side of the basin. The lake is thought to have been 28,000 km sq. and 36m deep. The Lonyumum member lake is known to have existed in the basin (Feibel, 1988). The lake was fresh and supported Nilo-soudanian fish fauna, molluscs, Ostracods and diatoms.

Around 3.9 to 2.6 million years a cycle of sedimentation took place. The earliest deposition was during the Moiti and Lokochot members and the Tulu Bor Tuff. Deposition of the Moiti member marks the broadest floodplain known to have existed in the region (Feibel, 1988). The Moiti member lacks a lacustrine episode. During the Lokochot member deposition, there is suggested increament in pluviality and subsequent formation of a stable relatively fresh lake. The first well-developed delta is noted at this time in Western Area 117. At the end of this phase, a shift back to deposition by a meandering river is recorded stratigraphically (Feibel, 1988).

The final phase of deposition is marked between 2.5 to o.7 million years ago. Between 2.5 to 2 million years ago Mt Kulal erupted and deposition of Koobi Fora ceased due presumably to upwarp of the area. The phase started with Burgi member deposition. A shallow, restricted waterbody indicated by diatoms for at least a part of this period is suggested. A Burgi member lake formed in the basin which had an initial surface area of 9,000 km sq. An outlet existed to the Southwest at this time and River Turkana reached to the Indian Ocean (figure 2). This corrindor (of R. Turkana) was probably the route used by the Indian Ocean Stingray (Dasyatis africana) to enter the basin. It may also be responsible for the record of the tree (Brachystegia in member G of the Shungura Formation (Brown, 1981). This tree today occurs only along the Kenya Coast and farther South. The outlet by the Turkana River enhanced the maintenanace of the freshness of the water. A fall in rainfall in the Ethiopian Highlands, or initial piracy of the ancestral Omo River by a neighbouring drainage, most likely river Nile, reversed this situation (Feibel, 1988).

There was a constant shift in deltaic sedimentation at this time. There was lowering of Ph and elimination of endemic mollusc species around 1.7 millions years ago there was marked braiding of the ancentral Omo river system which carried a coarse bedload. A scoured topography called KBS channel complex developed.

Okote member deposition are marked by an initial phase of volcaniclastic deposition. Pumiceous initial phase of volcaniclastic deposition. Pumiceous material found in the

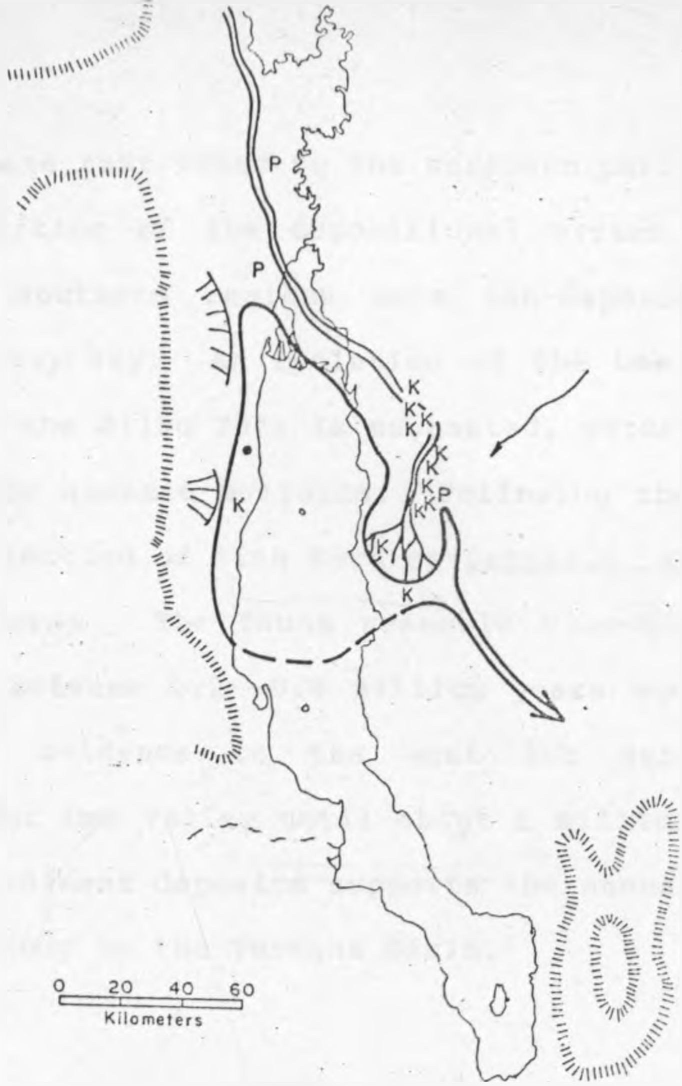


Figure 2. Reconstruction of the Turkana Basin at around 1.88m years ago, showing features of KBS Tuff. Black cicles represent exposures of lacustrine deposits, K indicates outcrops of KBS Tuff, P represents exposures of KBS pumiceous materials and the thick arrow an outlet to the south east creating a connecting corrindor-River Turkana (From Feibel, 1988).

Karari Ridge sequence indicate washing down of the pyroclastics from the Ethiopian Highlands by the ancestral Omo River (Feibel, 1988).

Chari Member deposition took place on a broad floodplain.

Omo Group deposits were restricted to the northern part of the basin. Implies shifting of the depositional system northwards over time. Southern regions were non-depositional, eroded and consequently dry. An isolation of the basin just before deposition of the Silbo Tuff is suggested, evidenced by speciation in phyletic endemic molluscs. Following the Chari member there is extinction of fish such as Dasyatis africana and Characid Sindacharax. The fauna resemble Nilo-Soudanian (see Feibel,1988). Between 1.2 -0.8 million years ago there is no depositional evidence to the west but deposition continued in the Lower Omo Valley until about 1 million years ago. The discrete sediment deposits supports the non-existent of a permanent waterbody in the Turkana Basin.

Holocene

The Palaeoenvironmental reconstruction of Lake Turkana relies on analysis and dating of beach ridges. Dates from shell and bone apatite are not very reliable (Collet and Robertshaw, 1983). Butzer's (1971) dates north of the lake indicate high lake levels from Circa 9,500 to 7,000 B.p. and from 6,200 to 3,900 B.p. (1980). Dated ridges indicate a high lake levels at about 8,800 B.p. of 430 to 460m (Butzer, 1980). There is evidence of slight regression prior to 9,300 B.p. and similar high levels lasting until Circa 7,000 B.p. These dates are derived from sites around Lake Turkana.

Around the Lothagam area, six dates indicate a high level from 8,600 - 7,000 B.p. nearing 430 - 460m above sea level (Robbins, 1972). In the Suguta trough, a high stand of Circa 482m is recorded at 9,660 B.p. (Truckle, 1976; From Stewart, 1989). At Lowasera, Southeast of the lake a date of Circa 9,470 B.p. is associated with a level of 73.8m and another high level at Circa 7,785 B.p. (Phillipson, 1977; 6-7).

At Koobi Fora, north-east of the lake, high levels are dated around 9,500 B.p. (Barthelme, 1981 and 1985). An overflow outlet through the Lotagipi Swamps at Circa 9,500 - 7,000 B.p. is suggested with levels fluctuating between 430 and 460 m above sea level. This indicates a connection between Lake Turkana and the White Nile. Another overflow is evident at Circa 9,000 B.p. (Gassee, Rognon and Street 1980 and 1981 From Stewart 1989). Stewart suggests subsequent introduction of the unexplained Soudanien fauna in Abenya - Chamo lakes. Diatom studies and palynology confirm this which resulted in refreshing of the lake. Pollen studies indicate that the Koobi Fora area was covered by a sub-desert steppe with herbaceous vegetation, with arboreal forms commom at 9,880 B.p. (Owen, et.al., 1982).

Evidence of regression is seen around Lake Turkana between 7,000 and 6,000 B.p. At Lothagam there is about 1,000 years gap 9 of high level dates from 7,000 B.p. to 6,000 B.p. (Robbins, 1972) and at Lowasera between 7,785 B.p. and at Circa 4,600 B.p. No high levels are dated at between 8,355 and 4,5[illegible] B.p. (Barthelme, 1985).

Stewart (1989) suggest a fall in lake level at some point to correspond with a reported fall in the Ethiopian Highlands which is a catchment of the Omo River, roughly between 8,000 and 6,000 B.p. second high lake levels commence at Circa 6,000 B.p. with a directly dated stand at 5,700 B.p. at 456m above sea level (Butzer, 1980). The high level persists until the lake falls again around 4,400 B.p. with a final high at 3,250 B.p. of 450 m. This is confirmed at Lothagam, Lovasera and Koobi Fora areas, giving consistent dates from 6,010 B.p. to 3,720 B.p. A level of Circa 422 to 435m average is recorded (Robbins, 1974; Phillipson 1977; Barthelme, 1981 and 1985).

The Kibish data (IVa and IVd) show that the regression brings the lake levels down to present levels from Circa 7,000 to 6,000 B.p. Second transgression fluctuated above the 450m outlet suggesting a connecting corrindor to the Nile, a refreshing of the lake and faunal exchange (Stewart, 1989:26).

According to Hamilton (1982), maximum level was reached during the Kibish IVa times at around 9,500 B.p. and the lake fluctuated between 60 and 80m. The other transgression is recorded during member IVb beginning 6,600 B.p. and reaching a level between 65 and 76m. The last transgression was at 3,000 B.p. reaching a level of 70m.

The early Holocene first transgressive - regressive phase is represented by thick sequence of diatomaceous silts in Area 102. The silts thicken South-eastward and correspond with the 75 to 80m beach deposits at GaJi I (Barthelme, 1985). Radio-carbon dates on molluscs from littoral sands south of the Kokoi highlands and near Illeret, have yielded dates between 9,540 and 9,360 B.p. In Area 127, dates of 8,710 and 8,520 B.p. on fish bone and mollusc shell from 73m to 75m beach sands have been obtained (Barthelme, 1985).

The second transgressive-regressive phase in Area 102 and 103 dates 5,060 and 4,540 B.p. were obtained from littoral sands with levels 70 and 67m respectively. The third phase levels are recorded by 6m of white diatomaceous silts located 5km south-east of Koobi Fora spit. The base of this sequence measures 35-40m (Barthelme, 1985).

In summarising, correlation shows that the Lake Turkana Basin experienced increasing rainfall, higher temperatures and vegetation which was moisture-loving in the early Holocene phase like other parts of Africa. This continued until 5,500 B.p. and a trend to aridity followed between 4,000 to 3,000 B.p. The high rainfall and overflow led to a connection of the lake to other fluvial systems to the north and southeast. Consequently, there was change in biotic composition of the lake. Localisation of transgressive-regressive intervals is observed (e.g. Barthelme 1981 and 1985, Hamilton, 1982).

Holocene Deposits

Existence of old lacustrine deposits in the Lake Turkana Basin was first recognized by Hohnel (1891) and later confirmed by Fuchs (1935,1939, see Butzer Brown and Thurber, 1969). The Kibish Formation were recognized by Butzer and

Brown (1967). These deposits extend from the Lower Omo Valley to the west side of the Turkana Basin. The formation is divided into four members. Members I, II and III consist of delta plain, delta fringe, and prodeltaic sediments. The three are of Plio-pleistocene age (Butzer, Brown and Thurber 1969). Member IVa and IVb have littoral deposits and are Holocene in age dating roughly between 8,000 - 9,000 B.p.. The Kibish Formation provides one of the largest and most detailed stratigraphic columns for the late Pleistocene and Holocene. (see Barthelme, 1985).

Holocne sediments on the western shore of the lake have been investigated by Walsh and Dodson (1969), Robbins (1972) and named the Kabua beds (Whitworth, 1965). On the southeastern lake shore, Phillipson (1977) and to the northeast have been investigated by Bower and Vondra (1973), Raynolds (1973) and Barthelme (1977). Holocene deposits at Koobi Fora are called Galana Boi. The Galana Boi beds at Lake Turkana consist of lacustrine and marginal lacustrine diatomaceous silts and fine to coarse sands (Owen <u>et.al.,</u> 1982). Where exposed, the beds are usually less than 10m thick but reach a thickness 32m in Area 103 (Raynolds, 1973). The beds are not affected by tectonics except near Kokoi horst where an uplift occurred (Barthelme, 1985). Throughout the Holocene, the fluctuating lake levels have resulted in the formation of lenticular sedimentary units which exhibit vertical and lateral facies variations over short distances.

Lacustrine Silts have infilled palaeovalleys while littoral sandy units crop out as discontinuous bodies that are parallel to former Holocene shore lines.

Owen's (1981, Owen et.al., 1982) research has revealed that nearshore, beach bars and littoral shelves are represented by fine to coarse grained heterogeneous sands which are well-sorted, showing mineral strata and sometimes form linear bodies less than 2m in thickness. Molluscs and fish bone are common in shoreline sediments including Mutela emini. Etheria elliptica and Pila Ovata. Stratification of those sediments is poor (Barthelme, 1985).

Low energy lacustrine environments are represented by clay, diatomaceous silt and fine sand lithofacies. The sediments are well-laminated and exhibit a maximum thickness of about 20m. Molluscs such as Melanoides tuberculata, Corbicula africana, Cleopatra Pirotrii and Bellaya Unicolor. Fishbone, Sponge Spicules, ostracods and pollen are well-represented (Barthelme, 1985).

Owen's work (1981, Owen et.al., 1982 has identified three biogenic Lithofarcies (see Berthelme, 1985). In high energy environments Etheria elliptica may form reefs up to 4m thick and in Area 127 up to 8km long (Barthelme, 1985). Melanoides tuberculata and Corbicula africana are predominant molluscan species in Silty Sand units less than 10cm thick within the second biogenic lithofacies. Thirdly, former lagoons and quite water embayments were recorded from several outcrops of impure diatomite (Barthelme, 1985:15).

The presence of such sediments like the Kibish Formation, which is dateable, make it possible to correlate the fluctuation of the lake temporally and spatially. The Galana Boi and Kibish sediments have been used extensively in reconstructing Holocene lake levels and in dating artifacts associated with those sediments. For instance, Butzer's research (1969) identified three high lake stands between 10,000 and 7,000 B.p. 6,500 and 4,000 B.p. and at Circa 3,250 B.p. lithofacies in the sedimeints such as mollusc shells are dateable and are vital in chronology.

The deposits found in the Lake Turkana Basin in the Holocene are Lacustrine and where they are found, are concrete evidence of the past expanse of the lake. The characteristic past meandering of the rivers draining into the basin and the lake changing levels are represented by the sediments. The presence of Kibish Formation deposits in the West of lake is an indication of deposition by the River Omo, where a delta seems to have been located to the westernside of the basin over most of the Holocene period.

The Lake Today

Lake Turkana is a closed-basin lake formerly known as lake Rudolf situated in Northern Kenya within the Gregory Rift Valley. The lake receives most of its waters (over 80%) from Omo River rising from Ethiopian Highlands (Feibel, 1988). The balance of the lake waters come from the Turkwell and Ker.o

Rivers to the Southwest. Though the lake is a dominant feature in the region today its geological past is very short (Brown and Feibel, 1989) Cerling (1986) suggest the lake has been in existence for less than 180,000 years in its present form. He argues that filling of the basin by sediments takes a period of 180,000 years. That means, if the lake is older than the age, it would have been filled by sedimeknts and no lake would exist today. (see Brown and Feibel, 1988).

The lake is alkaline, has an attitude of about 375m above sea level, area of about 7,500 kmsq, depth of about 73m, conductivity of 3,300 ksq 0, salinity of 2,482 g 1/10100 and a PH range of 9.5-9.7 (Hamilton, 1982). It experiences mixed seasonal winds. The lowest point is to the west, while two million years it was to the east. The new physiographic configuration has resulted in a larger region being drained today than in the past (Feibel, 1988).

The lake is situated in an absolutely semi-arid area. Rainfall is 200-400 mm per year, unreliable and unpredictable. When rain comes, it is episodic and in torents. The lake shore is shallow. The vegetation along the lake margin is semi desert. It is made up of grasses interrupted by forests along the river valleys. Dryness of the area affects the level and biochemistry of the lake.

The bare land along the lakeshore cannot support agriculture and consequently, the area is sparcily populated. Most of the people are pastoral nomads who move around with their herds looking for grasses. The movement is determined by the availability of grasses. To the east of the lake are the Dasanech who extend into Ethiopia and are predominantly pastoralists. To the west are the Turkana people. The Samburu and Elmolo are located to the southern fringe of the lake. These people normally do fishing in the lake to supplement other animal products. History has shown that the Turkana region has not always been a semi-desert. The land was green with vegetation and animals. Overstocking in the few past decades led to destruction of the vegetation leaving bare land prone to erosion. Hunting and poaching depleted big-game animals (Robbins, 1974). The lake has been a regular source of fish, crocodiles and turtles identified in food middens. The lake experience high evaporation due to dessication and continued shrinkage.

CONCLUSION

Evidence from pollen profiles and cores from lake bed sediments shows a generalised trend to aridity at the close of Pleistocene, in east and north Africa. The Holocene was characterised by increasing precipitation in east and north Africa. Regionalisation of start of wet intervals during Holocene is evident.

There is no evidence to support the development of a permanent lake in the Turkana Basin. What has been there permanently is the proto-Omo River or River Omo. The river is known to have meandered. Sedimentation of the basin caused oveflows of the lake and development of outlets either to the northwest or southwest.

Two Holocene sedimentary deposits are noted in the basin, the Galana Boi Formation covering Koobi Fora region, and Kibish Foramation to the north and southwest of the lake. Lake Turkana today is the main feature in the basin and it is about 180,000 years old.

CHAPTER 111

HOLOCENE ARCHAEOLOGY

INTRODUCTION

In this chapter, I am going to discuss the Holocene archaeology in east and north Africa. Basically, my discussion is to be centred on sites with harpoons. Diverse views of the past researchers towards the origin, spread and extent of the prehistoric cultures are incorporated in this section. The past research in the Holocene fishing settlements in the Lake Turkana Basin is critically reviewed. Harpoons and affinities are discussed. The conclusions drawn from the research are also outlined.

EAST AND NORTH AFRICA

The archaeology of fishing settlement sites was first recognized in the late 1950s. Arkell's (1949) work at Early Khartoum in sudan provided the earliest description of an early Holocene fishing settelement site. Earlier recognition of the sites consisted of reports of aquatic fauna associated with barbed bone points from Central Sudan (Kelley 1934 and Marchad 1936 From Stewart, 1989). After Arkell's report, many archaeologists became interested in the culture and a series of research followed in east and north Africa. The extensive research sparked off speculations and individual explanations about the source, geographical and spatial limit of the aquatic culture.

Arkell's excavation was the first source of evidence of permanent and semi-permanent settlement based primarily on exploitation of aquatic resources. Alongside this, were new procurement and processing methods reflected in the bone harpoons and wavy-line pottery assemblages. Arkell termed it "wavy line culture" extending beyond Khartoum and it showed similar geographic and temporal cultural-economic features. These "wavy-line culture" sites were located in the Sahelian-saharan zone of Africa according to Stewart (1989) and dated to the early Holocene. She argues they show similar cultural characteristics such as pottery, barbed bone points and reliance on fish and aquatic mammals-hippopotamus.

After publication of Arkell's report, two more settlements sites were excavated extending the geographic and temporal limits of his "wavy line culture" farther. Those sites are Esh Shaheinab, near Khartoum (Arkell, 1953) and Ishango, on lake Runtanzige (Formerly Edward), (de Heinzelin, 1957). The former was dated questionably about 2,000 yrs later than the early Khartoum which was dated to between 8,00 and 7,000 B.p. (Adamson, 1974). Its material culture, barbed bone points and pottery were direct derivatives from Early Khartoum forms (Arkell, 1953). Aquatic resources were less important as compared to Early Khartoum.

Ishango pushed the "wavy line culture" far beyond Arkell's geographic range to south of the Sahel. The material at Ishango lacked pottery (see Stewart, 1989). A reported stratigraphic sequence of harpoons, from biserial to uniserial make the site unique. Later, the site proved to be the oldest (see Stewart's footnote, 1989:248)

In the following years, isolated reports were made across east, central and north Africa, after the report of the three sites. The reports were in the form of isolated barbed bone points or wavy line pottery or both. (e.g. Oakley 1961, Petit Maire 1988, Connah 1975). Research at that time stressed on cultural manifestations as against resource base for Arkell's "wavy line culture". There was intensified comparison of cultural assemblages especially for barbed bone points and wavy line pottery (monod and Manny 1957, de Heinzelin 1957, 1962, Oakley 1961 and Arkell 1962). There followed discussion of diffussion of the aquatic culture (e.g. Leakey, Sutton 1977 and Arkell, 1962). De Heinzelin (1962) used observed technological changes of barbed bone points at Ishango to suggest the site as the origin and subsequently bone harpoons spread to the northeast, northwest to the Nile and the Sahara. Sutton suggest the tropical rain forest as the origin adjacent to Ishango. The origin of wavy line pottery was in the Nile region and potters took the knowledge westwards and came back with fishing and hunting techniques, especially design of barbed bone points.

In 1977, Sutton argued "wavy line culture" sites are a representation of evolutionary subsistence and cultural adaptations. He described them as "acqualithic". He suggests aquatic culture was the result of east-west migration of the people along the waterways of the Sahara-Sahel Zone. He stressed the importance of adaptation to a new plentiful economic base in the Sahelian-Saharan Zone. Initially, researchers believed wavy line pottery and barbed bone points were contemporary. This was especially due to their association in the Sudan. The new dates for Ishango going beyond the Holocene and absence of pottery in the assemblage, discredit the allegation. Based on the new date for Ishango (25,000 B.p.) and lack of pottery in the assemblage, I presume opposite direction of origin of the two traits that is, pottery from the north and harpoons from the South.

Within the past decade, researchers have redirected their work to investigating changes in exploitation strategies, the people's response to changes in climate during the Holocene and land-use pattern in North and east Africa (e.g. Mark and Sadr in 1988, Stewart, 1989 and Barthelme, 1985)

LAKE TURKANA BASIN

Study of the fishing settlement sites in the Lake Turkana Basin started in the 1980s. This was when the archaeologists had shifted their effort from investigating the source of aquatic culture to exploitation strategies, land-use pattern and the relationship between environmental change and resource exploitation.

The earliest detailed work was by Robbins (1974). His excavation was concentrated in the western Lake Basin. He analysed faunal and cultural assemblages at Lothagam to correlate variation in lithic aggregates with lake level changes. In his excavation he recovered lithic, bone tools and pottery. He used Elmolo ethnography to reconstruct settlement pattern, demorgraphy and technology of the past inhabitants of the Lake Turkana Basin. The Elmolo are present inhabitants just to the north of Loiengalani who depend primarily on aquatic resources. He concluded that, boats were the means by which new knowledge was transmitted, and that cultural innovations such as of harpoons enabled people to exploit new environments during the early Holocene. Robbins, Angel and Phenice (1980) did excavation at Lopoy near Lothagam where bone artifacts were recovered and human remains.

Phillipson (1977) at Lowasera used the same apporach as Robbins to investigate co-variation in lithic and barbed bone point assemblages in response to lake level and environmental change.

Barthelme, (1981 and 1985) surface collected seven sites at Koobi Fora, eastern side of the Lake Turkana. He excavated three of these sites in a bid to investigate land-use patterns. He found only semi-permanent beach camps and suggested differential utilization of resources at the sites are as a result of subsistence preferences or site location. Two sites were aceramic and barbed bone points varied morphologically betweeen the sites.

Stewart (1989) analysed fish remains from sites erlier worked by Phillipson, Robbins and Barthelme. Her concern was to find out the response of the people to a changing environment around Lake Turkana. She surveyed the remains to support the hypothesis that the abundance of remains was directly proportional to environmental change during the pleistocene-Holocene period. For instance the abundance of fish remains was high when the lake/river level was high. the study of Lake Turkana fish remains was done on a comparative basis with the site of Ishango.

The past research into the Lake Turkana Basin fishing settlements was inclined only to describing the assemblages in a single site or a group of sites. While much emphasis has been put on faunal assemblages, lithic and pottery, equal detailed study of harpoons is lacking. The origin of the aquatic culture inthe basin still remains a vexing issue. Intersite comparative analysis of barbed bone points within the basin and the technology of manufacturing is required.

HARPOONS AND AFFINITIES

There is no clear distinction between bone harpoons used in fishing during the Holocene and other harpoons used in hunting of terrestial animals. There are various tools named harpoons that have been used throughout human history for hunting and fishing. The difference can only be noted by looking at features of different hunting tools and function of a particular harpoon. All harpoons known are elements of composite tools for hunting or fishing. Hafting, mounting on a line or gun and use on bows are some of the forms in which harpoons have been used. Harpoons used in hunting terrestial animals normally do not have a series of barbs.

Spears and leisters are weapons mostly mistaken with bone harpoons due to a common raw material. Spearheads normally have one or multiple barbs which are carved from the shaft. In this case, there is no need of hafting and the weapon is normally thrown at an animal directly by hand. Leisters have single or multiple barbs. The head is made of bone which is hafted on a shaft and may either be uniserial, biserial or triserial. Multiple leister heads are mounted on a shaft. Spears and leisters are only known in hunting of terrestial animals unlike bone harpoons which are predominantly used in fishing.

Weighed harpoons are known throughout Africa and are used in killing large animals such as hippopotamus and elephants. These are not made of bone but iron or wood. They are used as snares set above animal trails. The harpoon is secured to a line whose end is buried below the trail and when the prey steps on it, it becomes lose and the heavy harpoon falls stabbing the animal's back (Lagecrantz, 1979).

In the lake Turkana Basin, the known harpoons are barbed and are made of bone. They are either uniserial, biserial, triserial and barbless (see figures 7,8, and 9). Uniserial harpoon have barbs only on one side, biserial on two sides and triserial on three sides. The numerical names are from the sides containing barbs on each harpoon.

The lake Turkana harpoons are distinguished by a lack of evidence of hafting, unlike leisters and spear points. Instead harpoons in the basin are mounted on a line or cord which is evidenced by incisions, grooves and notches on the butt ends. Hafting is prevalent where there are perforated or split-based harpoons but these traits are not known in Lake Turkana Basin.

As it seems, harpoons have been used at least since the mid-late pleistocene. But, it seems that the tools have been modified to serve the needs of the time (see chapter V1). The projectile and tanged points made during the pleistocene show morphological similarities with the late pleistocene-Holocene bone harpoons. The only clear cut distinctions are the raw material and function. It is likely that the design of barbed bone harpoons originated from lithic points which were similarly used as hunting weapons. The change, I suggest is an aspect of cultural evolution from the stone age to fisher-hunter life which was stimulated by environmental change in the Quarternary. This transition militated systematic changes as noted in harpoon technology. The harpoon replaced the resource exploitation tools to a great extent. There is little evidence of how bone harpoons were used in procuring the intended prey. Ethnographically, there are people who still use harpoons today in the lake Turkana region. The

Elmolo who are the only remnant of the past fishermen

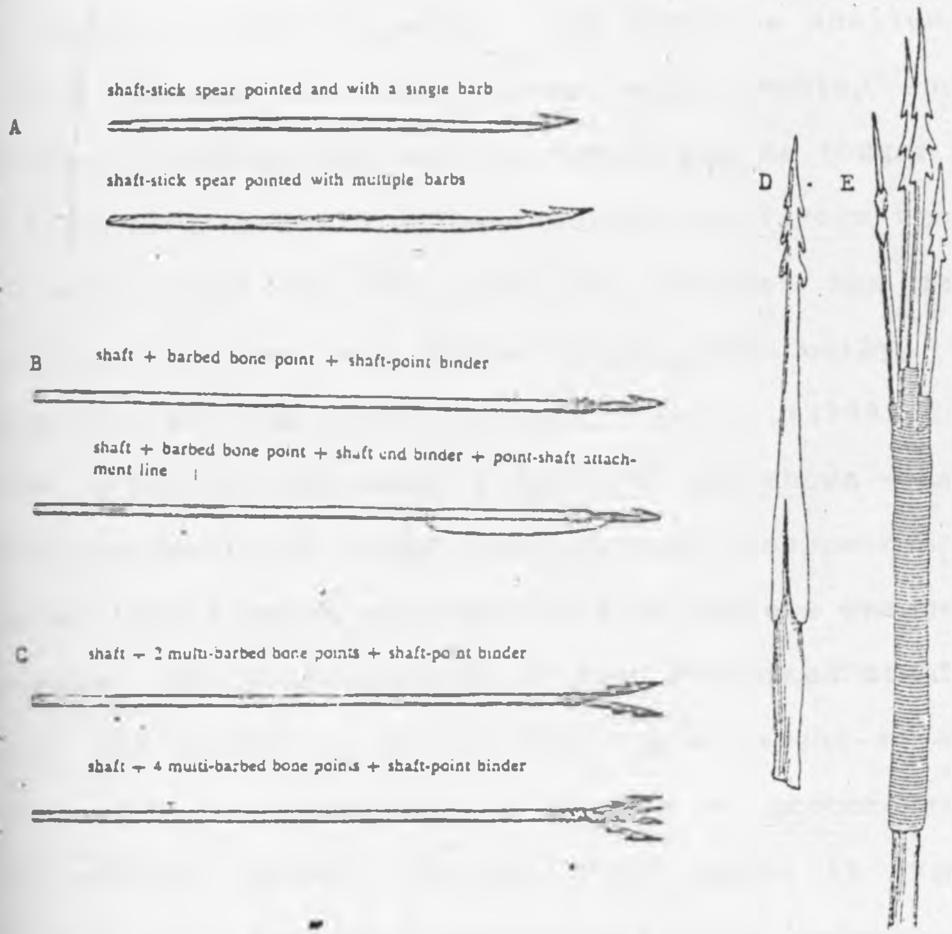


Figure 3.

Spear (A), Harpoons (B) and Leisters (C) according to Oswalt (1973). Spearhead (D) and Leister (E) used by Sarkawa fishers (Harris, 1930) From Stewart, 1989).

Reduction 70% actual size.

primarily fish using iron harpoons. It is very likely that the change from the Holocene high water levels to low levels which characterise the lake today, inspired a change in application of the harpoons. The Holocene shallow shoreline of Lake Turkana was clear water which enabled spearing and stabbing of extensive resources which are no longer present in the Lake Turkana Basin. The continued shrinkage that the lake has experienced for the past few decades has reduced the alkalinity of the lake tremendously, eventually, leading to extinction of some fish species, Stewart (1989: 20, 23, 24, 28-29 cited in Schuwartz 1983: 137) has shown that extreme alkalinity/salinity could have caused disappearance of fish species (some) which are sensitive to extreme changes in pH of the water. The pauperization of fish resources might also have forced the Elmolo to change their procurement strategies and increased their propensity to use several procurement methods. Such methods include netting, thus making it impossible to duplicate the procurement strategies using harpoons during the Holocene.

However, there are two surviving clues as to how harpoons were used. Hafting was possible, but no clear evidence of hafting is available. This is because wood is not preserved in archaeological sites. Securing on a line or cord is evidenced by grooves, notches and incisions on the bases of many artifacts. Alternatively, the two methods might have been applied contemporaneously, hafting on a shaft and securing the base of the harpoon on a line or a cord and similarly securing the other end of the line on a shaft. This later method is seen as a measure aimed at recovering the point after specific application. The two methods, securing on a line and hafting, are reported in other parts of the world, North America, Asia and Europe, among fishing societies (Tuck, 1974: 108; Clark, 1977).

In conclusion, barbed bone harpoons recorded from Lake Turkana sites exhibit some morphological similarities with other prehistoric tools and the likelihood of borrowing from them and modification is expressed. It is believed that in the Turkana Basin, hafting and securing of harpoons on a line or cord were common during the Holocene. But, the former lacks evidence.

CONCLUSION The appearance of fishing settlement sites in the Sudan was initially seen as an abrupt response to exploit an emerging resource base. The fishing culture was seen as restricted only to the Sahel-Saharan Zone. This led the first researchers to express it on a geographic and temporal basis. The aquatic resource exploitation was viewed as contemporaneously composed of barbed bone points and wavy line pottery.

Following more research, the culture was proved to have extended beyond the formerly suggested Sahelian-Saharan Zone. The discovery of the sites of Ishango, Gambles' Cave (Lake

Nakuru) and those in the Lake Turkana Basin is a prove of this. This new dimension culminated in a shift from investigation of the source and spread of the culture, to investigation of the relationship between the features derived from the assemblages and environmental change.

The spread of the culture beyond Sahel-saharan Zone sparked off new views. The archaelogists started viewing the culture as a systematic adaptation evolving from a pre-Holocene adaptation. This view is the most accepted one today.

The contemporaneity of barbed bone points and wavy line pottery in light of recent research is questionable. The new date for Ishango and the absence associated pottery discredited the view.

The new date is older than the Holocene period. Sites with wavy line pottery are younger than 8,500 B.p. (Barthelme, 1985), while sites with harpoons are older. Those sites with pottery are predominantly reported in the Sahel-saharan Zone.

CHAPTER IV

HARPOONSITES

INTRODUCTION

The fishing settlements sites are some of the well-known rich sources of archaeological materials in the Lake Turkana Basin. This chapter presents an outline of the geo-environmental setting, dating and artifactual context of the sites to be studied. The sites are; Lothagam, Lowasera, and two Koobi Fora sites- GaJi 11 and GaJi 12. The reasons for selecting these sites are twofold. First, the sites are well-distributed spatially thus offering an equal coverage of the study region. Second, the sites contain high number of bone harpoons.

Site formation in the study area is peculiar in that, sites are the result of lacustrine sedimentation. The past high lake levels in the Plesitocene-Holocene period culminated in high fluvial deposition as the river's discharge increased. The rivers could transport larger volumes of load due to increased energy resulting from high discharge. The water movements within Lake Turkana distributed these sediments.

Rise in lake level caused submergence of the fishing settlements adjacent to the lake margin. Lacustrine deposits covered artifacts such as harpoons, lithic tools, pottery and food middens. The sediments are initially volcanic ashes swept by the flowing Omo River from the Ethiopian Plateau, which are ideal for preservation of articrafts and assist in dating. The sediments, after the water's recession, are left as soft, uncompacted Soils. Blowing winds and erosive action by run-off carry the upper layer of soil away leaving exposures where archaeological materials can be seen eroding. Those are normally collected as surface finds; however, several sites have been excavated.

LOTHAGAM

The site is located in Turkana District to the north west of Kenya. The archaeological significance of the site was realized in 1965 when Robbins discovered it in the course of a Holocene beach archaeological survey. Articrafts could be seen eroding from the Holocene lake deposits and beach sediments over an area of about 500 x 300 m (Stewart 1989:155). Robbins excavated the site twice in 1965-66 and in 1975 he was joined by Lynch. Stewart (1989) worked on the fish remains from the site.

Geo-environmental Setting

The site is set in the Lothagam Hills, which Teleki and Hohnel were the first whitemen to see in 1888 (Robbins, 1974). The site is adjacent to the Kerio River delta. The relief of the site is interrupted by the Napedet Hills and the Kamutile-Merithipo ridge west and south west respectively. Relics of erosion can be seen in the form of gullies, shallow basin-like erosion features and sand dunes (Robbins, 1974)(see figure 4). The open landscape has patches of scattered shrubs. Grass is restricted to the lake margin near springs. Thicker

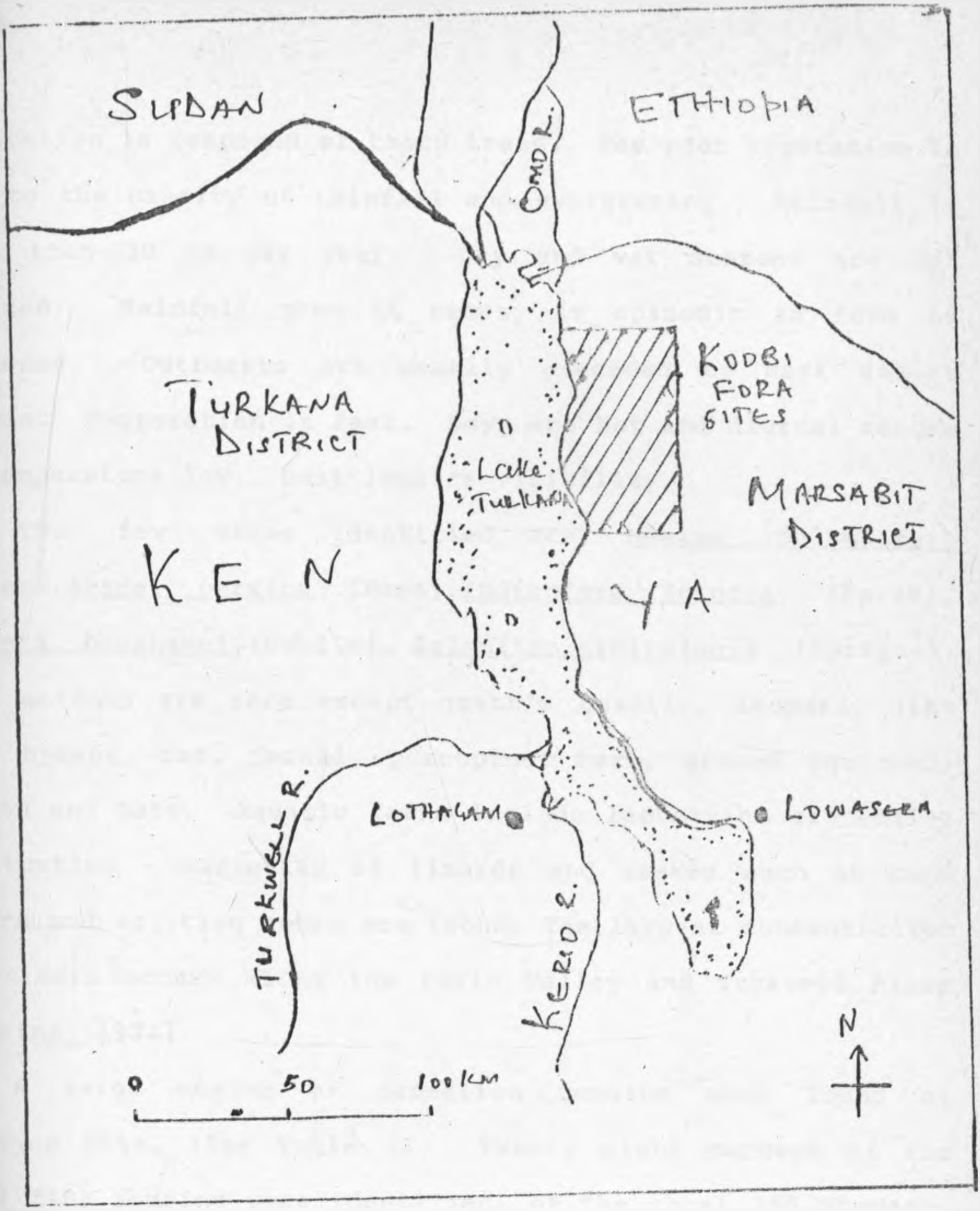


Figure 4 : Lake Turkana sites with harpoons. (After Barthelme, 1985)

vegetation is composed of thorn trees. The poor vegetation is due to the paucity of rainfall and overgrazing. Rainfall is less than 30 cm per year. Dry and wet seasons are not defined. Rainfall when it comes, is episodic in form of torrents. Outbursts are usually preceded by dark desert clouds. Evaporation is fast. Days are hot and diurnal ranges of temperature low. Dust impairs visibility.

The few trees identified are Maerua oblongifera (Forsk), Aerua persica (Burm), Indigofera Spinosa (Forsk), Seddera bagshawei (Rendle), Balamites orbiculanis (Sprague). Wild animals are rare except grant's gazelle, leopard, dik-dik, hyaena, cat, jackal, porcupine, hare, ground squirrel, baboon and bats. Aquatic fauna include lacustrine crocodiles and turtles - varieties of lizards and snakes such as sand vipers and spitting cobra are found. The largest concentration of animals occurs along the Kerio Valley and Turkwell River (Robbins, 1974).

A large number of mammalian remains were found at Lothagam site. (See Table 1). Twenty eight percent of the total fish remains were identified, of the total 355 Stewart, 1989:156).

Dating and Artifactual Context

Three exposures were identified namely: Lower, middle and upper excavations. Excavations were carried out on the basis of these exposures. Fossiliferous deposits were found in the middle excavation. None was found in the Lower

Excavation and few found in the Upper Excavation. Surface collection was done. The stone tools recovered were crescents, choppers, large bifacial tools and debitage indicating in situ materials. Over 250 barbed bone points were collected on the surface and 43 were found by excavation. Stone tools form the excavation were sidescrapers, crescents, burins, choppers, picks, borers and flakes (Robbins, 1974). The thinner oval and almond-shaped bifacial tools are crudely step flaked around the edges and resemble Fauresmith tools. Some oval-shaped bifacial knives have affinities with Neolithic hoes (Robbins, 1974; 169). Lava comprises the raw material for about 87% tools and chert 12% (Robbins, 1974).

	Common name	Genus/Species
Mammalian remains	1) Hippopotamus	Hippopotamus amphibians
	2) Zebra	Equus barchelli
	3) Warthog	Pharcochoerus aethiopicus
	4) Buffalo	Syncerus caffer
	5) Hartebeest	Alcephalini
	6) Dik-dik	Mandoqua(Rhynchotraqus) kirkii
	7) Gazzelle	Gazella Sp
	8) Reedbuck	Redunca Sp
	9) Topi	Damaliscus Konigum
	10) Giraffe	Giraffa camelopardis
	11) Baboon	Palio Sp
	12) Cane rat	Thrynomys gregorianus
	13) Hyaena	Crocuta crocuta
		(Robbins,1974)
Fish remains	1) Nile perch	Lates
	2) Catfish	Clarias
	3) Carp	Labeohouri
	4) Catfish	Bagrus bayad
	5) Catfish	Synodontis schall
		(Stewart 1989)

Table 1: Mammalian and fish remains from Lotham site.

Potsherds are absent on the surface however, they were recovered by excavation. The decorated sherds were called by Wandibba (1977:85) Nderit ware. About 734 decorated sherds were from the Middle Excavation which are "crude and friable" (Robbins, (Stewart, 1989:158). 1974:200). Pottery and barbed bone points are known throughout the site, but are more common in the Upper and Middle Excavations A radio-carbon date obtained from molluscs at the clay base place the lake level in the Kibish Iva (Robbins, 1974). This is equivalent to a date between 9,700 - 7,700 B.p. (See Brown and Thurber, 1969). The clay base is estimated to have been 84m above the modern lake level. Different horizons are identified showing oscillations in lake levels. Those fluctuations hinder the establishment of an absolute date. The Upper Excavation (1975) was dated at 6,300 + 800 B.p. (Robbins and Lynch 1978:619). A tentative date is given to the site, between 7,000 and 6,000 years ago. This is due to lack of dateable materials (Robbins, 1980;Stewart, 1989).

LOWASERA

The Lowasera site was discovered in 1974 by a cinematographic expendition led by J. Couffer. Later, it was reported to David Phillipson who toured the site and excavated it in 1975. The name Lowasera implies Sandriver, or "Lugga". The sequence of deposition at Lowasera is similar to that of Lothagam. The lacustrine clay and silt deposits are followed by consolidated beach grit deposits, and, unconsolidated terrestial coarse sandy sendiments (Stewart 1989:155). Both sites are located at similar altitudes above modern lake level of +70 to 80m (Stewart,1989:145). This suggest similar lake fluctuations during the Holocene.

Sixteen stratigraphic units are recorded. Two areas were selected for excavation. Area 1 where later terrestrial units were exposed and area 2, where the earlier units were recorded. Units 16 and 15 may date from the terminal pleistocene during the low lake levels (Philipson, 1977). Units 14 - 10 are diatomaceous silt with a thickness of about 7.5m. In unit 12, the lake was at Circa 80m above the modern lake level. Unit 9, is composed of fine sandy sediments and is contemporaneous with units 11-14. It has been dated at 7470 + 200 B.p. (Philliipson, 1977). Units 8-5 are beach deposits with a maximum thickness of about 7m. These units consists of unconsolidated coarse sands and pebbles. Units 7 is dated at 7785 + 150 B.p. hillipson, 1977). Units 4 - 1 are terrestrial deposits. Unit 4 is dated by radio-carbon on bone apatite at 4460 + 110 B.p. (Phillipson,1977). All the other dates except 7470 B.p. are on bone apatite and are unreliable according to collet and Robertshaw (1983).

Geo-environmental Setting

Lowasera is located 22km north of Loiengalani, on the way to North Horr. The site is a beach of about 480m above the present lake level. A portion of the beach is eroded and the uneroded part was selected for research (Phillipson, 1977)

(See Fig. 4).

Mammalian remains are scarce, comprising only 5% of the total faunal assemblage. Mammalian units reported below unit 4 yielded only one zebra tooth and several hippopotamus bones. From units 12 and 4 are found remains of equid, two bovids, a carnivore, a reptile, a primate and several hippopotamus (Phillipson 1977:28).

Fish fauna are reported from units 13 - 5. Lates and ciclids comprise 78% of the total number of fish species. Units 2 and 4 have eight different genera representing 40% of the assemblage (Stewart, 1989:152). Tetraodon, Bagrus, Synodontis and Clarias remains were recovered. (Stewart, 1989).

Dating and Artifactual Context

Fourty nine barbed bone points were found in excavated units and 24 on the surface. No pottery was found below uni 5. The recovered pottery is poorly "fired and friable". Perforated ostrich eggshell beads are found in units 1 and 2. There is a noted variation in shaped tool categories below unit 4. Most of the microlithics are made of obsidian and chalcedony while large tools such as choppers are made of lava (Phillipson, 1989). Units 11 - 14 are dated 7470 + 200 B.p. by radio-carbon from unit 9, units 4 - 1 are dated to 4460 + B.p. The only date which is accepted is 7470 B.p. from unit 9 as is not on bone apatite. Therefore, the site is dated at 7470 B.p. (Stewart, 1989).

KOOBI FORA SITES

GaJi 11

This is one of the seven sites worked by Barthelme. The fieldwork was divided into three phases. First and second phases were done in 1975 and the third phase in 1976.

Geo-evironmental Setting

The site is located north east of Allia Bay behind the Koobi Fora ridge. The river courses have exposed the Galana Boi sediments. The site is in area 127 and lies on a low ridge, 73 to 75m above the 1976 lake level. The Galana Boi deposits are distributed all over, overlying older units. Holocene beds rest on Plio - Pleistocene bioclastic cemented sandstone. Etheria elliptica and Mutela emini are recorded in the lower portion of the archaeological horizon. The top layer contained Melanoides and Corbicula shells (Barthelme, 1985).

Only one mammalian element and four fish genera were recovered. The fish genera were Clarias, Synodontis, Lates and Tetraodon. (Stewart, 1989). The site is set on a sandbar.

Dating and Artifactual Context The lower portion contained cobbles/choppers, bone fragments and stone artifacts. The top 30cm contained bone fragments. Stone artifacts among others are microliths, Outil e'cailles, cores and limaces. Over 140 bone artifacts were recovered and well-preserved human skeletal remains were found. (Barthelme, 1985).

Barthelme suggests that deposits of the sandbar and occupation of the site are contemporaneous with the formation of an *Etheria* reef or the latter, which predates the occupation. Three C14 age determinations were obtained from snail shells and bone apatite which are 8,520 + 130, 8,710 + 130 and 7,855 + 160 (Barthelme, 1985:23). Charcoal samples proved to be insufficient for age determination. The site is dated between 8,000 and 9,000 B.p., as other dates from *Etheria* shells proved to be modern.

GaJi 12

The site was excavated by Barthelme in the 1970s. The Holocene exposures are almost 500m in length. Three outcrops are identified, A, B, and C. The site seems to be a settlement, unlike site GaJi 11, due to presence of mammalian remains and pottery (Barthelme, 1985).

Geo-environmental Setting

GaJi 12 is located in Area 127 a few kilometres east of GaJi 11. The site lay 74 - 78m above 1970s lake level. The site is located on high Holocene beach. It was occupied twice by people with common technology and economic traditions (Barthelme, 1985;91).

Broken fragments of *Melanoides* and *Corbicula* are recorded in outcrop A. Mammalian elements recorded were of warthog *Pharcochoerns aethiopicus)* hippopotamus (Hippopotamus amphibians)*, Zera (*equus Sp) and several small-sized bovids (Barthelme, 1985). Fish elements recovered were *Lates,* Clarias, Synodontis and ciclids (Stewart, 1989: 142). Faunal remains were fragmented, water-rolled and mineralized.

Dating and Artifactual Context

In outcrop A, cultural remains were present on the uppermost horizons, while in B they were eroding from the uppermost layer. Uniserial harpoons, seventeen decorated and twenty four underdecorated potsherds, and a small collection of obsidian clippage were exposed in outcrop C (Barthelme, 1985). Among stone, artifacts, microliths dominated followed by outils e'cailles, core/choppers and scrapers. The morphology of the artifacts resembles that of the Karari Industry (Harris, 1978; Barthelme, 1985). A total of 19 harpoons were collected.

No absolute date is recorded for the site. The characteristics of artifacts, environment and location, in the vicinity of site GaJi 11, and the similarities observed between the two sites suggests a similar age of 8,000 - 9,000 B.p.

CONCLUSION

The sites are relatively of similar age. A close similarity of artifacts, stratigraphy and geo-environmental settings are noted. This suggests they were occupied by migratory people. The lack of permanent structures supports this. Only one site, GaJi 11 shows evidence of not being an occupation site and is most likely a procurement station for people from nearby occupation sites such as GaJi 12.

CHAPTER V

METHODOLOGY

Barbed bone harpoons are a fundamental aspect of the Holocene culture from the Lake Turkana Basin. The past work on fishing settlement sites in the basin has produced large assemblages of lithic, ceramic and faunal remains. These large assemblages contain bone harpoons. No detailed study has been done on these bone harpoons.

This study was initially intended to be restricted only to complete harpoons, that is, those with all the attributes required. But incomplete harpoons were included. My original aim was to select the sites with the highest number of harpoons. But this changed when I did not find the materials from some of the worked harpoon sites. I therefore, studied the four sites which had the most harpoons. The four sites are Lothagam, Lowasera, GaJi 11 and GaJi 12.

To test the hypothesis formulated (see chapter 1), attributes of harpoons were examined. In this work, the term 'attribute' is used to mean qualities of harpoons whether metric or non-metric. A harpoon in this work, is taken to be a barbed bone spear mounted on a line or shaft, used mainly for spearing large fish and probably other aquatic animals. Attributes are divided into either metrical or non-metrical.

The following are the metrical attributes and their definitions in this work:

Length. This is the maximum length between proximal and distal ends. Length was taken on the surface without barbs and on multi-barb sided harpoons, the gap between the two barb sides was used (see figure 5).

Width This is the distance from one side to the other at a right angle to the length. Normally, the measurements were taken from the head, butt end and middle and then the mean taken. Width was taken accross the barbs and in case of barbless harpoons, width is taken from the middle of the harpoon at right angle to the length.

Breadth. Breadth was measured at the widest part of the harpoon parallel to the barbs.

Barb Length. This is the length the barb projects from the trunk to the tip-end of the barb.

Barb number. This is the total number of barbs on a harpoon.

Non-metrical attributes:-

Raw material The organic substance used to make a specific harpoon.

Incisions. The ring-like markings going round the base of the harpoon just below the lowermost barb made by a line or cord.

Barbs These are the sharp projections on the side of the harpoons. They are carved from the trunk of the harpoon.

Notches These are the hollow-like wide depressions on the base of the harpoon characterised by saw tooth-like denticulated edges. They are made with a blade used in a saving motion. They are wider and deeper than the grooves. Their width suggest they might have been made with a retouched blade.

Grooves. These are the saw tooth-like cuts on the butt-end of the barbed bone harpoons. They are shallower and narrower to the notches (see figure 5). They are made in a sawing motion with a blade.

In describing the artifacts they were categorised into complete and incomplete. The complete are those with all the attributes defined above and the incomplete are the fragmented and the water-rolled ones. The complete and incomplete were converted into percentages of the total artifacts from each site and plotted on a bargraph (see chapter V1).

Where the fragmented and water-rolled harpoons could be identified, I categorised them into heads, mid-sections and butt ends. I converted this data into percentages of the total fragmented and water-rolled harpoons. The ones which could not be identified I called unidentifiables.

For the metrical attributes, length, width, breadth, barb number and barb length, the range was found and mean and standard deviations were calculated.

The non-metrical attributes such as incisions, notches and grooves were converted into percentages of the total complete harpoons from each site. The intra site comparison, done simultaneously with description, involved looking at

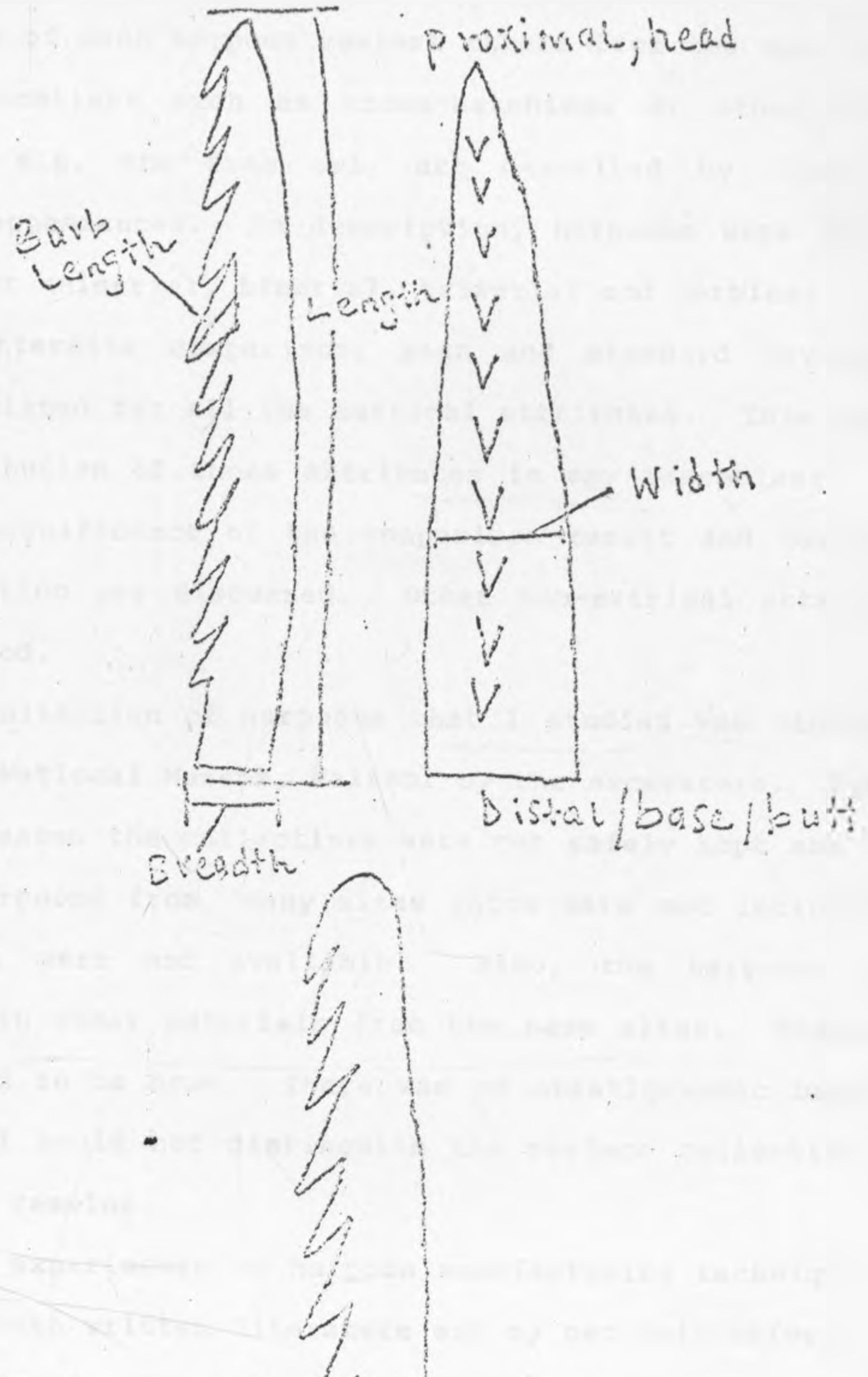


Figure 5 : Attributes Cited.

attributes of each harpoon against others from the same site. Other decorations such as cross-hatchings or other unique features, e.g. the bone awl, are described by their own physical appearances. In description, harpoons were divided into either uniserial, biserial, triserial and barbless.

In intersite comparison, mean and standard deviations were calculated for all the metrical attributes. This showed the distribution of those attributes in any assemblage. The cultural significance of the comparison result and taxonomic representation are discussed. Other non-metrical attributes are compared.

The collection of harpoons that I studied was stored in the Kenya National Museum, Nairobi by the excavators. Due to unknown reasons the collections were not safely kept and as a result, harpoons from many sites which were not included in this work, were not available. Also, the harpoons were mingled with other materials from the same sites. Therefore sorting had to be done. There was no stratigraphic bagging, therefore I could not distinguish the surface collection and excavation remains.

In my experiments on harpoon manufacturing techniques, I have used both written literature and my own initiatives. In this experiment, the main goal was to make a harpoon using domestic animal bones and obsidian flakes. The goal was to find the sequence and the style of manufacture of the harpoons.

The project encountered few problems. The major problem is lack of sufficient and relevant published work. There have been no detailed written studies of bone harpoons, therefore I had to develop my own approach. It was my wish to collect linguistic .pa and other oral data to supplement the knowledge of bone harpoons. Scarcity of aged people with knowledge of the artifacts and financial constraints on such an expensive project posed a major set back.

CHAPTER V1

DISCUSSION

INTRODUCTION

The harpoon assemblages of the four studied sites are described in this chapter. The chapter is divided into five sections. The second section concerns the description of artifacts. The description is based on attributes recognized from data collected and include the measurements taken. Emphasis is placed on features of the artifacts. In the third section, intersite comparison of artifact assemblages is undertaken whereby means and standard deviations of harpoons from various studied sites are calculated and presented. The fourth section deals with cultural reconstruction. An hypothetical origin and medium of spread of harpoon-using fishing cultures into the Lake Turkana Basin is reconstructed. Finally, a conclusion is made.

ARTIFACT DESCRIPTION

Lothagam

The Lothagam site has the largest number of bone harpoons ever recovered in the Turkana Basin in a single assemblage. This is a reflection of the long duration of fishing and a good supply of aquatic resources. About 280 bone harpoons, all uniserial, were recovered. Of those, only about 36% (N=111) are complete (see figure 6). This means the site has the highest number of incomplete harpoons (N=169).

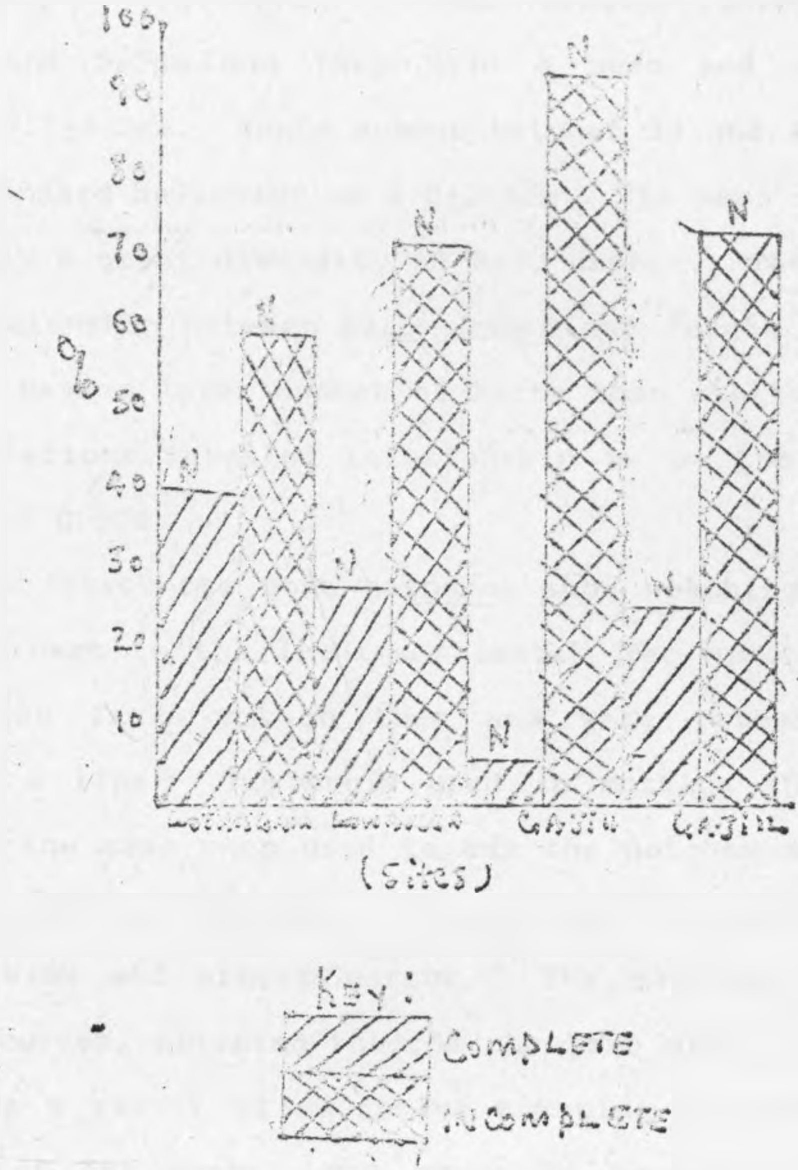


Fig 6. Bargraphs of bone harpoons from Lake Turkana sites.

The majority of incomplete harpoons seem to have been broken when in use. Others are highly weathered.

The points show great diversity in length ranging between 20 and 4.0 cm. This variation in length is confirmed by the mean and standard deviation (8.0±2.1cm). The bone harpoons portray a high degree of width variation which ranges between 1.0 and 0.5cm and they have a mean and standard deviation of 0.7±0.2cm. Barbs number between 14 and 1.0 with a mean and standard deviation of 5.0±2.0cm. The mean standard deviation imply a great diversity in barb number. There seem to be no relationship between barb number and length as some long harpoons have a lower number of barbs than shorter ones. However calculations revealed relationship to be too low, a relationship of 0.324.

About 7% of the bone harpoons show notching on the butt end just next to the lowermost barb. The notches have denticulate-like incisions on them and were probably for attachment of a line. The tools used in cutting the barbs probably were the same ones used to cut the notches as there are affinities between the cuts. The size of the notches vary as some are wide and others narrow. The majority of the harpoons are curved, oriented towards the barb side. This is most likely as a result of excessive scraping to smooth the reverse side of the barb. The curve is normally seen on uniserial harpoons. The high diversity exhibited in length, width and barb number may be interpreted as a lack of a standardized way of making the harpoons or many different people were making them. The size difference might reflect catching of different-sized fish using different-sized

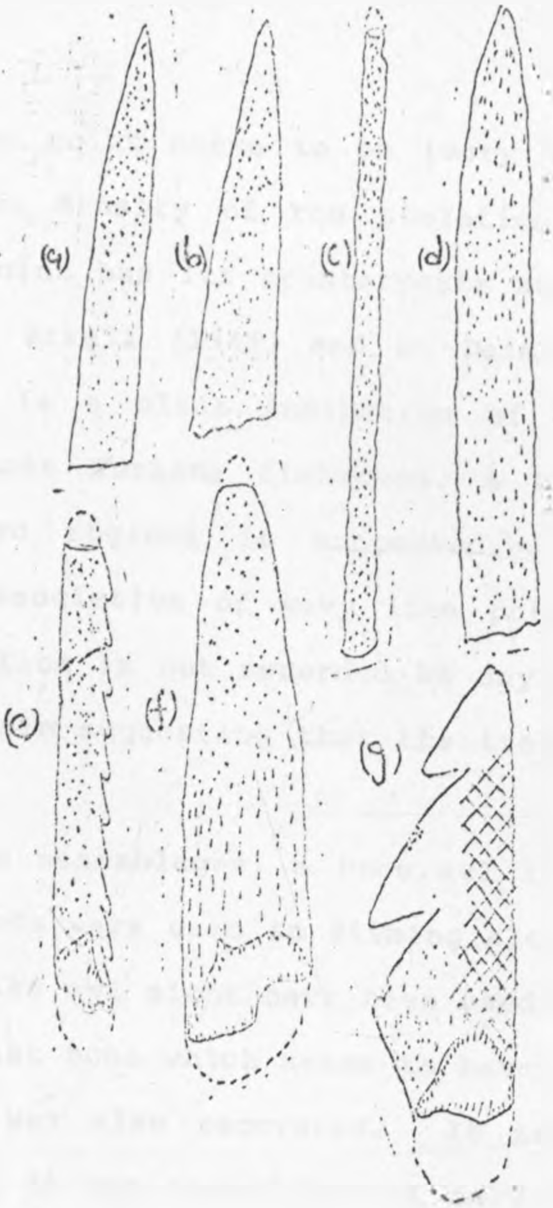


Figure 7. Lothagam artifacts.
30% actual size.
harpoons.

Among the lothagam harpoons, there is a unique single harpoon showing body cross-hatched decoration (See figure 7 g). The harpoon has unusual big barbs (14cm). The raw material of the point seems to be ivory as it has a higher density and the density of the striations is thick unlike bones. This point has its counterparts among those reported at Khartoum by Arkell (1949) and at Daima (Chad) by connah (1975). This is a clear indication of contact among the Khartoum and Lake Turkana fishermen. A movement by people between the two regions is suspected. This is further supported by association of wavy line pottery. The cross-hatching decoration is not recorded at any other site in the Lake Turkana Basin suggesting that the trait did not diffuse to other sites.

In the same assemblages, a bone awl is found indicating that other methods were used in fishing alongside harpooning, as the needle-like awl might have been used in net-making. A single worked flat bone which seems to have been prepared to make a harpoon was also recovered. It seems to have been discarded before it was carved into a harpoon. The presence of a bone awl indicate that bones were used to make various implements.

Of the incomplete harpoons, 28% are proximal ends, 12% distal ends and the rest either body parts or are indistinguishables. The presence of a higher number of proximal ends relative to distal ends implies that the fishermen either consumed the fish at the fishing site or prepared it before taking it to the camp. Hence, removed the proximal ends from the fish body. It is very likely that the broken ones are the used ones while some of the complete ones were unused. Ten of the harpoons are barbless. These are probably as a result of reworking after losing the barbs when in use or the difference is functional. Most of the harpoons are made of bones though there is suspiscion that ivory was being used to make one. From the structure of eroded barbed harpoons, John Kimengich (personal communication) argues that most of the harpoons are made of large animal ribs.

Lowasera

Lowasera seems to be an ideal site for the preservation of artifacts as most of the harpoons are not weathered. About 75 barbed harpoons were recovered of which only 28% (N=21) are complete (See figure 6). Two of the incomplete harpoons are beserial. All the complete ones are uniserial. Twelve percent of the broken harpoons are proximal ends, 45% body parts and 25% are distal ends. The harpocns length ranges from 13 to 3.7cm with a mean and standard deviation 8.0 ± 2.8. Width ranges from 0.9 to 0.5cm with a mean and standard deviation 0.7 ± 0.1. Barb number ranges from 10 to 2.0 with a mean and standard deviation 7.0 ± 3.0.

Only one barbless harpoon is noted at this site. About 76% of the complete harpoons have ring-like markings on the distal end which are not made by a cutting object but are most likely made by a line. Those marks go around the butt of the harpoon. All the harpoons may have those marks though they are not visible on a few highly eroded harpoons. This shows that securing of a line was a common phenomenon at Lowasera. This securing of a line to me seems to have been as a result of the small size of the harpoons from Lowasera. Two of the complete harpoons show grooving on the bases (See figure 8).

Most of the breaks are not fresh and they probably occurred at the time of use. Lowasera bone harpoons are relatively small and portray a generalized degree of uniformity in size and length. The harpoons reflect a high degree of standardization in making, presumably a common style of making or the same people were making them. The semi-circular curvature is not as pronounced as at Lothagam. It seems the curvature is a function of length as the harpoons at this site are smaller hence, the degree of curvature is accordingly lower. The small size makes handling when using impossible. This required securing of a line resulting in ring-like incisions, which are single or multiple in some cases.

A high degree of expertise is noted at Lowasera in harpoon manufacturing. The smoothness of the bone harpoons goes beyond the functional requirements to aestheticism. The scrapers found in association with the harpoons were probably used in polishing and scraping the artifacts. The small size of the harpoons implies they were made from bone splinters. Absence of debitage in the assemblage implies utilization of everything or that the workshop was located outside the fishing site. Calculations of correlation between length and

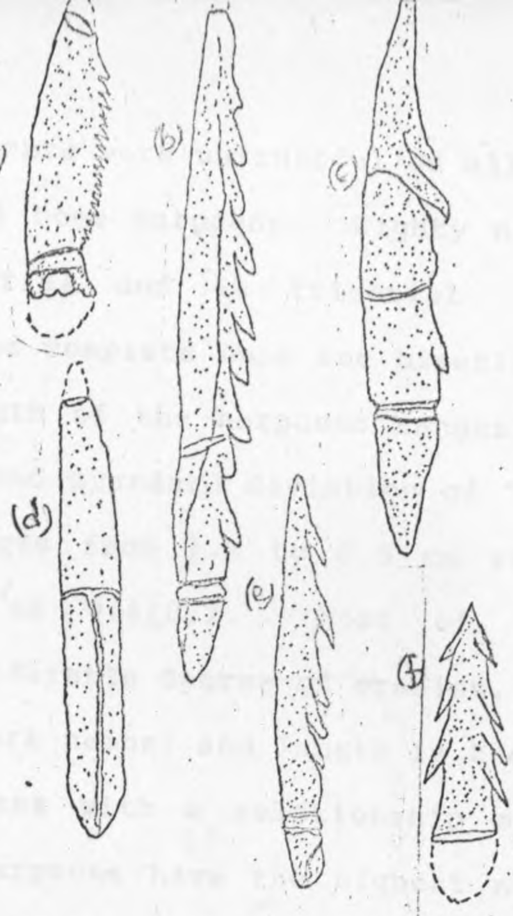


Figure 8. Lowasera artifacts.
30% actual size.

barb number revealed a little relationship of 0.770.

<u>GaJi 11</u>

The number of distinguishable bone harpoons from site GaJi 11 is 140. Out of these, only about 6% (N=9) are complete. The rest are fragmented (See figure 6). My effort to conjoin the fragments were unfruitful as all fragments seem to be from different bone harpoons. Eighty nine percent are uniserial, 3% biserial and 6% triserial. Only one is barbless. Two of the complete ones are biserial and the rest uniserial. The length of the harpoons ranges from 14 cm to 2.7 cm with a mean and standard deviation of 7.0 ± 3.0. Width of the harpoons ranges from 1.2 to 0.5 cm with a mean and standard deviation of 0.8 ± 0.2. Most of the fragmented harpoons show a considerable degree of erosion. At this site, the correlation of barb number and length is the highest among the four studied sites with a relationship of 0.981, The largest bone harpoons have the highest number of barbs and the shortest the lowest. This does not seem to have been the intention of the maker but the coincidence which might be contravened by the fragmented harpoons. (see Figure 9).

All the bone harpoons exhibit notching on the distal end just next to the lower most barb. Circular incisions are not observed at this site. The early date of site GaJi 11 (between 8,000 - 9,000 B.p.) and the absence of circular incisions and grooving suggest notching is older than the two former techniques. This is supported by presence of only notched bases at Ishango (Zaire) which dates to more than 20,000 years ago.

<u>GaJi 12</u>

Total number of bone harpoons from site GaJi 12,is 19, Barthelme (1981, 1985) records only 8. Amongst those 26%

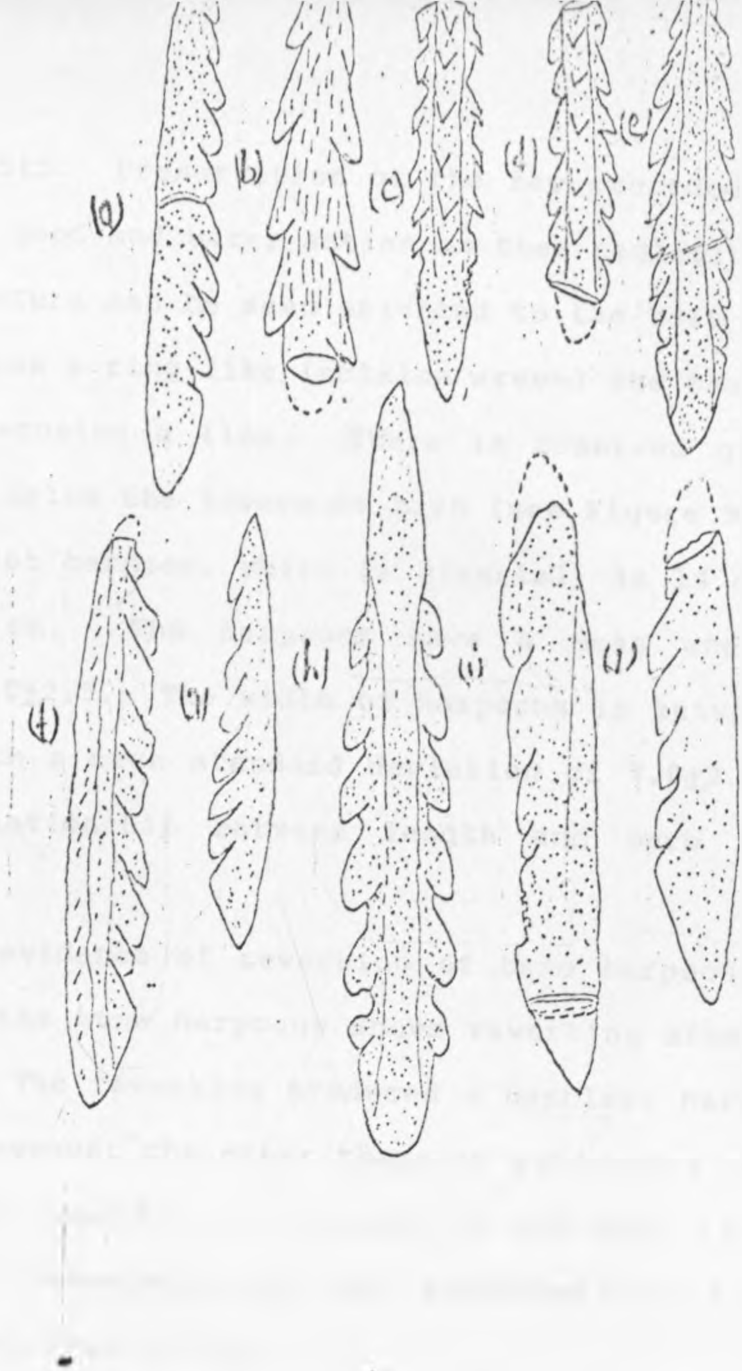


Figure 9. GaJi 11 and GaJi 12 artifacts.
30% actual size.

(N=5) are complete (see figure 6). The rest are fragmented or highly eroded. The breaks are not fresh, suggesting they occurred at the time of use. One is biserial and the others are uniserial. The complete harpoons show variations in length and width. Preservation of the few recorded artifacts is relatively good and water action on them negligible. Semi-circular curvature can be seen oriented to the barb side. One bone harpoon has a ring-like incision around the base which is evidence of securing a line. There is observed grooving on the base just below the lowermost barb (see Figure 9).

The biggest harpoon, which is biserial, is 14 cm and the smallest 7.3 cm. The harpoons have a mean and standard deviation of 10 ± 2.5. The width of harpoons is between 0.9 cm and 0.5 cm with a mean standard deviation of 7.0 ± 3.0. There is little relationship between length and barb number of 0.366.

There is evidence of reworking of bone harpoons at this site. One of the bone harpoons shows reworking after use and losing barbs. The reworking produced a barbless harpoon. At no other site amongst the other three is evidence of reworking detected. This reworking is viewed in two ways (1) Limited supply of raw materials and (2) maximization of resource utilization (see Figure 9 i)

The small size of the bone harpoons from this site might be a direct result of poor preservation. Otherwise, if the few specimens recovered were the only ones used, the site was occupied for a relatively short duration. GaJi 12 is a beach site where faunal analysis indicates that mammalian elements outnumber fish in a ratio of five to one (see Stewart, 1989). That wide difference in taxa representation is a clear reflection of the dominance of hunting over fishing. The inhabitants were hunting large animals such as hippopotamus, warthog, zebra and medium-sized bovids, presumably as a response of low supply of fish near the beach. The suggestion by Stewart that the meagre fish assemblage as a function of durability can only be acceptable if the low number of fish remains are associated with a large number of bone harpoons. Since this is the contrary, less fishing during the Holocene is more acceptable at GaJi 12.

This is seen as a localized preference or an ecological stimulus to other resource exploitation. Normally, the environment is seen as the compelling factor behind the food exploitation behaviour and tool caches recovered. This overemphasizes the contribution of other factors such as individuals tastes, preferences and group taboos which may end up as almost similar food remains in settelement sites. Though, those factors are impossible to understand from an archaeological site. Ethnographic observations have shown that these are contributary factors to the understanding of the eating behaviours
of the people especially fish among East African Communities. For instance only interacustrine peoples depend predominantly on fish.

COMPARISON

In comparing the intersite attribute, I relied much on metrical data. To be able to see the distribution of the metrical attributes the mean and standard deviations were calculated. The results are presented in table 2. The attributes have been displayed in figures for comparison.

Length Variation. The length of bone harpoons in all the four sites shows negligible variation. The only site which portrays a remakable variation is GaJi 11. The other three sites exhibit almost similar lengths. T-tests results fall within the critical range set and the hypothesis of artifacts similarity is accepted. Lowasera is the second in length distribution followed by GaJi 12 and finally by lothagam (see Figure 10). The low variation at Lothagam is undisputed because of the large assemblage of harpoons recovered from the site. The low length distribution is seen as a function of extensive use of the artifacts in the site which have possibly led to length standardization. The artifacts portray a great variation in length but metrically they are more standardized relative to other sites.

Width Variation. Width in all four sites shows slight 9variation. The variation at Lowasera is low relative to other sites. Earlier in this chapter, it was mentioned as morphological uniformity and standardization. The harpoons are finely polished. This uniformity is portrayed in width. The other three sites show slight width distributions which

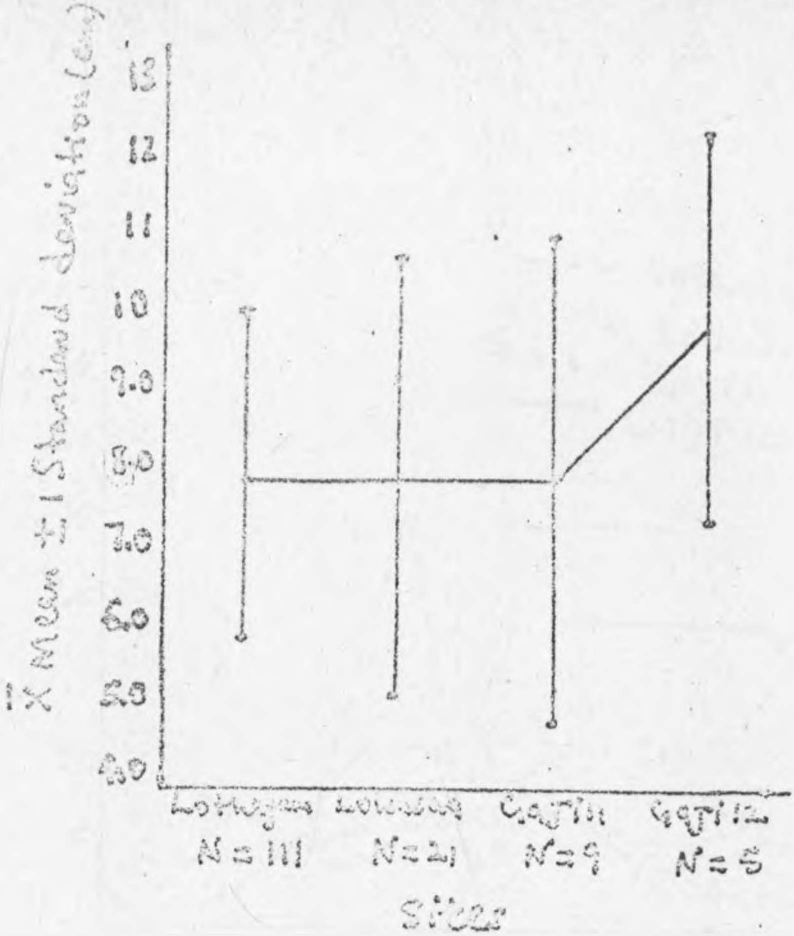


Figure10: Harpoon Length

are higher than that of Lowasera (see figure 12). Breadth Variation. The artifacts from all sites show variation in breadth. GaJi 12 has the greatest variation followed by GaJi 11, Lothagam and the least width is from Lowasera. This

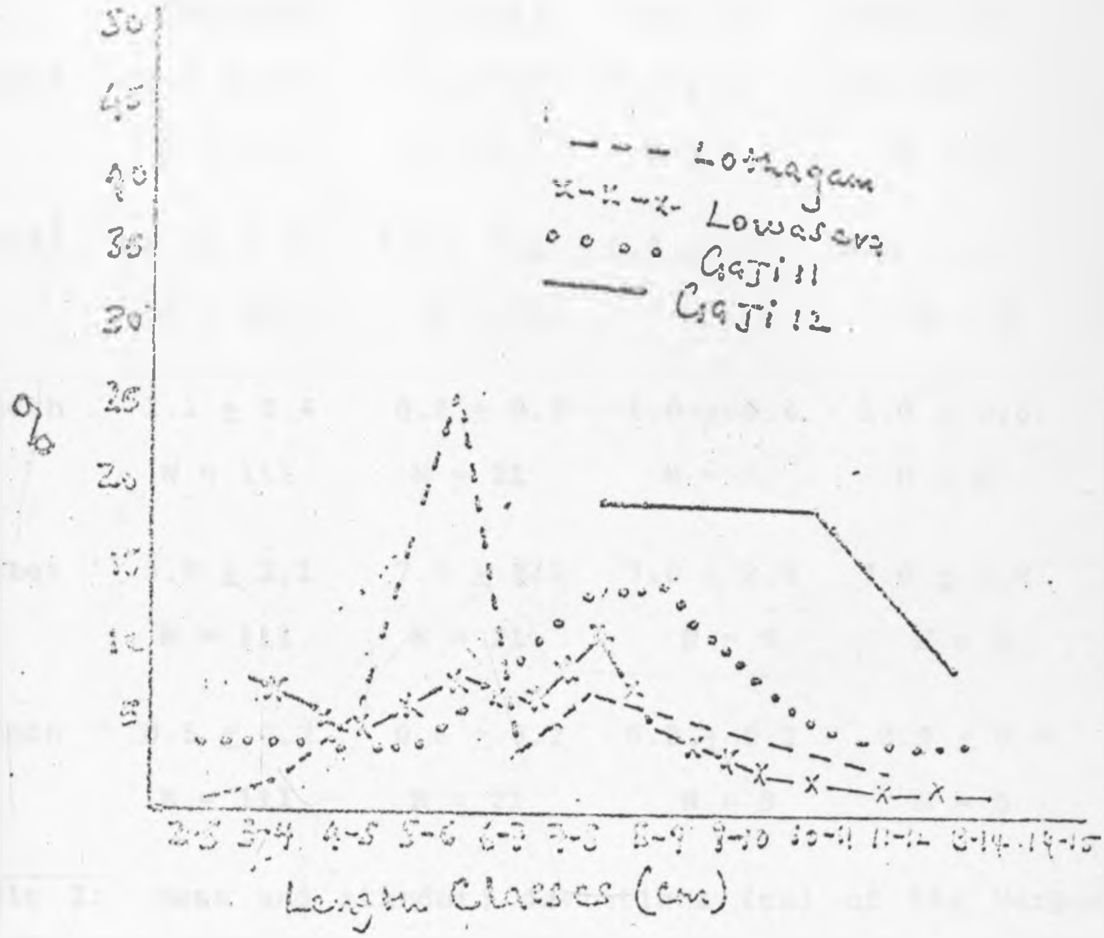


Figure 11: Frequency distribution of harpoon length from the four harpoons sites.

	Lothagam	Lowasera	GaJi 11	GaJi 12
Length	8.0 ± 2.1	8.0± 2.8	8.0 ± 3.1	10 ±2.5
	N = 111	N = 21	N = 9	N = 5
Width	0.7± 0.2	0.7 ± 0.1	0.8 ± 0.2	0.7 ± 0.3
	N = 111	N = 21	N = 9	N = 5
Breadth	1.1 ± 0.4	0.9 ± 0.2	1.0 ± 0.4	1.3 ± 0.6
	N = 111	N = 21	N = 9	N = 5
Barb number	5.0 ± 2.1	7.0 ± 3.2	7.0 ± 2.6	7.0 ± 2.8
	N = 111	N = 21	N = 9	N = 5
Barb length	0.5 ± 0.2	0.6 ± 0.2	0.8 ± 0.2	0.9 ± 0.4
	N = 111	N = 21	N = 9	N = 5

Table 2: Mean and standard deviations (cm) of the Harpoon attributes.

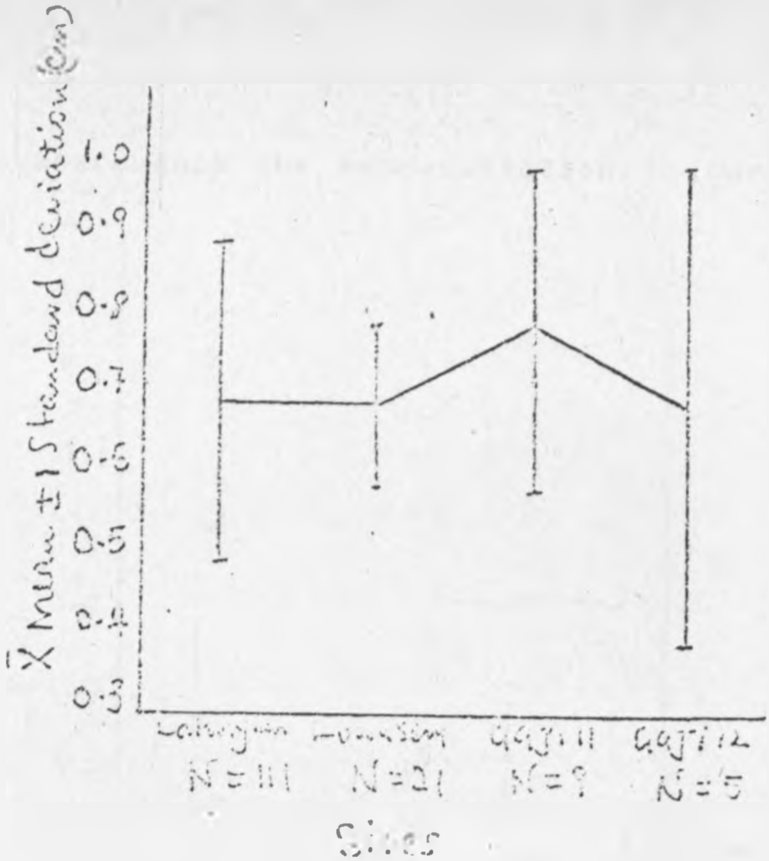


Figure 12: Harpoon Width

result is anticipated in the face of widespread intrasite similarity observed at all sites. The difference of mean and standard deviation of the breadth show a wide gap between Lowasera and other sites (see figure 13).

<u>Barb number Variation.</u> Lothagam has the lowest barb number variance for the specific artifacts. The sites GaJi 11, GaJi

12 and Lowasera show the same variation in barb number (see figure 14)

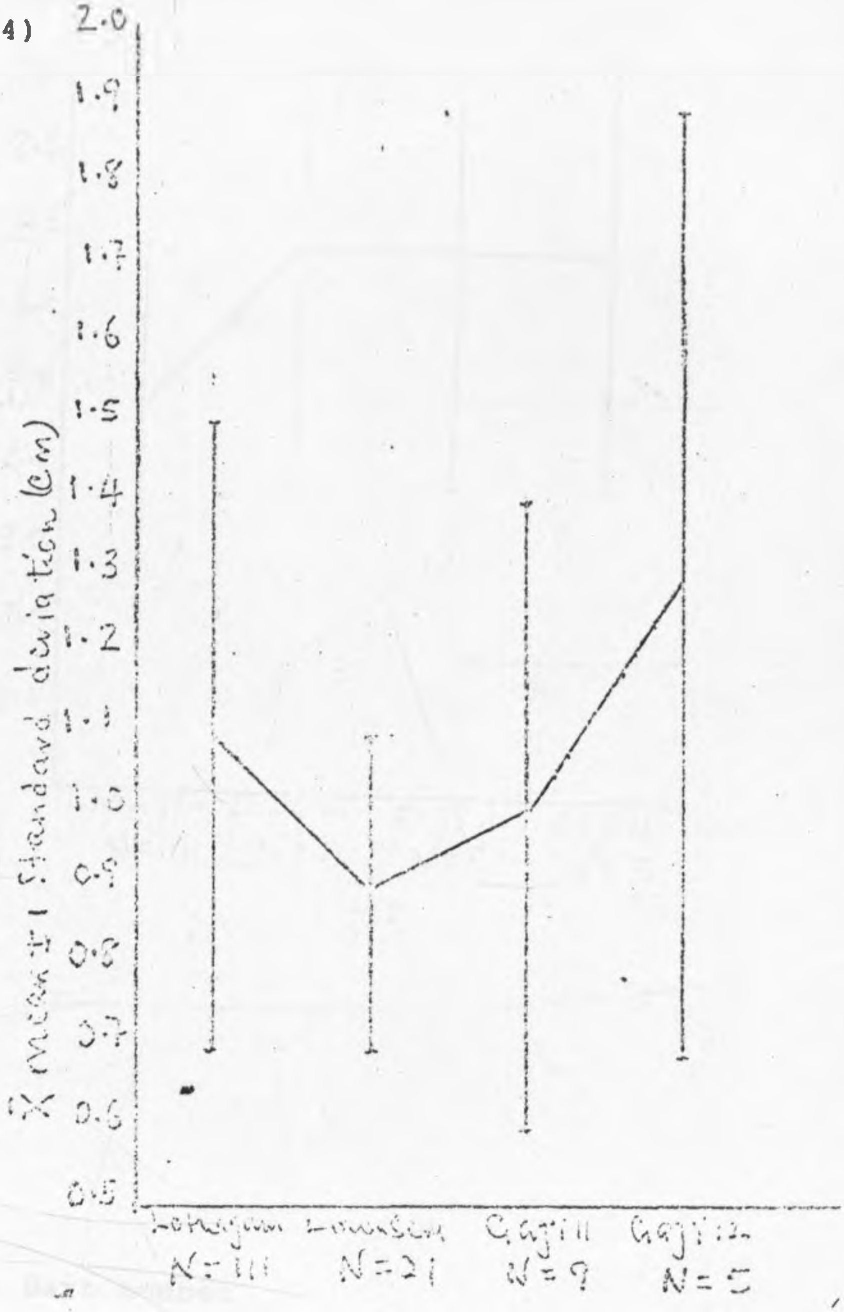


Figure 13: Harpoon breadth

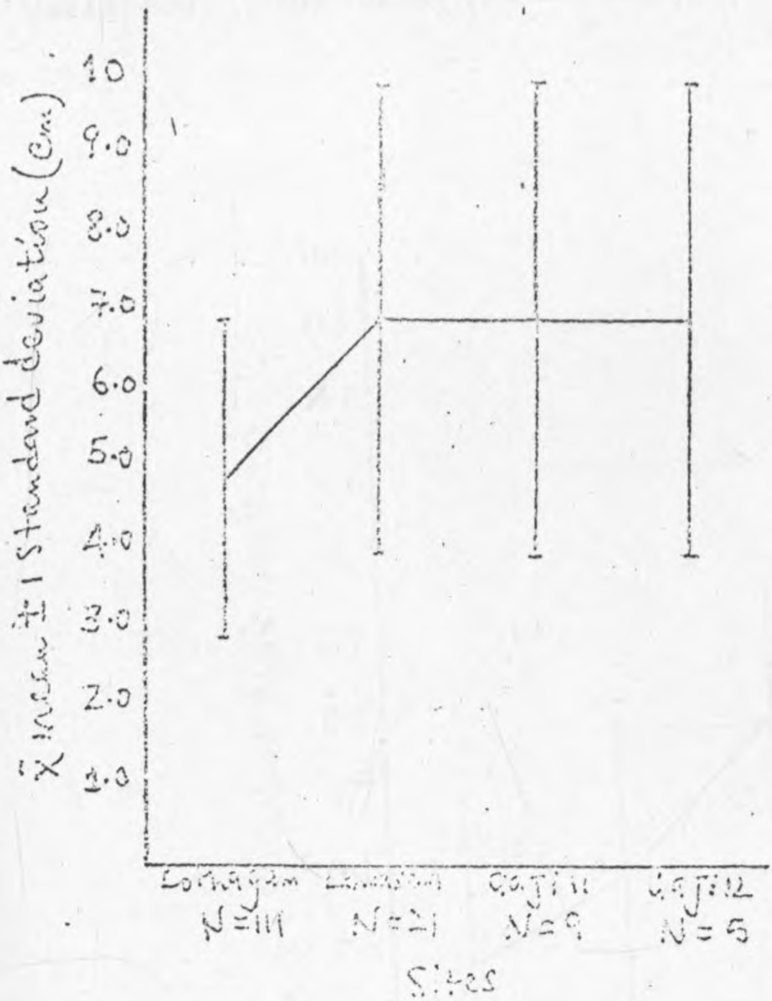


Figure 14: Barb number

<u>Barb Length Variation.</u> Little intersite barb length variance is exhibited by all sites. Only site GaJi 12 which shows

great variation. The other sites have same variation (see figure 15).

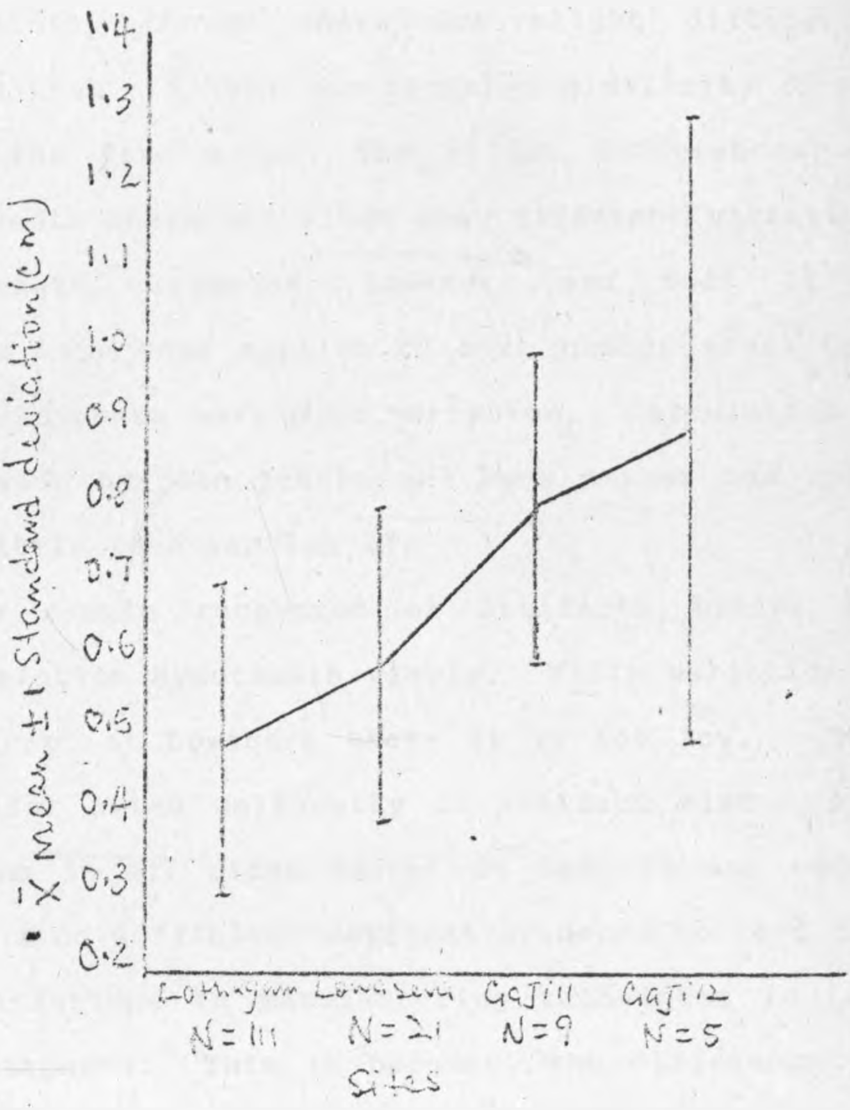


Figure 15. Barb length .

SUMMARY

All the harpoons from the four studied sites show a generalised affinity though there are slight differences observed between them. T-test has revealed similarity of the artifacts from the four sites. The slight differences are prevalent in breadth where all sites show different variation. In harpoons length, lothagam, Lowasera and GaJi 11 is negligible. The same case applies to barb number where GaJi 11, Gaji 12 and Lowasera have same variation. Calculation of correlation between harpoon length and barb number has shown it to be very little (see section 2).

The meagre sample recovered of artifacts hinder the testing of correlation hypothesis viably. Width variation is almost equal except at Lowasera where it is too low. This proves the earlier noted uniformity in artifact size. Barb length variations in all sites except at GaJi 12 are equal. However, there is no sufficient metrical evidence to lead to a deduction of difference in manufacturing techniques in Lake Turkana Basin harpoons. This is because, the differences in intersite attributes are very negligible, which might even be as a result of different sample sizes of artifacts recovered. Therefore, the technology of making harpoons in the basin is the same in all sites.

CULTURAL RECONSTRUCTION

The origin of harpoons is far from established. However, first published work which recognized bone harpoons is by McGhee (1941) from Canada among the Dorset culture. The work that has been done on harpoon sites in Africa is negligible. So far, the extent of the culture is not known in Africa. Since the aquatic culture was recognized in the 1950s, many theories have been forwarded as to the origin, spread and medium of diffusion. The theories range from independent development to diffusion by contact through fluvial systems. The former does not hold much water as no evidence supports it, whereas the latter is supported by dates and affinities of the tool assemblages. There is observed consistency in dates of sites which suggests transmisssion of the aquatic culture from one society to another. The decorations and other features on harpoons show affinities in different sites suggesting borrowing of such cultural items from one society to the other. The two, dates and artifact affinities, attest to widespread contact among Lake Turkana inhabitants and their northern counterparts during the Holocene at least. This parallelism is further supported by the association of wavy line decorated pottery in both regions. These common features are most prevalent in the assemblages from Sudan and the Lake Turkana Basin.

Phillipson (1977, 1985) has noted that, harpoons were pre-Holocene tools. Dates as early as 40,000 B.p. (Khormusa) have been obtained where harpoons were recovered. This led to a change in view of the culture as abruptly emerging, to a now widespread view of continuous cultural evolution. It is unanimously agreed by archaeologists that barbed harpoons were being used worldwide by fishers/hunters since the terminal pleistocene (clark, 1967). Clark (1967) notes that the oldest archaeological evidence of harpoons is from Europe during the Aurignacian. Barbed bone harpoons prior to the Holocene were used in killing terrestrial animals, as man was predominently a hunter. The barbed harpoons were for arming arrows. The use of harpoons was not as extensive during the late pleistocene as during the Holocene. This is shown by bone harpoon assemblage size recovered dating to both time periods. Holocene assemblages are more numerous and larger than those of Pleistocene.

Diffusion is known as a mode of transmitting ideas through time and space. Diffusion as a method of transmision takes place in cultural or commercial contact where there are no barriers such as desert, mountains or unfriendly relations among neighbouring groups. the transmission from the pleistocene to the Holocene witnessed changes which made transmission of ideas from one society to another possible. This is seen as an adaptive strategy leading to a series of modifications and innovations depending on cost-effectiveness (Barich, 1987; Hassan, 1987). Binford (1968) sees differences in Post-Pleistocene culture which are not environmentally explained, as resulting from social contact facilitated by movement of the population in response to local climatic deterioration. He supports other Holocene Scholars who see the adaptive cultural changes as environment-controlled. But, he stresses the possibility of social contact as another cause of observed changes. Such changes in this study, are the over dependence on aquatic resources during the Holocene. Both environment and social contact might have played contemporaneous roles in evolving adaptive changes. The transition from the African pleistocene to Holocene, contrary to Binford's view, the environment became more favourable. But the response of the people, whether the environment deteriorated or became more favourable, would still be expected in order to adapt to a new environment.

People began selecting small-sized animal species available in their habitat. This way of life was characterized by semi-sedentism, controlled population density and was ideal for the exchange of goods and ideas with the neighbouring communities. In the Holocene, inventions and innovations seem to have been done on a local basis, even if the idea was initiated from elsewhere. Innovation was done anew in th process of adapting to the local environment (Barich, 1987).

The similarities observed in bone harpoons from different Lake Turkana Basin sites, leads to deduction that, some if not all traits were borrowed from neighbours. This is seen in the technology of making harpoons and the presence of cross-hatchings decoration at Lothagam. This rules out the idea of the lake Turkana Basin as the origin of harpoon culture.

Lack of enough excavated materials from all parts of the continent hinders the effort to get systematic data which may aid in the establishment of the source of the aquatic culture. Many regions of Africa are unexcavated or there is no trace of artifacts. So far, what has been used and is being used presently as a base for artifact study are sites where preservation is good.

Adjacent to the oldest dated site today, (Ishango), Zaire) is the humid tropical forest where preservation of bone or wood is impossible. This frustrates the process of tracing the harpoon's origin. It is anticipated that with time more excavations would come up with new dates and a clear way of finding the source of the culture may be developed.

In reconstruction of the source of bone harpoons found in the Lake Turkana sites, it is inevitable to look beyond the frontier of the basin to the outlying areas. The adjacent areas are the Nile and Omo river valleys, Sahel-sahana, River Niger and Lake Chad, and Central Africa (see Figure 1). Those areas have dated sites (see Table 3).

Initially in studying fishing settlement sites, researchers connected wavy line pottery and neolithic pastoralism (N.P.) with harpoons. Wavy line decorated pottery has been reported in association with bone harpoons (Arkell, 1949, 1953; Connah, 1975) in the Sudan and Chad, respectively. Recently, the wavy line decorated pottery has proved to be not

1949, 1953; Connah, 1975) in the Sudan and Chad, respectively. Recently, the wavy line decorated pottery has proved to be not

Site name and country	Date	presence of pottery
Khormusa (Egypt)	40,000 Bp Phillipson 1985	NO
Ishango (Zaire)	three dates 8,000 B.p. (Brown 1975)18,000 B.p (Brooks and Smith 1986) 25,000 B.p. (Brooks, see Stewart 1989)	NO
Harpoon Hill (Ethiopia)	9,500 B.p (Barthelme, 1985)	NO
Hassi el Abiod (Mali)	8,450 B.p (petit-maine, etal, 1983)	NO
Tagra (Sudan)	8,130 B.p.(Adamson, et.al, 1974)	NO
Gaji 11}Kenya Gaji 12}	8,000-9,000 B.p. Barthelme, 1985)	YES
Cat fish Cave	7,060 B.p. (Mendt,1966)	NO
Lowasera (Kenya)	7,470 + 200 B.p. Phillipson, 1977)	YES
Lothagam (KENYA)	7,160 + 80 B.p. 7,000 -6,000 B.p. Robbins 1974) (see Stewart, 1989)	YES
Khartoum (Sudan)	7,000 - 8,000 B.p.(Adamson et al 1974)	YES
Gamble's Cave (Kenya)	7,000 B.p.(Phillipson etal; 1977)	YES
Siwa (Egypt)	10,000 - 7,000 B.p.(Hassan, 1987)	NO
Sahara Sites (Sahara)	8,000 - 6,000 B.p.(Sutton 1977)	SOME
Daima (Chad)	3,000 B.p. (Conah, 1975)	YES

Table 3: Dates of Harpoon Sites in Africa.

of much help in tracing the source of harpoons. The oldest sites with such pottery around fishing settelements date to 8,500 B.p. and later. The sites with harpoons are older, however, (see Barthelme, 1985). The site of Ishango which is dated earliest, lacks any pottery. Furthermore, some sites in the Sahara dating to the Holocene lack any pottery e.g. Siwa (Hassan, 1987). All this suggests that the origin of the wavy line decorated pottery and harpoons is different and where found in association, it is a coincidence resulting from common users.

As regards pastoralism, the NP sites are too young to be of much help. NP sites such as Nderit, Kansyore, Narosura, Akira, Maringishu and Remnant appeared about 3,000 B.p according to Bower (1973), Ambrose (1977, 1984) and Marshall (1986). Though controversial, in north Africa NP might be contemporaneous with the Holocene aquatic culture as there is evidence of domestication dating as early as 9,000 B.p. in Egypt (Wendorf and Schild, 1980, Wendorf et al. 1984 cited in Barich, 1987; Fagan 1980). But, NP is younger in sub-saharan Africa than the harpoon sites.

Recent dating has shown that the oldest site with harpoons known in Africa is Ishango. This discovery makes the history of the origin gf the harpoons more complex. The site has three well-known dates. Earlier, it was dated to 8,000 B.p. (Brown, 1975). Recent Radio Carbon dates of 18,000 B.p. (Brooks and Smith, 1986 Cited in Stewart 1989), and 2,5000 B.p. (Brooks in press Cited in Stewart, 1989) have been reported. These dates are clear evidence that the site is old. The wide gap of the site date and next oldest site (Harpoon Hill, Ethiopia 9,500 B.p.) shows that the culture flourished in Central Africa for a long time before diffusing to other parts (see Table 3).

It is likely that the culture spread to the adjacent equatorial forest but no evidence so far has been found. This view is expressed by Sutton (1977). After the culture moved outside the Ishango area, it spread rapidly to the north as sites lie within a common chronological range of between 9,500 and 7,000 B.p. The possible medium through which this spread could have taken place is fluvial systems and personal contact. Robbins (1974) argues that boat-paddling was a common activity during the early to mid-Holocene. He bases his argument on the pronounced clavicular roughness of the human remains associated with artifacts from Lothagam site. The same view is expressed by Mbua (1988). She argues that clavicular roughness and proximal clavicular grooves seen on human remains from eastern lake Turkana are as a result of canoe paddling. She notes that similar grooves have been reported by Phillip Houghton (1980) on the skeletons of the inhabitants of coromandel peninsular, New Zealand neighbouring islands who are regular canoe paddlers.

If the hypotheses are valid, the corrindors connecti the Nile and Lake Turkana as a result of the lake overfl between 9,000 and 7,000 B.p. (Barthelme 1985), could ha created a good waterway. A pass to the northeast joinin Rivers Nile and Omo between 8,000 and 9,000 B.p. (Butzer e al; 1972, 1980) is another possible highway. The corrindor which linked Lake Turkana with Ethiopian lakes such as Chew Bahir (Stephanie) (Grove et al, 1975 Cited from Barthelme,1985) and the combining of Lakes Nakuru and Elementaita to form a continuous watermass, in the early and mid-Holocene, might have served the same purpose (Butzer et al. 1972: 1070-1071)

Those outlets had the effects of refreshing the lakes and providing systems for exchange of fauna. At the same time, the corrindors might have created routes for human migration along the river banks following the moving fish. This would eventually lead to contact, borrowing of ideas and assimilation. Southward migration by people from the north is suspected on two grounds during the early to mid-Holocene;

(1) depletion of aquatic resources especially in Khartoum due to long time of exploitation and

(2) pressure on Khartoum inhabitants from saharan people where aridity set in around 8,000 to 7,000 B.p (Faure, 1966; Jakl, 1979 Cited from Stewart, 1989:ı6

among others).

Dates show that from Ishango, the culture reached Harpoon Hill, Ethiopia. A dispersal center seems to have developed there whereby one trail spread northward to sudan and later the same trail spread southward to western Lake Turkana and resulted in Lothagam and Lowasera. This is based on closeness of dates and some harpoon characteristics, for instance the cross-hatching decoration recorded at Lothagam. The wavy line decorated pottery from both regions gives more weight to this. The second trend from Harpoon Hill turned southward and reached sites GaJi 11 and GaJi 12 (see figure 16). These two sites date to approximately the same age (see Table 3). The movement might have been caused by depletion of the resources and a need to look for plentiful bases around the lake. This also accounts for the absence of permanent camps, though mosquito infliction and submergence of the camps when the lake level rose might also have hindered the establishment of a sedentary way of life. The long shoreline and permanency of the water attracted fishermen and hence the presence of many settlement sites (see figure 16).

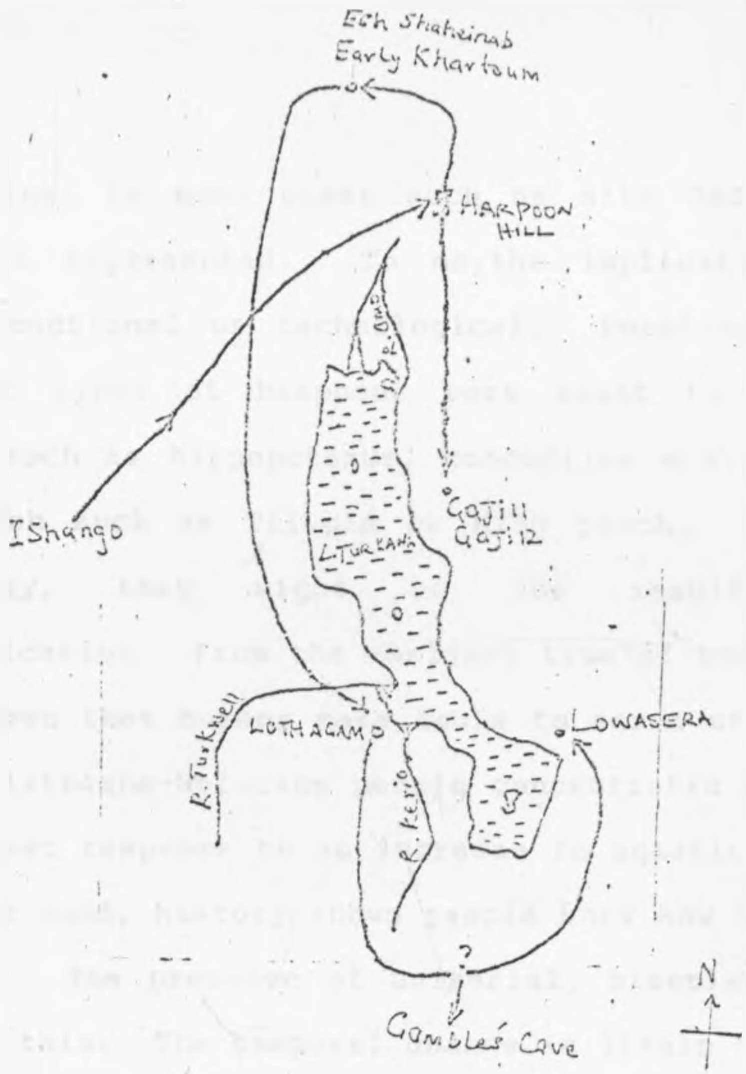


Figure 16. An hypothetical diffusion trail of the harpoon culture into the Lake Turkana Basin.

CONCLUSION

The presence of uniserial, biserial, triserial, and barbless bone harpoons at the four sites studied is very interesting. In some cases such as site GaJi 11, all four interesting. In some cases such as site GaJi 11, all four types are represented. To me,the implication of this is either functional or technological. Functionally, the four different types of harpoons were meant to kill different animals such as hippopotamus, crocodiles e.t.c or different-sized fish such as Tilapia or Nile perch. In the case of technology, they might be the result of toolkit diversification. From the earliest time of human tool-making, it is known that humans make tools to serve an emerging need. Late Pleistocene-Holocene people concentrated much on fishing as a direct response to an increase in aqautic resources. On the other hand, history shows people knew how to diversify the tool-kit. The presence of uniserial, biserial and triserial supports this. The temporal change in lithic tool types shows humans diversified their tool kit with time.

If the suggestion by Phillipson (1977), that the making of uniserial harpoons was inspired by the fish bone spine is true, no doubt our predecessors were truly modifiers. The manufacturing of biserial and triserial harpoons presumably is a reflection of advanced technology as compared to the uniserial harpoons. Alternatively, it may indicate the killing of fish at different water depths according to stewart (personal communication). The uniserial harpoons are easier to make than the others and the high number of them in the assemblages confirms this (see Chapter V11).

The harpoons from the four sites studied exhibit a high degree of similarity though there are few noted differences. The site of Lowasera shows less variation in width than the others. This supports earlier noted uniformity and standardization of artifacts. The common features seen on bone harpoons from the four sites, close dates and affinities with artifacts from the north, suggest movement, contact and borrowing within and outside the Lake Turkana Basin. Holocene inhabitants in the basin chose what items of the external culture to endorse. This probably is the reason behind cross-hatching decoration of a single harpoon from Lothagam. It seems due to unknown reasons, the decoration did not take root at the site. It may be that the artifact was brought from the north rather than made at the site. The decoration did not diffuse to other sites. At Lothagam site, the inhabitants were making other implements with bones. Such implements were bone awls (bone-needle) probably used in knitting fishing nets. Such implements were also recovered at Khartoum (Arkell 1949). Lothagam, though not permanently inhabited during the Holocene, was occupied seasonally for a long time. This is based on the high number of artifacts recovered from the site.

Wavy line decorated pottery and Neolithic pastoralism though associated often with harpoons cannot help in tracing the origin of the artifacts. This is because the two are recent relative to harpoon culture. The wavy line decorated pottery is not older than 8,500 B.p. and Neolithic pastoralism in sub-saharan Africa appeared around 3,000 B.p.. The onset of neolithic pastoralism in East Africa was contemporaneous with the disapearance of aquatic culture as the lakes/rivers levels were receding.

The harpoon assemblage sizes recorded from the four sites have cultural significances on the users. This is whereby the preferences laid on aquatic resources exploitation by each group of fishermen seem to have been guided by customary believes. A case in point is GaJi 12 where terrestrial animal fauna highly outnumber fish fauna. This implies the inhabitants depended much on terrestrial animals. Ethnographic observations have shown that this could happen whereby some East African communities despise fish eating or consume very little.

The Holocene fishing culture in the lake Turkana Basin has its counterparts in other areas of Africa. The similarities observed in the bone harpoon assemblages suggest a cultural diffusion in the course of following the aquatic resource supply. Boat-paddling during this time is one of the most likely means of communicating and dispersing the culture. This was possible when lakes overflowed developing connective corrindors. The lake Turkana Basin harpoon culture seems to have come from Ethiopia where sites with dates closer to those of lake Turkana are recorded. The suggestion of Central Africa as the source of the culture is further evidenced by new dates from Ishango. Sporadic spread of the culture as it left Central Africa is exhibited by narrow ranges of dates from sites to the north of Ishango. This is presumably caused by accelerated human movement. The culture seems to have reached Ethiopia earlier than Sudan. In Ethiopia, a dispersal center developed resulting in two trends, one to the north and the other to the south. The northern one shifted southward and reached Lothagam and Lowasera sites, based on similar dates.

The southward trend resulted in sites GaJi 11 and GaJi 12. The overlapping dates suggest forward-backward movement. This procesional diffusion reconstruction is based on affinities of archaeological materials-harpoons, and dates of these sites. The utilization in the future of other sources of information, such as linguistic studies which is unexplored or inexhaustively investigated might reveal a more appropriate picture of the origin and spread of the aquatic culture.

CHAPTER VII

TECHNOLOGY - EXPERIMENTAL WORK

It is certain that man shaped bone, antler and other organic substances for intentional use. This to an extent supports the Osteodontokeratic tool culture suggested by Dart (1957), also Binford (1981;37,1983). Bones are not readily preservable except in rare ideal environments. Consequently, little has been recovered to support the hypotheses put forward by bone analysts. This brings in the requirement of experimental studies to find out the bone breaking behaviours of hominids and other animals.

Animals are proven agents of bone modification which may easily be confused with the intentional modification by hominids. The breaking of bone for marrow extraction by hyaenas, dogs and erosion are other agents of bone modification. The solution to this problem is only found in experimenting with bones and watching the behaviour of ther agents. These lines have been pursued by people such as Binford (1981,1983), Cole (1973), Oakley (1967) and Semenov (1964).

It is not clear what led man to embark on using both bone and stone tools especially during the upper palaeolithic.

Unavailability of suitable stones, an urge to diversify the tool kit and availability of bones are probable contributary factors.

In making harpoons with bones, a real result of what was done cannot be demonstrated, but, a model of it can be constructed from the experiment to help reveal the past. In this work, I cannot duplicate the method to manufacture harpoons. What is intended is to establish a general manufacturing techniques focussing on style and sequence.

In my experimental venture I used cow long bones (tibia-fibula). The portions that I used were splinters from tibia-fibula. The reasons of using long bones are because of the extensive surface area and straightness. Another advantage is that longbones can be split readily using a hammerstone, the splinters can be shaped into harpoons by rubbing against a rough stone. Long bones are the appropriate bones for carving harpoonsand by analogy, long bones of bovids or hippopotamus could have been usedby Holocene fishermen. Obsidian was used for making cutting tools and chert for an anvil and hammerstones. Obsidian was used due to ease of flaking it intentionally considering its fine nature, its availability and the sharpness of its tools.

The first step was to prepare bone which involved the removal of the periosteum to achieve controlled breaking. This was done by scraping using a rough stone or by rubbing the stone against a bone. Bone in its natural form has to be reduced into a size for shaping into a harpoon. This starts with the removal of the distal and proximal ends. This is done by making a deep groove around the point of diaphysis - epiphysis fusion. The groove was made by a sawing motion using a sharp - edged blade, a retouched blade could do it equally well. The groove is made to avoid spiral-breaking which could easily destroy the shaft by the development of striations and fissures.

To reduce the bone further, I split it by chopping the mid-section. But if the bone is not large, tapping using a stone hammerstone can reduce it. In the case of ribs, only the head was removed but my bid to make a barbless point out of a cow rib failed due to presence ot the bone marrow. For a controlled reduction, tapping the bone on an anvil stone is important. The splinters, if of sufficient size, could be used for shaping into harpoons.

When a bone is split, longitudinal scratches or striations are produced. These irregularities are removed by scraping or polishing. The head of the harpoon is reduced by retouching on an anvil using a small light stone, to make it pointed. Bones are a fragile substance and precision and care are required when retouching. Chipping can alternatively serve the same purpose using a light hammerstone. The head is normally reduced more than the butt end.

The next step is to carve the barb crest. This is the ridge-shaped edge from which the barbs are carved. The crests were made according to the dimensions required for a specific harpoon. If uniserial one crest is made, biserial two crests and triserial three. For the barbless harpoon, no crest is required and the body of the point is made as round as possible. The crest is normally not pronounced but it is important as it guides the carver when cutting the barbs and in making the straight line of barbs observed on all harpoons.

The barbs were the most important and fragile features of a harpoon. They are also the hardest features to make. They were meant to inflict a wound on the prey and to bleed it to death. The presence of the barbs shows the harpoons were meant to be trapped within the fresh of the prey. The barbs look like small harpoons. They are delicate and break easily when in contact with harder objects such as stones. This calls for extra care when making them. I made them using a sharp blade in a sawing motion with the blade slanted obliquely at an angle. The cutting started from the head to the butt-end. This resulted in the barbs being pointed towards the base of the harpoon. The distance from one barb to another had to be established before cutting to maintain the size of each barb and to avoid one skewing the other. The number of barbs on each harpoon was determined by the size of the barbs and the harpoon. The barbs were sharpened by polishing the sides as it is impossible to scrap between them (see figure 17).

The grooves and notches of barbed bone harpoons from lake

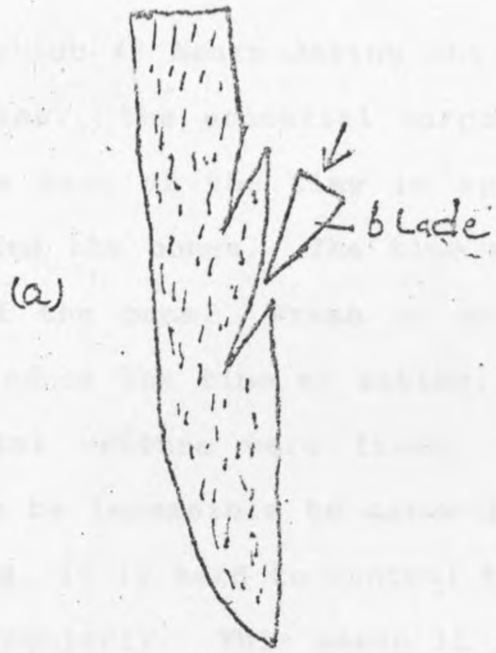
Turkana Basin sites are cut with the same tools used in cutting the barbs ad the cut-marks are the same except that, the cuts are shallower. Since the grooves do not circle the harpoon and normally are next to the lowermost barb, they might have been intended to cut barbs, but due to error in distancing the barb, they are left without being cut. The sharp edges of the groove are cut in a sawing motion. Mostly, grooves and notches are seen on uniserial harpoons.

The semi-circular curvature which is a characteristic of uniserial and barbless harpoons might be either as a result of modification, especially scraping, when smoothing the artifacts after cutting the barbs. Normally, the curvature is oriented on the side of the barb. It might also be as a result of natural form of the bone, such as ribs and femera.

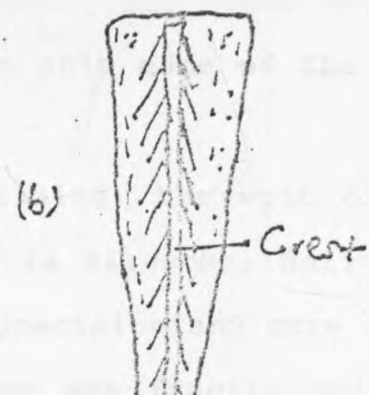
Ring-like marks circling the base of some harpoons and it is not clear how they came about. They are not cuts but could be marks made by a string or cord tied on the base. They are most pronounced on harpoons from Lowasera. Notching, grooving and incising on the base of the harpoon are related to the function of the harpoon.

Cross-hatching decorations are rare among the Turkana harpoons. A single harpoon was found at Lothagam with cross-hatchings. These cross-hatchings are made with a sharp-pointed object most likely the edge of a blade, burin or a borer.

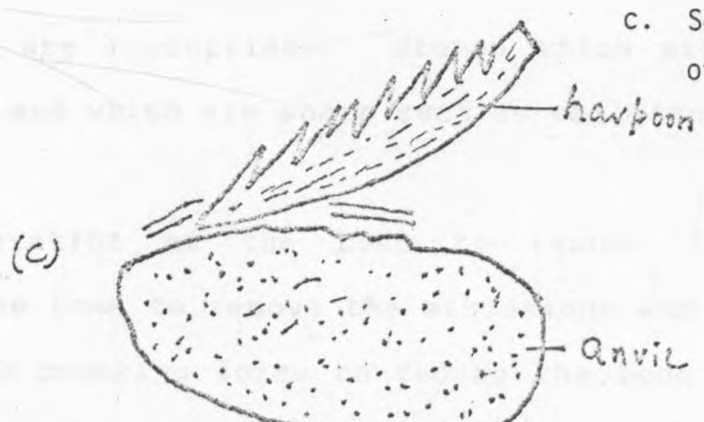
The making of a single harpoon requires much time. In my



a. Cutting of the barbs.



b. The crest on which the barbs are cut.



c. Scraping and polishing of the harpoon.

Figure 17. Methods of harpoon manufacture.

case, I spent about 48 hours making one. Cutting barbs took half of that time. The uniserial harpoon is the least time consuming. The rest of the time is spent in preparing the cutting tools and the bones. The time spent also depends on the hardness of the bone. Fresh or wet bone are easier to work with and reduce the time of making. The bones I used in this experimental venture were fresh. Fossilized and dry bones proved to be impossible to carve into a harpoon. With fossilized bones, it is hard to control the cuts as they break or splinter irregularly. This makes it impossible to control the size of the barbs. Dry bones destroy the cutting tools. This is because the thin edge of the blade is blunted by the bone.

In summarising, the work of making a bone harpoon using lithic tools is tiresome, delicate and time consuming. There is need for precision and care in carving of the barbs. Unlike stones, bones are fragile and the artifacts are true manifestation that our predecessors had the characteristics of bones in mind in order to be able to use them. The procedure started with finding appropriate bones and stone tools. Fresh long bones are appropriate. Stones which are easy to make tools from and which are sharp such as obsidian and chert were used.

The preperation of the bone to remove the periosteum, scraping the bone to remove the striations and splinter marks made by the breaking force to reduce the bone size followed.

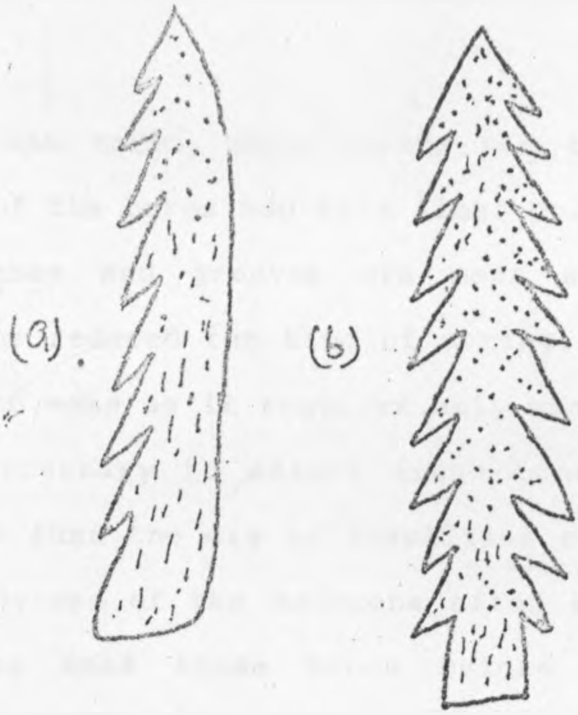


Figure 18: The two harpoons made by the writer (a) is an uniserial and (b) biserial. The curve observes in (a) is as a result of scraping of the side with no barbs and the initial form of the bone. The barbs on (b) are not pained unlike the archaeological specimens. This is due to my lack of experience.

To make the barbs, barb crests had to be made followed by cutting of the barbs and then final polishing.

Notches and grooves are made and any other feature. Experience reduced the time of making. The barbless point is easiest to make as it requires only smoothing after reduction. It was necessary to select fresh bones which are easier to work with than the dry or fossilized ones. It is very likely that fishermen of the Holocene after killing big animals and defleshing used those bones before they were dry. The generalized resemblance of bone harpoons from Lake Turkana sites manifest expertise.

CHAPTER V111

SUMMARY AND CONCLUSION

Study of pollen profiles and cores from lake sediments shows a generalised trend to aridity at the close of Pleistocene in east and north Africa. The Turkana Basin experienced increasing rainfall, higher temperatures and greater vegetation which was moisture-loving in the early Holocene. This coincides with correlation from other parts of Africa. The lake Turkana Basin experienced three intervals of high rainfall between 9,500 and 3,000 B.p.. A trend to aridity started between 4,000 - 3,000 B.p.

The high rainfall led to an overflow of the lake to other fluvial systems to the north and southeast. Consequently, there was a change in the biotic composition of the lake. Localisation of transgressive-regressive intervals is observed in East, North Africa and in the Lake Turkana Basin.

There is no geological evidence to support the development of a permanent lake in the Turkana Basin. What has existed there permanently is the proto-Omo River or River Omo. The river is known to have meandered, changing its course frequently. Sedimentation of the lake caused overflows and development of outlets either to the northwest or southeast. Lake Turkana today is the main feature in the basin and it is about 180,000 years old. Two Holocene sedimentary deposits are noted in the basin. The Galana Boi and Kibish Formations covers Koobi Fora and northern regions respectively.

The appearance of fishing settlement sites in the sudan was initially seen as an abrupt response to exploit an emerging resource base. The culture was seen as restricted only to the Sahel-saharan zone. At the same time, the aquatic resource exploitation was viewed as contemporaneously composed of barbed bone harpoons and wavy line pottery.

Following more research, the culture wa proved to have extended beyond formerly suggested sahelian-saharan zone. This is proved by the discovery of the sites of Ishango, Gamble's Cave (lake Nakuru) and those in the Lake Turkana Basin. This new dimension led to change from investigation of the source and spread of the culture, to investigation of the relationship between the features derived from the assemblages and of environmental change.

The spread of the culture beyond sahel-saharan zone, changed archaeologists' view of the culture as a systematic adaptation evolving from a pre-Holocene adaptation. The new older date for Ishango and absence of associated wavy line pottery discredited the earlier view of contemporaneity of barbed harpoons and wavy line pottery. Similarly, lackof archaeological evidence of Neolithic pastoralism before 3,000 B.p. in sub-saharan Africa, proves harpoon and Neolithic pastoralism to be different cultural lines.

The sites Lothagam, Lowasera, GaJi11 and GaJi 12 are relatively similar in age. A close similarity of artifacts, stratigraphy and geo-environmental settings is noted. The sites were occupied by migratory people. The lack of permanent structures adds weight to this. Only site GaJi 11 shows evidence of being an occupation site. It is a procurement station for people from nearby occupation sites such as GaJi12. Lothagam site was occupied seasonally for a long time.

Barbed bone harpoons recorded from Lake Turkana sites exhibit morphological similarities. In line with this, the likelihood of makers who were in close contact is expressed. The bone harpoons from the Lake Turkana sites show morphological similarities with other prehistoric tools. This suggest borrowing from those prehistoric tools and modification. Hafting and securing of harpoons on a line or cord was a common phenomenon in the Lake Turkana Basin during the Holocene.

Four types of harpoons were represented in the four sites studied. These are uniserial, biserial, triserial and barbless. Bones were used to make other implements in the Lake Turkana Basin such as bone awls. It has beenseen that Holocene people in the Lake Turkana Basin knew how to diversify their tool-kits. The four harpoons types were used to kill different-sized fish at diffent water depths.

Uniserial harpoons have been experimentally proved to be easier to make. This justifies their large number in all four site assemblages.

Attribute comparison has demonstrated that harpoons from all four sites are similar. The people who were making them were in close contact or were the same people moving around the lake. Close checking has revealed that the culture of the lake Turkana people have been influenced from outside. There was widespread movement, contactand borrowing within and outside the basin during the Holocene. Holocene fishing culture in the Lake Turkana Basin has its counterparts in other area of Africa. These similarities imply culture diffusion in the course of following the aquatic resource supply. Boat-paddling during this time was one of the means of dispersing the culture. This was possible when lakes overflowed developing connective corrindors. In this way, the Holocene aquatic culture reached the Lake Turkana Basin from the north. The Lake Turkana fishing culture came from Ethiopia where sites vith dates closer to those of the Lake Turkana sites are recorded. The culture reached Ethiopia from Zaire. This supports the earlier view of Central Africa as the source of the aquatic culture where earlier dates are recorded.

The culture reached Ethiopia earlier than sudan. In Ethiopia, a dispersal center developed which resulted in trends, one to the north and the other to the south. The northern one later shifted southward and reached Lothagam and Lowasera. The southward trend resulted in sites GaJi 11 and GaJi12. At the same time, a coincident southward movement from sudan to the Turkana Basin is evident. This is caused by waves of southward movement form sahara caused by the onset of aridity and start of desertification. The culture was spread in forward-backward movement. This resulted in overlapping dates. The taxonomic representation of bone harpoons from the four sites has demonstrated that Holocene people's eating behaviours were guided by customary believes.

Experimental work has demonstrated that the work of making a harpoon is tiresome, delicate and time-consuming. There was a need for care and precision in making of the barbs. In order to use bone to make artifacts, the knowledge of characteristics of bones was necessary. The barbless harpoon is the easiest to make followed by uniserial, biserial and triserial. Experience accumulated over time reduced time of manufacturing a specific harpoon. It has been demonstrated that there was need to select big straight and fresh bones. The experiments support the earlier mentioned Osteodontokeratic tool culture.

Generalised similarities which have been observed on barbed bone harpoons contradict the hypothesis that, the artifacts from the four different sites portray temporal-spatial variations in styles and sequence of manufacture. The study has shown that the makers were the same people, who were in close contact and used the same technology of manufacturing. The semi-sedentary life shows the people were moving from one site to another. This movement and seasonal occupation of a site was dependent on resource availability. Mosquito infliction and submergence of campsites hindered the establishment of sedentary way of life.

attributes of each harpoon against others from the same site. Other decorations such as cross-hatchings or other unique features, e.g. the bone awl, are described by their own physical appearances. In description, harpoons were divided into either uniserial, biserial, triserial and barbless.

In intersite comparison, mean and standard deviations were calculated for all the metrical attributes. This showed the distribution of those attributes in any assemblage. The cultural significance of the comparison result and taxonomic representation are discussed. Other non-metrical attributes are compared.

The collection of harpoons that I studied was stored in the Kenya National Museum, Nairobi by the excavators. Due to unknown reasons the collections were not safely kept and as a result, harpoons from many sites which were not included in this work, were not available. Also, the harpoons were mingled with other materials from the same sites. Therefore sorting had to be done. There was no stratigraphic bagging, therefore I could not distinguish the surface collection and excavation remains.

In my experiments on harpoon manufacturing techniques, I have used both written literature and my own initiatives. In this experiment, the main goal was to make a harpoon using domestic animal bones and obsidian flakes. The goal was to find the sequence and the style of manufacture of the harpoons.

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SITE NUMBER LOTHAGAM 1399

SHEET NO. 1

NO.	LENGTH	WIDTH	UNI.	BIS.	TRI.	BARBS NO.	BLUNT.	POINT.	LENGTH	RAW MATERIAL	DRILL	NOTCH	Breadth GROOVE
1	5cm	1 cm	Barbless	—	—	—	—	—	—	Bone	—	—	0.8 cm
2	8 cm	1cm	✓	—	—	5	✓	—	0.5 cm	Bone	on base	—	0.4 cm
3	10cm	1cm	✓	—	—	6	—	✓	0.5cm	Bone	✓	—	0.9 cm
4	9 cm	0.5cm	✓	—	—	4	broken		—	Bone	—	—	0.7 cm
5	6cm	1cm	✓	—	—	12	✓	—	0.5 cm	Bone	—	—	1.3 cm
6	5.5cm	0.5cm	✓	—	—	5	✓	—	0.5cm	Bone	—	—	1.1 cm
7	8.5 cm	0.5cm	✓	—	—	8	—	✓	0.5cm	Bone	—	✓	0.8 cm
8	6cm	0.8cm	✓	—	—	5	—	✓	0.5 cm	Bone	—	—	1 cm
9	8 cm	0.8cm	✓	—	—	9	—	✓	0.4cm	Bone	On base	—	0.9 cm
10	8.5cm	0.5cm	✓	—	—	4	—	✓	0.6cm	Bone	—	—	1.6 cm
11	7cm	1cm	✓	—	—	5	—	✓	0.5cm	Bone	—	—	1 cm
12	11 cm	0.6cm	✓	—	—	4	—	✓	0.8cm	Bone	On base	—	1 cm
13	8 cm	0.8cm	✓	—	—	5	✓	—	0.8 cm	Bone	On base	—	1 cm
14	6 cm	0.6cm	✓	—	—	7	—	✓	0.5 cm	Bone	—	—	1.3 cm
15	8 cm	0.8cm	✓	—	—	5	✓	—	0.5 cm	Bone	—	—	1.3 cm
16	9cm	1 cm	✓	—	—	6	—	✓	1 cm	Bone	On base	—	0.8 cm
17	8.5cm	0.8cm	✓	—	—	5	✓	—	1 cm	Bone	—	—	0.8 cm
18	6cm	0.8cm	✓	—	—	5	✓	—	0.5cm	Bone	—	—	0.9 cm
19	6.8 cm	0.6 cm	✓	—	—	5	—	✓	0.5 cm	Bone	On base	—	1.5 cm
20	7.8cm	0.7cm	✓	—	—	5	✓	—	0.5cm	Bone	—	—	1 cm
21	8.5 cm	0.6cm	✓	—	—	3	—	✓	0.5 cm	Bone	—	—	1.4 cm
22	8.cm	0.4cm	✓	—	—	4	—	✓	0.4 cm	Bone	On base	—	0.9 cm
23	6.7cm	0.5cm	✓	—	—	5	✓	—	not visible	Bone	—	—	1 cm
24	5cm	0.7cm	✓	—	—	3	—	✓	0.3 cm	Bone	—	—	0.9 cm
25	7.5cm	0.7cm	✓	—	—	4	—	✓	0.5 cm	Bone	—	—	1.4 cm

Lothagam 1399 SHEET NO. 2

NO.	LENGTH	SITE WIDTH	NUMBER UNI.	BIS.	TRI.	BARBS NO.	BLUNT.	POINT.	LENGTH	RAW MATERIAL	DRILL	NOTCH	Breadth GROOVE.
28	8 cm	0.7cm	barbless	—	—	—	—	✓	—	Bone	—	—	1.3 cm
9	7.5cm	0.7cm	✓	—	—	3	—	✓	1cm	Bone	—	—	1.3 cm
0	11.3 cm	0.5cm	barbless	—	—	—	—	✓	—	Bone	—	—	0.7 cm
1	11.4 cm	0.6cm	barbless	—	—	—	—	+	—	Bone	on base	—	0.9 cm
2	8.2 cm	0.5cm	✓	—	—	4	—	✓	0.5cm	Bone	on base	—	0.9 cm
3.	9 cm	0.6cm	✓	—	—	4	—	✓	0.5cm	Bone	on base	—	1 cm
34	8 cm	0.6cm	✓	—	—	9	—	✓	0.4cm	Bone.	on base	—	0.9 cm
5	7.5cm	0.7cm	✓	—	—	6	—	✓	0.4cm	Bone	—	—	0.8 cm
6	7.5cm	1 cm	✓	—	=	6	✓	—	0.5cm	Bone	on base	—	1.3 cm
7	8 cm	0.8cm	✓	—	—	4	—	✓	0.1cm	Bone	on base	—	0.9 cm
8	6 cm	0.5cm	✓	—	—	4	—	✓	0.5 cm	Bone	—	—	1.3 cm
9	7cm	0.8cm	✓	—	—	6	—	—	—	Bone	—	—	1.4 cm
0	5.5cm	0.8cm	✓	—	=	2	=	—	0.7cm	Bone	—	—	1.2 cm
1	11 cm	1 cm	barbless	—	—	—	—	—	—	Bone	—	—	0.5 cm
2	7 cm	0.9cm	✓	—	=	2	✓	—	—	Bone	—	—	1.1 cm
3	5.5cm	0.6cm	✓	—	=	6	✓	—	0.5cm	Bone	on base	—	1.2 cm
4	4.5cm	0.6cm	✓	—	=	5	—	✓	0.5cm	Bone	—	—	0.8 cm
5	4.6cm	0.5cm	✓	—	=	5	✓	—	0.3cm	Bone	—	—	0.9 cm
6	5.2cm	0.4cm	✓	—	=	4	✓	—	N/Visible	Bone	—	—	0.9 cm
7	47.8cm	0.5cm	✓	—	=	—	N/ Visible		N/Visible	Bone	on base	—	0.9 cm
8	6.5cm	0.8cm	✓	—	=	2	✓	—	0.5cm	Bone	—	—	1.8 cm
9	8.3 cm	1 cm	✓	—	—	6	—	✓	0.6cm	Bone	=	—	0.8 cm
0	7 cm	0.5cm	✓	—	—	+ =	—	✓	—	Bone	—	—	1.1 cm
7	9 cm	0.9cm	✓	—	—	8	—	✓	0.7cm	Bone	—	—	1.3 cm
2	7.2 cm	0.6cm	✓	—	—	6	✓	—	0.5cm	Bone	—	✓	1.6 cm

SITE NUMBER Lothagam 1399 SHEET NO. [illegible]

NO.	LENGTH	WIDTH	UNI.	BIS.	TRI	BARBS NO.	BLUNT	POINT	LENGTH	RAW MATERIAL	DRILL	NOTCH	Beach GROOVE
55	8 Cm	0.7 Cm	✓	—	—	5	✓	—	0.6 Cm	Bone	—	✓	0.6 Cm
56	10 Cm	0.9 Cm	✓	—	—	3	✓	—	1.4 Cm	Ivory?	—	—	1.4 Cm
57	6.5 Cm	0.6 Cm	✓	—	—	5	✓	—	0.7 Cm	Bone	—	—	1.1 Cm
58	8.8 Cm	0.7 Cm	✓	—	—	3	✓	—	1 Cm	Bone	—	✓	0.9 Cm
59	4.5 Cm	0.4 Cm	✓	—	—	5	✓	—	—	Bone	—	—	1.6 Cm
60	11 Cm	0.6 Cm	✓	—	—	8	✓	—	0.5 Cm	Bone	—	✓	1.2 Cm
61	5.4 Cm	0.7 Cm	✓	—	—	3	✓	—	0.7 Cm	Bone	—	—	1.3 Cm
62	8.3 Cm	0.8 Cm	✓	—	—	3	✓	—	0.8 Cm	Bone	—	—	1 Cm
63	7 Cm	1 Cm	✓	—	—	6	✓	—	0.7 Cm	Bone	—	—	0.6 Cm
64	8 Cm	0.9 Cm	✓	—	—	5	✓	—	0.5 Cm	Bone	—	—	1 Cm
65	6 Cm	0.8 Cm	✓	—	—	5	✓	—	0.6 Cm	Bone	—	—	2.4 Cm
66	5 Cm	0.6 Cm	✓	—	—	2	✓	—	1 Cm	Bone	—	—	1.3 Cm
67	4.7 Cm	0.6 Cm	✓	—	—	3	✓	—	0.5 Cm	Bone	—	—	1 Cm
68	4.8 Cm	0.5 Cm	✓	—	—	2	✓	—	0.4 Cm	Bone	—	—	0.9 Cm
69	3.8 Cm	0.4 Cm	✓	—	—	3	✓	—	—	Bone	—	—	1 Cm
70	7.5 Cm	0.7 Cm	✓	—	—	2	✓	—	0.6 Cm	Bone	—	—	1 Cm
71	3.7 Cm	0.3 Cm	✓	—	—	4	✓	—	0.3 Cm	Bone	—	—	1.3 Cm
72	6.2 Cm	1 Cm	✓	—	—	1	✓	—	0.9 Cm	Bone	—	—	0.9 Cm
73	4.2 Cm	0.5 Cm	✓	—	—	4	✓	—	0.3 Cm	Bone	—	—	1.2 Cm
74	20.7 Cm	1 Cm	✓	—	—	broken barbs	✓	—	1.2 Cm	Bone	—	—	2.8 ([illegible]
75	9 Cm	0.6 Cm	barbless	—	—	—	✓	—	—	Bone	—	—	2.1 Cm
76	6.9 Cm	0.8 Cm	barbless	—	—	—	✓	—	—	Bone	—	—	1 Cm
77	7.5 Cm	0.7 Cm	✓	—	—	8	✓	—	0.5 Cm	Bone	✓	—	1.6 Cm
78	6.3 Cm	0.7 Cm	✓	—	—	5	✓	—	0.7 Cm	Bone	—	✓	1.5 Cm
79	7.3 Cm	0.6 Cm	✓	—	—	8	✓	—	0.6 Cm	Bone	—	—	0.6 Cm

Lithgow 1399

SHEET NO. 4

NO.	LENGTH	SITE WIDTH	NUMBER UNI.	BIS.	TRI	BARBS NO.	BLUNT	POINT	LENGTH	RAW MATERIAL	DRILL	NOTCH	Butt edge GROOVE
82	9.2 cm	1.1 cm	✓	—	—	8	✓	—	0.9 cm	Bone	—	—	1 cm
83	8.5 cm	0.8 cm	✓	—	—	11	✓	—	0.4 cm	Bone	✓ base	—	1.4 cm
84	8 cm	0.6 cm	✓	—	—	8	—	—	0.7 cm	Bone	—	—	0.8 cm
85	6.9 cm	0.8 cm	✓	—	—	3	—	✓	0.6 cm	Bone	✓ base	—	1 cm
86	9.7 cm	1 cm	✓	—	—	3	✓	✓	1 cm	Bone	—	—	1.2 cm
87	8.3 cm	0.5 cm	✓	—	—	6	✓	—	0.5 cm	Bone	✓ base	—	1.8 cm
88	15.7 cm	0.8 cm	barbless	—	—	—	✓	—	—	Bone		—	0.9 cm
89	7.4 cm	1 cm	✓	—	—	4	✓	—	0.7 cm	Bone	✓ base	—	0.6 cm
90	8.1 cm	0.7 cm	✓	—	—	7	✓	—	0.7 cm	Bone	—	—	0.6 cm
91	7 cm	0.7 cm	✓	—	—	8	—	✓	0.8 cm	Bone	✓ base	—	0.9 cm
92	13 cm	1.2 cm	barbless	—	—	—	—	✓	—	Bone	—	—	1.9 cm
93	10 cm	0.8 cm	✓	—	—	7	✓	—	0.5 cm	Bone	✓ base	—	1.1 cm
94	5.8 cm	0.7 cm	✓	—	—	6	✓	—	0.6 cm	Bone	✓ base	—	1.5 cm
95	7.8 cm	0.9 cm	✓	—	—	6	✓	—	0.5 cm	Bone	- base	—	1.0 cm
96	8 cm	0.6 cm	✓	—	—	3	✓	—	0.5 cm	Bone	✓ base	—	1 cm
97	7.6 cm	0.6 cm	✓	—	—	5	✓	—	0.5 cm	Bone	✓ base	✓	0.5 cm
98	7.2 cm	0.8 cm	✓	—	—	5	✓	—	0.9 cm	Bone	✓ base	—	1.2 cm
99	5.9 cm	0.7 cm	✓	—	—	4	✓	—	0.5 cm	Bone	—	—	1.1 cm
100	4.5 cm	0.4 cm	✓	—	—	4	✓	—	0.3 cm	Bone	—	—	0.8 cm
101	6.3 cm	0.7 cm	✓	—	—	3	✓	—	0.7 cm	Bone	✓ base	—	1.7 cm
102	7.4 cm	0.7 cm	✓	—	—	5	—	✓	0.7 cm	Bone	—	—	1.1 cm
103	7.2 cm	0.7 cm	✓	—	—	6	✓	—	0.7 cm	Bone	✓ base	—	1.3 cm
104	10.8 cm	1.1 cm	✓	—	—	14	✓	—	0.6 cm	Bone	✓ base	—	0.9 cm
105	9.7 cm	0.6 cm	✓	—	—	13	✓	—	0.4 cm	Bone	—	—	1 cm
106	6.2 cm	0.7 cm	✓	—	—	4	—	✓	0.7 cm	Bone	✓ base	—	2.1 cm

Lothagam 1899

SHEET NO. 5

NO:	SITE LENGTH	WIDTH	NUMBER UNI.	BIS.	TRI	BARBS NO.	BLUNT	POINT	LENGTH	RAW MATERIAL	DRILL	NOTCH	Presence GROOVE
109	7.5 Cm	0.6 cm	✓	—	—	5	—	✓	0.5 Cm	Bone	—	—	1 Cm
110	5.6 Cm	0.6 Cm	✓	—	—	4	✓	—	0.6 Cm	Bone	—	—	1.1 Cm
111	7.6 Cm	0.7 cm	✓	—	—	4	✓	—	0.6 Cm	Bone	—	—	1.6 Cm

118

LOWASERA

SHEET NO. 1

NO.	LENGTH	SITE WIDTH	NUMBER UNI.	BIS.	TRI	BARBS NO.	BLUNT	POINT	LENGTH	RAW MATERIAL	DRILL	NOTCH	GROOVE
1	5.5 cm	0.7 cm	✓	—	—	5	✓	✓	0.5 cm	Bone	on base	—	— 0.5
2	4 cm	0.7 cm	✓	—	—	3	✓	—	0.5 cm	Bone	✓ on base	—	— 1.1
3	5 cm	0.5 cm	✓	—	—	3	✓	—	0.4 cm	Bone	✓ on base	—	— 0.6
4	5.4 cm	0.9 cm	✓	—	—	3	✓	—	0.4 cm	Bone	✓ on base	—	— 1
5	5.2 cm	0.6 cm	✓	—	—	2	✓	—	0.7 cm	Bone	✓ on base	—	— 1
6	5.4 cm	0.7 cm	✓	—	—	4	✓	—	0.5 cm	Bone	✓ on base	—	— 0.7
7	7.5 cm	0.9 cm	✓	—	—	4	✓	—	0.5 cm	Bone	✓ on base	—	— 0.6
8	6 cm	0.6 cm	✓	—	—	4	✓	—	0.6 cm	Bone	—	—	Base 0.9
9	6 cm	0.7 cm	✓	—	—	6	✓	—	0.7 cm	Bone	✓ on base	—	— 0.7
10	3.7 cm	0.6 cm	barbless	—	—	—	—	—	—	Bone	—	—	— 1.2
11	7.3 cm	0.9 cm	✓	—	—	4	✓	—	1 cm	Bone	✓ on base	—	— 0.6
12	5.5 cm	0.6 cm	✓	—	—	4	✓	—	0.7 cm	Bone	✓ on base	—	✓ Base 0.9
13	5.9 cm	0.8 cm	✓	—	—	3	✓	—	0.6 cm	Bone	✓ on base	—	— 0.8
14	7.8 cm	0.7 cm	✓	—	—	5	✓	—	0.7 cm	Bone	✓ on base	—	— 0.9
15	5.1 cm	0.7 cm	✓	—	—	2	✓	—	1 cm	Bone	✓ on base	—	— 1
16	4 cm	0.5 cm	✓	—	—	3	✓	—	0.2 cm	Bone	✓ on base	—	— 0.8
17	[illegible]	0.8 cm	✓	—	—	10	✓	—	0.8 cm	Bone	✓ on base	—	— 1.1
18	[illegible]	0.6 cm	✓	—	—	4	✓	—	0.4 cm	Bone	✓ on base	—	— 1.2
19	5.1 cm	0.6 cm	✓	—	—	5	✓	—	0.4 cm	Bone	✓ on base	—	— 0.7
20	5.2 cm	0.8 cm	✓	—	—	5	✓	—	0.6 cm	Bone	✓ on base	—	— 0.9
21	5.2 cm	0.7 cm	✓	—	—	3	✓	—	0.6 cm	Bone	✓ on base	—	— 1.3

4ATi11

SHEET NO. 1

LENGTH	SITE WIDTH	NUMBER UNI.	BIS.	TRI	BARBS NO.	BLUNT	POINT	LENGTH	RAW MATERIAL	DRILL	NOTCH	GROOVE
2.6 cm	0·6cm	✓	—	—	7	✓	—	0·6cm	Bone	—	✓	— 1.4cm
14 cm	1·2cm	—	✓	—	12	✓	—	0·8cm	Bone	—	✓	— 1 cm
2.7cm	0·5cm	— [illegible]		—	—	✓	—	0·9cm	Bone	—	✓	— 0·9cm
5·7cm	0·6cm	✓	—	—	4	—	✓	0·9cm	Bone	—	✓	— 0·7cm
8cm	1·1cm	—	✓	—	7	✓	—	0·9cm	Bone	—	✓	— 1·1cm
10.6cm	0·8cm	✓	—	—	10	✓	—	0·8cm	Bone	—	✓	— 0·7cm
9.cm	0·7cm	✓	—	—	7	✓	—	0·9cm	Bone	—	✓	— 1·1cm
8.5cm	1cm	✓	—	—	7	✓	—	0·8cm	Bone	—	✓	— 1·4cm
4.8cm	0·6cm	✓	—	—	3	✓	—	0·8cm	Bone	—	✓	— 2.1cm

Gaji 12.

SHEET NO. 1

No.	LENGTH	SITE WIDTH	NUMBER UNI.	BIS.	TRI	BARBS NO.	BLUNT.	POINT.	LENGTH	RAW MATERIAL	DRILL	NOTCH	Breadth GROOVE
1.	10.5 cm	0.9 cm	✓	—	—	4 2	✓	—	1 cm	Bone	base	base	1.6
2.	7.6 cm	0.6 cm	✓	—	—	9	✓	—	0.6 cm	Bone	—	—	1.2
3.	7.3 cm	0.5 cm	✓	—	—	8	✓	—	0.5 cm	Bone	—	—	2.2
4.	10.2 cm	0.5 cm	✓	—	—	8	✓	—	1.4 cm	Bone	—	—	1.0
5	14 cm	1.2 cm	—	✓	—	12	—	✓	0.8 cm	Bone	—	—	2.0

SITE NUMBER LOTHAGAM 1399

SHEET NO. 1

NO.	LENGTH	WIDTH	UNI.	BIS.	TRI	BARBS NO.	BLUNT.	POINT.	LENGTH	RAW MATERIAL	DRILL	NOTCH	Breadth GROOVE
1	5 Cm	1 Cm	Bonbless	—	—	—	—	—	—	BONE	—	—	0.8 Cm
2	8 Cm	1 Cm	✓	—	—	5	✓	—	0.5 Cm	Bone	on base	—	0.11 Cm
3	10 Cm	1 Cm	✓	—	—	6	—	✓	0.5 Cm	Bone	—	—	0.9 Cm
4	9 Cm	0.5 Cm	✓	—	—	7	broken		—	Bone	—	—	0.7 Cm
5	6 Cm	1 Cm	✓	—	—	12	✓	—	0.5 Cm	Bone	—	—	1.3 Cm
6	5.5 Cm	0.8 Cm	✓	—	—	5	✓	—	0.5 Cm	Bone	—	—	1.1 Cm
7	8.5 Cm	0.5 Cm	✓	—	—	8	—	✓	0.5 Cm	Bone	—	✓	0.8 Cm
8	6 Cm	0.8 Cm	✓	—	—	5	—	✓	0.5 Cm	Bone	—	—	1 Cm
9	8 Cm	0.8 Cm	✓	—	—	9	—	✓	0.4 Cm	Bone	On base	—	0.9 Cm
10	8.5 Cm	0.5 Cm	✓	—	—	4	—	✓	0.6 Cm	Bone	—	—	1.6 Cm
11	7 Cm	1 Cm	✓	—	—	5	—	✓	0.5 Cm	Bone	—	—	1 Cm
12	11 Cm	0.6 Cm	✓	—	—	4	—	✓	0.8 Cm	Bone	On base	—	1 Cm
13	8 Cm	0.5 Cm	✓	—	—	5	✓	—	0.8 Cm	Bone	On base	—	1 Cm
14	6 Cm	0.6 Cm	✓	—	—	7	—	✓	0.5 Cm	Bone	—	—	1.3 Cm
15	8 Cm	0.8 Cm	✓	—	—	5	✓	—	0.5 Cm	Bone	—	—	1.3 Cm
16	9 Cm	1 Cm	✓	—	—	6	—	✓	1 Cm	Bone	On base	—	0.8 Cm
17	8.5 Cm	0.8 Cm	✓	—	—	5	✓	—	1 Cm	Bone	—	—	0.8 Cm
18	6 Cm	0.8 Cm	✓	—	—	5	✓	—	0.5 Cm	Bone	—	—	0.9 Cm
19	6.8 Cm	0.6 Cm	✓	—	—	5	—	✓	0.5 Cm	Bone	On base	—	1.5 Cm
20	7.8 Cm	0.7 Cm	✓	—	—	5	✓	—	0.5 Cm	Bone	—	—	1 Cm
21	5.5 Cm	0.6 Cm	✓	—	—	3	—	✓	0.5 Cm	Bone	—	—	1.4 Cm
22	8 Cm	0.4 Cm	✓	—	—	4	—	✓	0.4 Cm	Bone	On base	—	0.9 Cm
23	6.7 Cm	0.5 Cm	✓	—	—	5	✓	—	not visible	Bone	—	—	1 Cm
24	5 Cm	0.7 Cm	✓	—	—	3	—	✓	0.3 Cm	Bone	—	—	0.9 Cm
25	7.5 Cm	0.7 Cm	✓	—	—	4	—	✓	0.5 Cm	Bone	—	—	1.4 Cm
26	5 Cm	0.3 Cm	✓	—	—	6	—	✓	0.8 Cm	Bone	—	—	1.2 Cm
27	3 Cm	0.7 Cm	barbless	—	—	—	—	—	—	Bone	—	—	— [illegible]

Lothagam 1399 SHEET NO. 2

NO.	LENGTH	SITE WIDTH	NUMBER UNI.	BIS.	TRI	BARBS NO.	BLUNT	POINT	LENGTH	RAW MATERIAL	DRILL	NOTCH	Breadth GROOVE
28	8 cm	0.7 cm	barbless	—	—	—	—	✓	—	Bone	—	—	1.3 cm
29	7.5 cm	0.7 cm	✓	—	—	3	—	✓	1 cm	Bone	—	—	1.3 cm
30	11.3 cm	0.5 cm	barbless	—	—	—	—	✓	—	Bone	—	—	0.7 cm
31	11.4 cm	0.5 cm	barbless	—	—	—	—	—	—	Bone	on base	—	0.9 cm
32	8.2 cm	0.5 cm	✓	—	—	4	—	✓	0.5 cm	Bone	on base	—	0.9 cm
33	9 cm	0.6 cm	✓	—	—	4	—	✓	0.5 cm	Bone	on base	—	1 cm
34	8 cm	0.6 cm	✓	—	—	9	—	✓	0.4 cm	Bone	on base	—	0.9 cm
35	7.5 cm	0.7 cm	✓	—	—	6	—	✓	0.4 cm	Bone	—	—	0.8 cm
36	7.5 cm	1 cm	✓	—	—	6	✓	—	0.5 cm	Bone	on base	—	1.3 cm
37	8 cm	0.8 cm	✓	—	—	4	—	✓	0.1 cm	Bone	on base	—	0.9 cm
38	6 cm	0.5 cm	✓	—	—	4	—	✓	0.5 cm	Bone	—	—	1.3 cm
39	7 cm	0.8 cm	✓	—	—	6	—	—	—	Bone	—	—	1.4 cm
40	5.5 cm	0.8 cm	✓	—	—	2	—	—	0.7 cm	Bone	—	—	1.2 cm
41	11 cm	1 cm	barbless	—	—	—	—	—	—	Bone	—	—	0.5 cm
42	7 cm	0.9 cm	✓	—	—	2	✓	—	—	Bone	—	—	1.1 cm
43	5.5 cm	0.6 cm	✓	—	—	6	✓	—	0.5 cm	Bone	on base	—	1.2 cm
44	4.5 cm	0.6 cm	✓	—	—	5	—	✓	0.5 cm	Bone	—	—	0.8 cm
45	4.6 cm	0.5 cm	✓	—	—	5	✓	—	0.3 cm	Bone	—	—	0.9 cm
46	5.2 cm	0.4 cm	✓	—	—	4	✓	—	Nl visible	Bone	—	—	0.9 cm
47	47.8 cm	0.5 cm	✓	—	—	—	Nl visible		Nl visible	Bone	on base	—	0.9 cm
48	6.5 cm	0.8 cm	✓	—	—	2	✓	—	0.5 cm	Bone	—	—	1.8 cm
49	8.3 cm	1 cm	✓	—	—	6	—	✓	0.6 cm	Bone	—	—	0.8 cm
50	7 cm	0.5 cm	✓	—	—	—	—	✓	—	Bone	—	—	1.1 cm
51	9 cm	0.9 cm	✓	—	—	8	—	✓	0.7 cm	Bone	—	—	1.3 cm
52	7.2 cm	0.6 cm	✓	—	—	6	✓	—	0.5 cm	Bone	—	✓	1.6 cm
53	7.5 cm	0.6 cm	✓	—	—	5	—	—	0.5 cm	Bone	—	—	1 cm
54	6.5 cm	0.5 cm	✓	—	—	9	—	✓	0.4 cm	Bone	—	✓	0.8 cm

LOTHAGAM 1399 SHEET NO. 3

NO	LENGTH	SITE WIDTH	NUMBER UNI.	BIS.	TRI.	BARBS NO.	BLUNT.	POINT.	LENGTH	RAW MATERIAL	DRILL	NOTCH	Bead GROOVE
55	8 Cm	0.7 Cm	✓	—	—	5	✓	—	0.6 Cm	Bone	—	✓	0.6 Cm
56	10 Cm	0.9 Cm	✓	—	—	3	✓	—	1.4 Cm	Ivory? Bone?	—	—	1.4 Cm
57	6.5 Cm	0.6 Cm	✓	—	—	5	✓	—	0.7 Cm	Bone	—	—	1.1 Cm
58	8.8 cm	0.7 cm	✓	—	—	3	✓	—	1 Cm	Bone	—	✓	0.9 Cm
59	4.5 Cm	0.4 cm	✓	—	—	5	✓	—	—	Bone	—	—	1.6 Cm
60	11 Cm	0.8 Cm	✓	—	—	8	✓	—	0.5 Cm	Bone	—	✓	1.2 Cm
61	8.4 Cm	0.7 Cm	✓	—	—	3	✓	—	0.7 Cm	Bone	—	—	1.3 Cm
62	8.3 Cm	0.8 Cm	✓	—	—	3	✓	—	0.8 Cm	Bone	—	—	1 Cm
63	7 Cm	1 Cm	✓	—	—	6	✓	—	0.7 Cm	Bone	—	—	0.6 Cm
64	8 Cm	0.9 Cm	✓	—	—	5	✓	—	0.5 Cm	Bone	—	—	1 Cm
65	6 Cm	0.8 Cm	✓	—	—	5	✓	—	0.6 Cm	Bone	—	—	2.4 Cm
66	5 Cm	0.6 Cm	✓	—	—	2	✓	—	1 Cm	Bone	—	—	1.3 Cm
67	4.7 Cm	0.6 Cm	✓	—	—	3	✓	—	0.5 Cm	Bone	—	—	1 Cm
68	4.8 Cm	0.5 Cm	✓	—	—	2	✓	—	0.4 Cm	Bone	—	—	0.9 Cm
69	3.8 Cm	0.4 Cm	✓	—	—	3	✓	—	—	Bone	—	—	1 Cm
70	7.5 Cm	0.7 Cm	✓	—	—	2	✓	—	0.6 Cm	Bone	—	—	1 Cm
71	3.7 Cm	0.3 Cm	✓	—	—	4	✓	—	0.3 Cm	Bone	—	—	1.3 Cm
72	6.2 Cm	1 Cm	✓	—	—	1	✓	—	0.9 Cm	Bone	—	—	0.9 Cm
73	4.2 Cm	0.5 Cm	✓	—	—	4	✓	—	0.3 Cm	Bone	—	—	1.2 Cm
74	20.7 Cm	1 Cm	✓	—	—	broken barbs	✓	—	1.2 Cm	Bone	—	—	2.8 ([illegible]
75	9 Cm	0.6 Cm	barbless	—	—	—	✓	—	—	Bone	—	—	2.1 Cm
76	6.9 Cm	0.8 Cm	barbless	—	—	—	✓	—	—	Bone	—	—	1 Cm
77	7.5 Cm	0.7 Cm	✓	—	—	8	✓	—	0.5 Cm	Bone	✓	—	1.6 Cm
78	6.2 Cm	0.7 Cm	✓	—	—	5	✓	—	0.7 Cm	Bone	—	✓	1.8 Cm
79	7.3 Cm	0.6 Cm	✓	—	—	8	✓	—	0.6 Cm	Bone	—	—	0.6 Cm
80	6.2 Cm	0.7 Cm	✓	—	—	6	✓	—	0.5 Cm	Bone	—	—	0.6 Cm
81	4.9 Cm	0.4 Cm	✓	—	—	5	✓	—	0.6 Cm	Bone	—	—	1.7 Cm

Lothagam 1399

SHEET NO. 4

NO.	LENGTH	SITE WIDTH	NUMBER UNI.	BIS.	TRI	BARBS NO.	BLUNT.	POINT.	LENGTH	RAW MATERIAL	DRILL	NOTCH	Breadth GROOVE
87	9.2cm	1.1cm	✓	—	—	8	✓	—	0.9cm	Bone	—	—	1cm
83	8.5cm	0.8cm	✓	—	—	11	✓	—	0.4cm	Bone	✓ base	—	1.4cm
84	8cm	0.6cm	✓	—	—	8	—	—	0.7cm	Bone	—	—	0.8cm
85	6.9cm	0.8cm	✓	—	—	3	—	✓	0.6cm	Bone	✓ base	—	1cm
86	9.7cm	1cm	✓	—	—	3	✓	✓	1cm	Bone	—	—	1.2cm
87	8.3cm	0.5cm	✓	—	—	6	✓	—	0.5cm	Bone	✓ base	—	1.8cm
88	15.7cm	0.8cm	barbless	—	—	—	✓	—	—	Bone		—	0.9cm
89	7.4cm	1cm	✓	—	—	4	✓	—	0.7cm	Bone	✓ base	—	0.6cm
90	8.1cm	0.7cm	✓	—	—	7	✓	—	0.7cm	Bone	—	—	0.6cm
91	7cm	0.7cm	✓	—	—	8	—	✓	0.8cm	Bone	✓ base	—	0.9cm
92	13cm	1.20cm	barbless	—	—	—	—	✓	—	Bone	—	—	1.9cm
93	10cm	0.8cm	✓	—	—	7	✓	—	0.8cm	Bone	✓ base	—	1.1cm
94	5.8cm	0.7cm	✓	—	—	6	✓	—	0.6cm	Bone	✓ base	—	1.5cm
95	7.8cm	0.9cm	✓	—	—	6	✓	—	0.5cm	Bone	- base	—	1.6cm
96	8cm	0.6cm	✓	—	—	3	✓	—	0.50cm	Bone	✓ base	—	1cm
97	7.6cm	0.6cm	✓	—	—	5	✓	—	0.5cm	Bone	✓ base	✓	0.8cm
98	7.2cm	0.8cm	✓	—	—	5	✓	—	0.9cm	Bone	✓ base	—	1.2cm
99	5.9cm	0.7cm	✓	—	—	4	✓	—	0.5cm	Bone	—		1.1cm
100	4.5cm	0.4cm	✓	—	—	4	✓	—	0.3cm	Bone	—		0.8cm
101	6.3cm	0.7cm	✓	—	—	3	✓	—	0.7cm	Bone	✓ base	—	1.7cm
102	7.0cm	0.7cm	✓	—	—	5	—	✓	0.7cm	Bone	—	—	1.1cm
103	7.2cm	0.7cm	✓	—	—	6	✓	—	0.7cm	Bone	✓ base	—	1.3cm
104	10.8cm	1.1cm	✓	—	—	14	✓	—	0.6cm	Bone	✓ base	—	0.9cm
105	9.7cm	0.6cm	✓	—	—	13	✓	—	0.4cm	Bone	—	—	1 cm
106	6.2cm	0.7cm	✓	—	—	4	—	✓	0.7cm	Bone	✓ base	—	2.1cm
107	6.3cm	0.6cm	✓	—	—	5	✓	—	0.5cm	Bone	✓ base	—	0.8cm
108	5.6cm	0.7cm	✓	—	—	4	✓	—	—	Bone	—	—	1.3cm

117