

A FOCUS ON THE STYLE OF BONE HARPOONS IN THE EARLY HOLOCENE:
AN ANALYSIS OF BONE HARPOONS FROM KOOBI FORA, KENYA.

by

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ABSTRACT

ASHLEY JAMES HOVIS. A focus on the style of bone harpoons in the Early Holocene: an analysis of bone harpoons from Koobi Fora, Kenya. (Under the direction of DR. JANET LEVY)

While undergoing archaeological fieldwork in Ileret, Kenya, two Early Holocene (10,000-6,000 BP) sites are found containing bone harpoons. The purpose of this study is to examine the style of Early Holocene bone harpoons to see if people of East Lake Turkana were making similar or different bone harpoon styles within social groups. For methods, bone harpoon measurements are used to run Student *T* Tests to see if there is a difference for the bone harpoon styles between the two sites. An experimental replication of a bone harpoon provides insight on how the learning process of an object can influence style. Theoretical perspectives on group and personal identity are applied to the Ileret bone harpoons. The statistical results state the two sites had no statistical difference between the styles of bone harpoons. Because of the consistent form, I am inclined to believe that the Early Holocene fisher/hunter gatherers are making the bone harpoons in a group setting within each site and most likely shared ideas. The conclusions to take away from this study focus on how group membership can influence style and the production of objects. In a larger scope, these northeastern Lake Turkana bone harpoon styles can offer information about the variations of bone harpoon styles found in East Africa.

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INTRODUCTION

This master's thesis examines the ways Early Holocene bone harpoon style expressed social messages. This study focuses on data and artifacts from archaeological fieldwork and statistical analysis of bone harpoons found in East Lake Turkana, Kenya. The anthropological work of Wiessner (1983,1984) and Shackley (2000) provide a theoretical framework for how personal and group identity influenced style and manufacture of craft items. Ferguson (2008) and Minar and Crown (2001) provide theoretical background on the significance of the learning process for craft production as novices can alter the products and waste products of lithic, ceramic, or pottery assemblages in the archaeological record (Minar and Crown 2001). Kamp's (2001) information about how children learn also aids my research in how the learning process for making bone harpoons worked in the Early Holocene.

The research area is the Koobi Fora region of Kenya. The area has desert-like vegetation on the ground and exposures with sedimentary deposits from different time periods. The deposits that are the focus of this study are the Early Holocene Galana Boi Formation, but the region has deposits from the early Pliocene through Plio-Pleistocene ages (Kiura 2005: 1). The Early Holocene dates to 10,000 to 6,000 BP and its people were fisher/hunter-gatherers using bone harpoons to hunt aquatic animals for their subsistence.

Objectives of the Study

The objectives of this research are to examine the style of bone harpoons to see if people of East Lake Turkana were making similar or different bone harpoon styles within social groups, as evidenced by a comparison of the harpoons found at two sites. In order

to do this, I will look at similarities and differences in bone harpoon morphology and manufacture within and between sites. In this study, I am examine the bone points themselves and call the points, bone harpoons, but others such as Robbins and Yellen refer to my set of data as barbed bone points. When I talk about harpoons, I am referring to the functional definition of a harpoon in which the body has holes or notches so a line can be fastened to the detachable head (Robbins 1975: 632-633). I will use these data to propose theories about social identity, within group learning, and group membership.

Three Research Questions

The three main research questions are: (1) Does group membership influence the manufacture of Holocene bone harpoons in East Africa? (2) Are learning and teaching practices visible through style in Early Holocene bone harpoons? (3) Does Early Holocene bone harpoon style serve as a marker of group and personal identity in East Africa? By examining these research questions, this study will contribute to the archaeological knowledge about bone harpoons in Africa, specifically in this region on the northeastern shore of Lake Turkana.

LOCATIONAL BACKGROUND OF THE RESEARCH AREA: LAKE TURKANA

The research area is located in East Africa with a focus on Lake Turkana as shown in figure 1 in the Appendix. Lake Turkana is located in northern Kenya and “is one of the oldest and largest (7500 km² and 125 m maximum depth) closed-basin water bodies found in the semi-arid East Africa Rift system” (Ndiema et al. 2011: 1087). The primary water sources pouring into the lake are groundwater from rainfall in the region and surface water from the Omo River. The Omo River drains surface discharge from the Ethiopian Highlands. Lake Turkana is 250km long. The lake’s dimension for the widest section is 40 km and the “narrowest section is approximately 20 km from the eastern to the western shores” (Ndiema et al. 2011:1087).

HOLOCENE ENVIRONMENT OF EAST LAKE TURKANA

The Early Holocene sequence of East Lake Turkana can be found within the deposits identified as the Galana Boi Formation. The Early Holocene Galana Boi beds lie on top of the Plio-Pleistocene Koobi Fora formation. The Early Holocene sediments are gray in color and consist of siltstones, sands, and mollusk shells. These gray lacustrine and diatomaceous sands spill out of the high lake stands (Koobi Fora Field School 2014). The Early Holocene sequence is vertically 80 m above the 1976 lake level. The strata from the Early Holocene dates to 10,000 to 6,000 years before present and can be 10 meters thick in the survey area, but in other areas the strata can be 32 meters thick (Ashley et al. 2011: 810).

The lake levels dictated where the research team surveyed. The team focused on sediments that were at least 80 m above the 1976 lake levels; this is where the Early Holocene lake level would have been. The lake level is relevant because people in the past and present chose to live near water and establish fishing communities. High lake stands characterize the Early Holocene. During the Holocene, the lake was characterized by both high-energy and low-energy waves. Today, evidence of past waves is shown in exposed sediment of the Galana Boi beds. High energy within the water created strong and forceful waves; thus deposits on the shoreline will be few because the high energy waves pushed back the artifacts, such as bone harpoons, pottery, fish bone, mollusk shells, and other materials (personal communication, E. Ndiema: 6/28/14). Only pebbles and small rocks are found in high energy depositional settings, thus archaeologists would identify high energy waves in sediments that are coarse-grained. Low energy waves create thicker deposits as the low energy waves and slow currents release shells and other

materials in the sediment. Archaeologists would find artifacts on the surface of the sediment if past waves had low energy. Low energy lake environments were appealing to large mudfish and are similar to those hunted by modern people today.

ARCHAEOLOGICAL HISTORY OF BARBED BONE POINTS FROM THE EARLY HOLOCENE AT LAKE TURKANA

Previous archaeological research conducted by Robbins, Barthelme, Yellen, and K.M Stewart demonstrated that barbed harpoons are widespread in the shoreline context and also inland around Lake Turkana. The oldest barbed point dates to 9,100 +/- 300 B.P and is 16 cm long (Robbins 1975: 632). Lawrence Robbins suggested these bone implements found on top of lake sediments and with freshwater mollusks indicate they were used in “shallow-water wading or use of a boat” (Robbins 1975: 632). Most archaeological reports from around Lake Turkana say the bone points were used as harpoons. Robbins writes “it is possible that the deep notches on the bases of some of the larger Lake Rudolf [now named Lake Turkana] points may have fashioned for the purpose of securing harpoon lines” (Robbins 1975: 633). The relevant Holocene archaeological sites are distributed in arid and semiarid environments that are agreeable to survey (Yellen 1998: 176). The history of past Early Holocene archaeological sites and the conclusions made by the archaeologists who excavated these sites reveal information about bone harpoons in relation to what species of fish was hunted, fish procurement, and what material items such as pottery and lithics were associated with harpoons.

Before the 1960s, the Lake Turkana area was not well documented, but barbed bone points were found. On the north and southwestern side of Lake Turkana, bone harpoons were discovered at Nanaropus in the 1930s and Lothidok and Labur hills in 1959 (Robbins 2006: 73). In 1965, Lawrence Robbins found the site of Lothagam Hill, which was behind the Kerio River delta and seven miles from the shoreline of the lake (Robbins 2006: 74). Lothagam was a Later Stone Age (LSA) fishing site, which had over

two hundred barbed bone spear and harpoon points, undecorated pottery, fish bones, and fragmented remains of twenty-one human skeletons in burials. This became one of Africa's most bountiful sites for bone artifacts (Robbins 2006: 75). In 1969-70, Robbins worked in a large Early Holocene inlet between Lothagam and the Napedet Hills. Robbins found bone harpoons, but the significant find here was wavy line pottery found in Early Holocene lake sediments and dated to ca. 7960 +/- 140 BP (2006: 79). Also on the western side of the lake, Lowasera is a stratified site with a beach line of 70-80m above the current lake level. Yellen reports that in 1977, Phillipson's early units 11-7 produced bone apatite which radiocarbon dated between 9420 and 7735 BP. The assemblage with the bone points included microliths, fish, and riverine-related fauna, but did not have pottery or domesticated animals. Units 5-1, which are the upper levels, had the same materials as their lower sequence, but possessed pottery (Yellen 1998: 176).

Other archaeologists excavated on the eastern side of Lake Turkana and found information on how Early Holocene peoples adapted to the ancient beaches (Robbins 2006: 79). Barthelme discovered surface and in situ sites on the northeastern Turkana shoreline (Yellen 1998: 176). Two of his sites, GaJj11 and FxJj12, had shell radiocarbon dates and were in stratigraphic context on a 75-80m beach above modern lake levels. The two sites date to 8710 BP and 8394 BP and have barbed bone points and a lithic industry with microliths. GaJj11's fauna consist of mostly fish and some hippopotamus and crocodile bone. FxJj12 possessed a variety of land mammals (Yellen 1998: 177). It's important to note that Barthelme found thirty sites and his 1985 work associated wavy line pottery with deposits from the Early Holocene (Robbins 2006: 80).

Robbins believes boats traveling on the waterways allowed people to establish contact between groups. The evidence for his conclusion came from the Lothagam site, where a large bone harpoon was found in a deep-water lake deposit, which dated between 7000 to 8000 BP. Thus, it seems that this harpoon was lost by people using a boat. More evidence for Robbins' argument was a dugout canoe discovered near Lake Chad that dated to 8000 BP, suggesting that appropriate boat technology existed in sub-Saharan Africa at this time (Robbins 2006: 80). Also, Robbins thought the region would supply multiple and secure food resources like aquatic animals such as Nile perch and turtles. K.M. Stewart (1989) discovered the first people at Lake Turkana ate mostly Nile perch, but after the lake levels decreased, different kinds of fish appeared. Robbins (2006: 80) cites the work of Stewart (1989) as demonstrating that at Lake Turkana in the Early Holocene, the fishing adaptation was small hunting groups readily using the varied fishing resources on a seasonal rotation (Robbins 2006: 80). Robbins agrees people living in this enlarged and rich lakeside environment would move the wavy line pottery, bone harpoons, and the tradition of building cemeteries on the lake edge throughout the region (2006: 81). Therefore, Lake Turkana's environment could have influenced the setting for diffusion of the earliest African ceramic and bone harpoons (2006: 82).

AN ETHNOARCHAEOLOGICAL STUDY: LINKING MODERN LAKE TURKANA PEOPLES TO EARLY HOLOCENE FISHING TECHNIQUES AND DIET

Studies on modern people living around Lake Turkana aid archaeologists in understanding how people lived in the past. Purity Kiura (2005) studied food consumption of modern groups living on the east side of Lake Turkana to give a better portrayal of “subsistence strategies and diet of people believed to have occupied the region during the last 10,000 years” (Kiura 2005: ii). To find answers, Kiura did interviews and everyday observations about peoples’ dietary decisions and recorded food waste from food processing and consumption activities. Next, Kiura analyzed hair samples from local people for “stable carbon and nitrogen isotope analysis to determine the food types consumed” (Kiura 2005: iii). From the animals Kiura’s test subjects ate, she ran isotope tests on the animals’ bones and teeth. The plants the animals ate were tested also (Kiura 2005: iii). Of course, these are modern people. However, the groups studied, Dassanech, Gabra, and El-molo “are not direct analogues for the Holocene peoples but do have diets similar to those proposed in the region by Barthelme” (1985) (Kiura 2005: ii). She concluded that even though the three groups all live in the same region, they did not have the same dietary behaviors (Kiura 2005: iii). Kiura writes the El-molo group’s diet consisted mostly of fish. Thus this group can provide information about how some groups 10,000 years ago may have fished in Lake Turkana and how they consumed aquatic species.

The El-molo

On the southeastern beaches of Lake Turkana, the El-Molo bay is home to a community of around 700 people (Kiura 2005: 81). The El-molo still keep and practice traditional customs of culture and “this community, therefore, retains aspects of a distant past of a world that today no longer exists” (Kiura 2005: 81). Yet, the community is not without outside influence as El-molo women are married off to other tribes because men from richer tribes can pay a bride price. Brides from other tribes are not common because the El-molo men are too poor to pay a bride price (Kiura 2005: 81). The way of life for the El-molo people was documented for the first time for the western world in the late 19th century (Kiura 2005:81). Kiura visited the El-molo in 2001 to see if these modern people had altered their subsistence strategies.

The El-molo Diet

While interviewing the El-molo, Kiura found out the El-molo people still “almost exclusively rely on fresh or dried fish for their food, although presently they are incorporating other foods that are provided to them by the government through relief agencies” (2005: 90). Yellow maize, soybean flour, cooking oil, and beans are the relief foods given to the community. When possible, the El-molo will eat crocodile, turtles, and hippos, but these are rare. Also, wild fruit is eaten seasonally and birds that live on the lakeshore are food. Some of the birds are pelicans and Egyptian geese (Kiura 2005: 91). Archaeologists know people in the Holocene consumed different species of fish, thus the diet of Early Holocene peoples may resemble the El-molo because both groups had access to mostly fish for subsistence. Multiple species of fish are caught in different

months in the year because the fish will migrate to different areas; thus, several fishing techniques are used in different zones of the lake.

The El-molo Fishing

Kiura writes the El-molo hunt fish by “harpooning, netting, and hooks on line” and in the late 19th century harpooning was the only technique used to hunt fish (2005: 91). Kiura notes when she was with the El-molo in September they caught Nile perch (*Lates niloticus*), catfish (*Ictalurus, I. punctatus*), mudfish (*Neochanna galaxiid*), and tigerfish (*Hyrocynus alestidae*). Kiura learned that several species, including catfish, squeaker, and Nile perch (*Bargus sp., Synodontis sp., and Lates sp.*, respectively) swim from inshore to offshore during the high waters from March to June. The most productive time to catch fish is in the dry season when the water is low and during the wet season as the water is receding from the shoreline (Kiura 2005: 92).

El-molo netting today is made from modern nylon thread. Men will make the nets and conduct repairs if damaged. Women no longer make the nets as they did in the past (Kiura 2005: 91-92). One way to use a net is to lay out the net in the water in the afternoon and leave the nets overnight. In the morning, the men get up at dawn and extract the nets from the water. The women will be waiting on the beaches as it is their role to help to extract the fish from the nets and clean them after the men come back on their fishing boats. The multiple El-molo fishing techniques shed light on the gender roles as well as how the techniques were used.

There are different forms of boats utilized by the El-molo. One kind of boat is the modern boat, which is given to the El-molo by non-government organizations. I observed modern boats when I went to see how the locals fished on Lake Turkana. The El-molo

local boats are rafts made from tree trunks such as a palm tree. The raft boats are not strong enough to hold a large amount of weight so only used for small fishing activities (Kiura 2005: 94).

Kiura writes, “crocodiles and hippos are hunted primarily using harpoons and they are normally attacked on land and not in the water” (2005: 94). El-molo men using harpoons are shown in figure 2 in the Appendix. Today, Sibloi National Park protects these animals from hunters, so crocodiles and hippos have moved north to the park (Kiura 2005: 94). It is unknown if men or women or adults or teenagers fished or made the bone harpoons in the Early Holocene, yet Kiura has included the roles of men and women during fishing activities. Therefore studying ethnographic reports of people’s behavior in the location of where Early Holocene peoples would have lived and fished may give some information about the past. The study on the El-molo contributes to my research because their identity comes from the resources they use and their environment. Hence their culture can tell me more about how bone harpoon style influences group identity.

ARCHAEOLOGICAL EVIDENCE OF FISHING AND BOAT USE FOR LAKE TURKANA

Ndiema et al. (2011) demonstrate that Holocene peoples were using watercraft as transportation to obtain obsidian on North Island; thus, they assume Holocene peoples also used watercraft for fishing. The island is located 25 km from the eastern shore of Lake Turkana and 18 km from the western shore (Ndiema et al. 2011:1085, 1092). The obsidian on North Island is accessible only by boat. This study is important to my research on bone harpoons because it represents another piece of evidence that people were using boats on Lake Turkana. Ndiema et al. found North Island obsidian on the eastern shore of Lake Turkana in Pastoral Neolithic archaeological sites. This discovery suggests the mid-Holocene peoples may have journeyed to the island frequently or “interacted with populations living on the island” (Ndiema et al. 2011).

In the Early Holocene, fisher/hunter-gatherers would probably hunt aquatic species on a seasonal basis. In the mid-Holocene, the lake levels lowered, but Stewart (1989) found the diversity of fish species increased. The mid-Holocene peoples were mobile and included multiple subsistence systems and procurement strategies as a result of having access to both aquatic resources and domestic stock (Ndiema et al 2011: 1086,1095). With Ndiema et al. finding North Island obsidian during the transitional mid-Holocene period, it seems that “fish may have been an important prehistoric resource throughout early-to-mid Holocene, and boat transportation may have been a significant means for mobility, resource procurement and exchange” (Ndiema et al. 2011: 1095).

THEORETICAL BACKGROUND ON STYLE

What is Style?

I will use the term “style” following Polly Wiessner’s definition. Wiessner proposed “there is a behavioral basis for much of the variation in material culture that has been called style by archaeologists” (Wiessner 1984: 191). This section will explain the theories about style in production of tools and craft items that I am applying to my analyses. Also, sources based on learning processes in craft production are presented to express how learning new tasks perpetuates style.

Understanding How Archaeologists can Study Style

The work of Polly Wiessner (1983, 1984), Kathryn Kamp (2001), Jill Minar and Patricia Crown (2001), and Jeffery Ferguson (2008) contributes background to study style in this prehistoric case for East Africa. Wiessner, Kamp, Minar, Crown, and Ferguson’s studies are not focused on the same prehistoric time period, but each case explains how behavior from a group of people influences the style of material items. First, Polly Wiessner’s ethnographic work with the Kalahari San of southern Africa demonstrates how San projectile points and beaded headbands carry social information in exchange systems using style. A projectile point’s formal attributes can tell others about group identification and group membership (Wiessner 1983, 1984). Wiessner explains that ethnographers can study style through direct observation of production. However, as an archaeologist, I studied the bone harpoons to understand style because I cannot study the behavior directly. Second, Minar and Crown focus their research on how craft workers learn. The learning process of craft production aids archaeologists in understanding the factors of continuity and change in material culture. Continuous or

changing learning structures affect style over time (Minar and Crown 2001). Third, Kathryn Kamp and Jeffery Ferguson want to know more about how children and novices learn; thus they studied the social, environmental, and economic factors that influence the making of material objects. I am not focusing on children, but the information that Kamp and Ferguson have found is a solid foundation on identifying types of instruction for craft production (Kamp 2001, Ferguson 2008).

Introducing Wiessner's Ethnographic Work

I used two ethnographic studies by Polly Wiessner. Wiessner's "Style and Social Information in Kalahari San Projectile Points" focuses on which characteristics of San projectile points transmit social information and "the correspondence between style in San projectile points and San organization" (Wiessner 1983: 253). Wiessner's study reveals how material objects can reflect the San's social structure and the role of the projectile points during intergroup interactions (Wiessner 1983: 253).

In her study on "Reconsidering the Behavioral Basis for Style: A Case Study among the Kalahari San" Wiessner "proposed that there is a behavioral basis for much, but not all, of the formal variation in material culture that has been called style by archaeologists" (Wiessner 1984: 190). Behavior can influence material variations as people compare their stylistic choices to others. This action is called stylistic behavior and happens "on the basic human cognitive process of identification via comparison" (Wiessner 1984: 190). A social and stylistic comparison directly affects stylistic development and change (Wiessner 1984: 190).

Both of Wiessner's studies were done in the field between 1973 and 1977. The groups studied were the !Kung, the Nharo, and G/wi, and the !Xo. All the groups were

located in eastern Botswana and northwestern Namibia in southern Africa. These different groups are hunter-gatherers, but “all Kalahari San supplement their hunting and gathering subsistence for at least part of the year with income from wage labor, sale of crafts, or occasionally small-scale agriculture” (Wiessner 1984: 195). I did not have the opportunity to interact and interview with the Early Holocene peoples as Wiessner did with the San peoples (Wiessner 1983: 253). The archaeological artifacts during my fieldwork will be my evidence.

Wiessner’s research shows how style influenced material culture through an ethnographic study on the San peoples. A concept I took from Wiessner’s study on beaded headbands is that features of style are influenced by “cultural and symbolic structures operative in society that define persons and groups as being comparable along certain dimensions” (1984: 204). An example of this is kindred membership. Among the Kalahari San, a woman will discuss a potential exchange with another friend or relative and think about the designs the other woman uses. She considers if the designs are beautiful, complex, or very simple (Wiessner 1984: 204). During her ethnographic study, Wiessner found that a large number of !Kung put effort into creating beautiful artifacts to make a positive personal image. The !Kung made elaborate and high quality objects for certain exchange partners whom they desired to impress. Women spent a good amount of time to achieve perfection for their craft items in hopes that exchange partners would reciprocate. Wiessner reported for 48 women “who gave a reason for investing stylistic effort in beadwork, 42 (88%) mentioned a desire to impress the opposite sex, 37 (77%) to promote reciprocal relations, 23 (48%) to gain self-satisfaction, and 17 (35%) to impress Bantu agriculturalists” (1984: 204). I believe I might find the same type of social and

stylistic comparisons in the Early Holocene. Like the San, the Early Holocene peoples were hunter-gatherers, crafted their own tools, lived in small, mobile, kin-based groups, and exchanged between other outside groups.

Ethnographic study among the !Kung, !Xo, and the Tshu-Khwe focused on their manufacture of arrows (Wiessner 1983: 253). Wiessner studies the arrows' stylistic attributes and manufacture because these factors transmit messages of social identity and social standing within a group structure. She explains how style affects the relationships between individuals and how it conveys messages through the organization (Wiessner 1983; 255).

Attributes on San projectile points carry social information and stylistic information such as manufacture time. Wiessner said "the greater the number of transformational stages an item goes through, the greater its chances of bearing social information, because each stage provides an opportunity to add social expression" (Wiessner 1983: 259). For Wiessner, this view is ideal for studying projectile points. I agree with Wiessner that it is important to find the factors that influence stylistic investment whether it is morphological or design differences (Wiessner 1983: 259). For the San peoples, to find the material items that influence stylistic investment, Wiessner "plotted according to type and frequency of stylistic content by manufacturing time and useful lifetime" (Wiessner 1983: 259). The manufacture time and useful lifetime are both factors that give archaeologists information about style (Wiessner 1983: 260). Wiessner writes that messages would reach more people if the item had a long lifetime. Other factors that affect the stylistic content are measured in two ways. First, if an item did or did not change in "type or form over space." Second, if the item had any decoration such

as engraving, carving, or beadwork, and if the item's decoration decreased or increased over time or space contributes to the measurement (Wiessner 1983: 260).

The San people threw away items such as stirring sticks and hammerstones immediately after use because these items were not needed. These easily discarded items had minimal stylistic content and only took minutes to manufacture so are easily thrown away (Wiessner 1983: 260). In contrast, Wiessner observed items which "took a number of hours to manufacture and that were kept for a year or more-spears, knives, clubs, awls, musical instruments-showed considerable variation in their forms" (1983: 260). Also, items that could be seen by others were more decorated. Some of these items are bone pipes, beaded handbags, and clothing. Wiessner discussed two exceptions that were not congruent with the above relationships. The two exceptions are: (1) "items that took a long time to manufacture but had little stylistic content because of limitations imposed by materials and/or function-carrying nets, dance rattles made of cocoons;" or (2) items that were hastily manufactured yet still expressed an emblematic style as they were part of group identity or represent a religious object such as oracle discs and arrows (Wiessner 1983: 260). Wiessner concludes that artifacts, which have strong emblems, are important to social identity. Wiessner focused on the arrow because San projectile points created many styles yet have a short manufacture time and short useful lifetime (1983: 260).

Arrow points can contain style markers that identify them to a certain group. Wiessner found among the !Kung, G/wi, and !Xo language groups in her case study, each group could pick out the stylistic differences that were not theirs and from other groups. Wiessner ran *T*-tests "on all variables and chi-square tests on all attributes" in order to compare G/wi and !Xo points (1983: 267). Significant differences between these two

groups' points appear in tip, body, and base shape. The point's attributes are stylistically distinct for each language group and "readily observable and discretely distributed within their group boundaries" (Wiessner 1983: 268).

Wiessner also had the opportunity to observe linguistic groups interacting in places where bow and arrows are still used by the local people. At one of these places, the G/wi and !Xo live about 5-25 km apart and exchange arrows with each other. Each group has their own style of arrows. Wiessner reports that three !Xo informants claimed the G/wi arrows were sharper and better when answering for the reasons they liked to get the other group's arrows. These informants said the reason they did not make arrows sharper is because they are !Xo and do not know how to make them. Wiessner explains "since G/wi and !Xo engage in important exchanges of meat and skin for access to water and store-bought goods, this stylistic difference may help maintain formal relations and thus promote smoother interaction" (1983: 268). Hunters from the different groups went back to their region to hunt and continued to use their own group's style even though the groups have consistent interaction (Wiessner 1983: 269). As with San projectile points, the different linguistic groups recognize each other's style, so the style of the arrow point reflects the group identity.

Relating Wiessner's Work to Research Questions

For this set of data I have collected in the northeastern region of Lake Turkana, I want to answer the questions: does group membership influence the manufacture of Early Holocene bone harpoons in East Africa? And does Early Holocene bone harpoon style serve as a marker of group and personal identity in East Africa? Wiessner explores how stylistic behavior is transmitting information about social identity. The Early Holocene

people might have gained information about others within their group or outside of it by looking at the style of individual bone harpoons and seeing if the designs are similar or different to their own. Similarities and differences of style will reflect not only identity but also social relationships. Stylistic similarities and differences can alter, disrupt, or create social relationships. This idea that stylistic choices influence social choices such as personal identity and/or group membership applies to my research questions. For instance if an Early Holocene hunter-gatherer copied the style of others from his group, then the hunter-gatherers' style might hide differences and express unity. Or a hunter-gatherer could borrow a few style elements from another and in turn express solidarity (Wiessner 1984: 194). Early Holocene peoples might have had social and/or economic reasons for copying a style or creating new ones, and then a new style could alter the group's identity. When Wiessner asked the San men's reasons for giving stylistic investment for arrow making, their reasons were similar to the women's, but it is interesting to note that 12 hunters said they put stylistic effort into arrow making "because others do" (Wiessner 1984: 204). Using Wiessner's ideas on stylistic behavior and identity, I can look at my bone harpoon data set to determine if group membership influences the production of bone harpoons or if bone harpoon style reveals personal or group identity.

Learning and Craft Production

Minar and Crown

Now I will move in a slightly new direction, which focuses on work by Jill Minar and Patricia Crown about learning and craft production. Information about the process of teaching and learning skills can help archaeologists understand continuity and change in material culture (Minar and Crown 2001: 369). In their introduction, these archaeologists

explore cases where “learning appears to affect the production and distribution of material culture attributes” (Minar and Crown 2001: 369). Craft traditions are passed down to the next generation, yet Minar and Crown write that archaeologists often do not know how either adults in the community or newcomers or children learn knowledge and skill (Minar and Crown 2001:370). Nor do archaeologists know why or how traditional designs or structure altered over time. What caused the change in technology? A suggestion could be an error in the passage of knowledge or that the community of crafters found a more favorable style (Minar and Crown 2001:370). Also, different learning structures could affect preservation or change in form, technology, or design over time. Minar and Crown review the leading theoretical perspectives on learning and may apply to the learning process of Early Holocene peoples (Minar and Crown 2001:370- 371).

Kamp and Ferguson

Kamp’s (2001) and Ferguson’s (2008) information about how children and novices learn aids my research by contributing to the understanding of how the learning process for making bone harpoons worked in the Early Holocene. Kathryn Kamp’s research on the archaeology of childhood overlaps into my research because the process of learning a craft influences style, subsistence strategies, social organization, population growth, and culture change (2001: 1). The age of a child determines when a skill set is started, but the type of instruction also varies and will not be the same in each prehistoric culture (Kamp 2001: 12). In work or play activities, a learning environment can form to help children gain a new skill. Kamp declares archaeologists have not done research on

learning situations for children as cultural anthropologists, educators, and psychologists have done (2001: 13).

The process of identifying inexpert workmanship can help in recognizing children and novices in the archaeological record, but Jeffery Ferguson takes the study further as he focuses separately on craft skill acquisition by novices and children visible in archaeological assemblages. Ferguson argues that archaeologists do not put enough importance on the factors that “are involved in incorporating new producers into craft production” (2008: 51). In his paper, Ferguson discusses patterns that allow us to recognize the difference between novices and children, and gives six factors which affect whether adults will let children begin their training and practice in craft production (Ferguson 2008: 52). Lastly, Ferguson does his own experiment that points towards scaffolding as the best teaching method for novices to acquire a new skill. Scaffolding is a teaching method in which the teacher is with the student for each new step in learning a skill. Ferguson’s work is applicable because his paper provides insight into how to find traces of novices and children in the archaeological record. He argues certain teaching methods, such as scaffolding, will lessen variability. Thus, traditional designs may survive over time and space (Ferguson 2008: 52)

Looking at teaching methods will provide more information about craft manufacture of bone harpoons, which is a factor that influences style. In Ferguson’s own experiments teaching the manufacture of stone tools, he split his experimental population into two groups. One group is only instructed verbally and the other by scaffolding. Ferguson said of the scaffolding group that by the end of the project, students could achieve advanced flake removals (Ferguson 2008: 52). By studying the learning process,

archaeologists might also find explanations for factors that influence craft production such as social and economic motivation (Ferguson 2008: 53).

Certain aspects of production can leave archaeological signatures. Later in this paper, I will discuss each of these six factors with reference to the bone harpoons under discussion. These factors are: “(1) raw material access, (2) raw material value, (3) raw material recyclability, (4) dangers associated with craft production, (5) individual physical and mental development, and (6) social/contextual factors” (Ferguson 2008: 52). Ferguson studies these factors in relation to stone tool production, but I will focus on bone since harpoons are made from this raw material. Raw material access and value in stone tool production affect the age and methods of teaching children the knapping skill. For example, waste material was only given to apprentice gunflint knappers to practice. Ferguson writes “although the flint was plentiful, it required elaborate quarrying procedures, and the resulting value of the material was high enough to prohibit wasteful experimentation by unskilled knappers” (Ferguson 2008: 53). Yet when the raw material is low in value and the materials are not scarce, but plentiful, children are allowed to experiment. I believe raw material access and raw material value can impact the manufacture of bone harpoons. Access to the raw materials that make a harpoon will affect how many are made. Children would use adult techniques and the same tools in areas of low-cost raw materials, but the artifacts found by archaeologists might not have been fixed by skilled knappers and will show evidence of physical and mental mistakes. Yet, Ferguson believes “the inverse should occur in cases of rare or valuable raw material, in which novice experimentation is unsanctioned and novice instruction occurs in a context of scaffolding to reduce the loss of raw material” (2008: 54).

As raw materials will cause different production and recycling techniques, a child's development may depend on multiple social, mental, and physical factors. Children develop at different mental speeds so Ferguson says, "the participation of a child in an informal lithic apprenticeship may have been based more on the child's individual development than on a specific calendar age" (2008: 55). The technological organization of a group can influence what time a child would start an apprenticeship. Also, the teacher's age and gender will affect when the child begins to learn. Lastly, the role of play will help a child grasp the knapping skill. Smith's (2005) study declares children at least 15 months old will play with objects that help them develop the skills for future knapping (Ferguson 2008: 56). In my own case, I think the issues above apply as the novices will have to practice a fair amount in order to achieve the skill to make a harpoon. Overall, many cultural factors play a role in when a child will start learning a craft and there can be many different archaeological traces which indicate a novice.

SHACKLEY BRINGS STYLE, IDENTITY, AND LEARNING TOGETHER IN THE CASE OF WHETHER OR NOT ISHI WAS A YAHY

In 2000 Shackley looked at how the attributes on projectile points can be studied to find out a person's ethnicity and stylistic choices (Shackley 2000: 693). Shackley's work connects with Wiessner's ideas about style because Ishi's identity can be revealed through his arrow points. Also, the way Ishi learned about stone tool production influenced his style choices. This article opens up more discussion on how style and learning of craft production can be determined and understood. As "a member of the Yahi/Yana hunter-gatherer group of north central California;" Ishi was discovered in Oroville, California in 1911 and taken in by the Museum of Anthropology at the University of California, Berkeley (Shackley 2000:695). Shackley wrote of Ishi: "before his death he provided one of the most complete (and uninfluenced) informant- born cultural records of any hunter-gatherer group in North America" (2000: 695). While at the museum, Ishi made a few different forms of projectile points using obsidian or glass (Shackley 2000: 700). In order to find out if Ishi's projectile points are traditional Yahi, Shackley looked at two sites that were excavated in Southern Yana and Yahi Territory. Glass arrow points and flaked glass were found at both sites that are called Kingsley Cave and Payne's Cave. The Kingsley Cave and Payne's Cave upper portions are "late prehistoric if not protohistoric occupations" (Shackley 2000: 702). Yet, these Yahi projectile points do not match Ishi's points.

Next, Shackley decided to look at a protohistoric site that is nearby the ancestral Yana sites, but this site is identified as ethnically Wintu or Nomlaki. The site is called the Blue Tent Creek Site and located "north along the Sacramento River from Yahi territory

near Red Bluff” (Shackley 2000: 704). Occupation dates between A.D 1800 and 1850. Shackley notes this Wintu/Nomlaki site is of that same period as the two sites, Kingsley Cave and Payne’s Cave, which is in the time range when Ishi was born (200: 704). After comparing the Blue Tent Creek’s Desert Side-notched points to Ishi’s points, Shackley found that Ishi’s points are the same as the Desert-Side-notched points (Shackley 2000: 704). This is important because it raises the question: why would Ishi use stylistic designs from another group?

In conclusion, Shackley questions why Ishi’s style of projectile points do not match the group Ishi identified with, but match the Wintu/Nomlaki Desert Side-notched, Redding subtype. Ishi said the men who made the stone tools would do it in a group, preferably in a warm sunny place. Thus, the Yani and Wintu/Nomlaki point style may have become standardized as men produced arrows together. The men could then recognize a Yahi point style over a Wintu/Nomlaki style (Shackley 2000:707) Yet, this discovery does not make Ishi not Yahi because “Sapir’s linguistic analysis of Ishi’s spoken language, as well as published references by other trained anthropologists, suggest that he considered himself a Yahi” (Shackley 200: 707-708). Historically, the proto-Yana had hostile relations with the Penutian speaking groups who became the ancestors of the Maidu and the Wintu/Nomlaki. In the historic period, scholars believe the Yahi were friendly with the Wintu/ Nomlaki in lower Deer Creek, but not with the Maidu peoples (Shackley 2000: 708). Shackley writes, “this circumstance could certainly have included the Wintu/Nomlaki group that lived at the nearby Blue Tent Creek site, and this amity relationship could explain the presence of the Wintu type Desert- Side-notched point at Kingsley Cave” (2000: 708). The Yahi raided the Maidu sites and took

their women and children, thus this action sets up a few scenarios. One of these could be Ishi was a Maidu and was incorporated into the Yahi society. Ishi could have learned style from a Wintu father figure. Shackley wrote “What emerges from these historical details and archaeological inference is a picture of an amalgam culture by the early-to mid nineteenth century, where a Wintu/Nomlaki-Yahi boy learned to produce projectile points as a Wintu/Nomlaki but lived the life of a Yahi in the Lassen foothills until no more Yahi remained” (2000: 709). This article shows how learning stone tool production can influence style and how social disruptions and social organization dictates how style, identity, and learning is transmitted.

Shackley presents theories on style, learning, and identity, which provide insight to answering my study’s three research questions. The manufacture of stone tools provides a setting for group membership and for training novices. Ishi reveals how the men would gather together and make stone tools; therefore the craft workers were influenced by each other’s styles. This group membership may produce a standardized point style. The Early Holocene peoples could have likely made their bone harpoons in a similar setting. Ferguson’s scaffolding method may also apply if men are working together in the same area. Teachers could give the novices instruction while they worked on their own stone tools or bone harpoon.

EXPERIMENTAL HARPOON MANUFACTURE

Before continuing with the analysis of these Early Holocene bone harpoons, I will discuss a project conducted at the Koobi Fora field school to experimentally produce a harpoon. An experimental archaeologist and U. of Georgia Ph.D. candidate Russell Cutts and I did an experiment in which we learned how to make a bone harpoon. In doing this experiment, I hoped to gain an understanding of harpoon manufacture to enhance my analysis and to identify decision-making moments in the process.

Today, archaeologists do not know which species was used to make Rift Valley harpoons. Conversations with local archaeologists suggested small to medium mammals were used (although the bones might come from a large fish). Thus the species utilized to make bone harpoons may be about the size of a modern goat or sheep (Personal Communication, Russell Cutts: 7/7/2014 and 10/16/14). Russell and I chose a goat and obtained one from the local Dassanech people in Ileret. Cutts writes, “Previous experience with paleolithic bone-working technology suggested the metacarpal as a fairly straight bone, easy to split, with mostly uniform thickness throughout the shaft” (personal communication, Russell Cutts, 10/16/14). The following table summarizes the decision-making process that was suggested by this experiment.

Table 1: Replication experiment for a bone harpoon (p. 28-31)

Order of steps	Action	Decision made in experiments	Possible alternate decisions	Outcome
Step 1	To pick a species	Choose a goat. Why: archaeologists believe small to medium	-Other species Zebra Dikdik Crocodile	Bone size: small to medium

		animals were used and the modern goat fits the size requirement.	Types of fish	
Step 2	Catching the prey	The local Dassanech tribe gave the field school a goat, which they had butchered for us.	-hunt, trap, or scavenge to get the animal. Or if the harpoon was made from fish bone, Early Holocene people may have used nets.	Bone to make a harpoon
Step 3	Remove skin from one of the goat's forelimbs	Opted to use our hands and an unmodified knapped flake of chalcedony to cut skin off the goat	-Different raw materials such as chert, quartz, or bone. -Use a flake tool or a awl to pierce/slice the skin -use a handheld scraper to remove the skin	Skinless goat forelimb
Step 4	Break up the joints to get the metacarpal	Disassemble the joints with unmodified knapped flake of chalcedony	-use a blade or flake tool -break with bare hands	A free metacarpal

Step 5	Select size of body of harpoon	Determine how slender or thick. I choose slender.	The body size depends on the species of fish or mammal being used to make a harpoon or depends on makers preference for size/shape. If using a species of fish then the body of harpoon could be already slender.	Size for the body of harpoon decided.
Step 6	To cut a lengthwise line on the front and back of the metacarpal	Elected to cut in “the natural metacarpal groove” on the bone with the same flake, but now slightly altered due to serrated retouch.	-Scraping a groove into bone to score a line on metacarpal -a medium nodule of stone with a pointed tip to scrape a line along the bone	Now the metacarpal has a cut to help with the splitting process
Step 7	Splitting the metacarpal	Selected an anvil, which was a wedge-shaped cobble-spall. Selected a hammerstone. Then tapped the hammerstone on the anvil to split the	-Use a cleaver and split the bone with a chopping motion. -Or use a wedge.	Two equal pieces of metacarpal

		metacarpal along top to bottom into two pieces.		
Step 8	Selected a tool to take out marrow. Bones are mostly hollow, but contain sponge-like marrow.	Picked a twig to take out marrow	-use a scraper or flake tool to remove marrow -cook/boil	Bone free of marrow
Step 9	Need to shave the pieces of metacarpal	Used a flake and a rough basalt slab to grind down the pieces of metacarpal. Scraped the bone hard and in all directions.	-could use your stone tool and hammerstone to refine the blank before grinding on basalt slab.	This process shaped the bone into a harpoon blank.

Concluding Thoughts about the Replication Experiment

The experiment greatly contributed to my study as I saw how each step during my learning process can lead to different styles. After the replication experiment, I realized the Ileret bone harpoon assemblage represents many small decisions made by prehistoric peoples. Then their signature, which is the style, is left on the artifact. Also scars and manufacture marks left on the artifact will reflect the decision process. Russell Cutts guided me through each step in the process of making a bone harpoon. Prehistoric

peoples may have learned in a similar way in which each step is taught from other members of the group. Different stylistic elements happen because of a decision in the manufacture process. These decisions are influenced by how the prehistoric person learned to make the craft item. Not all bone harpoons will be made the same way because not all groups of people teach a task the same way or used the same tools or raw materials.

When making decisions during the manufacture process, choices will be made not only about style but also about raw materials. Russell Cutts and I successfully used an unmodified knapped flake of chalcedony to cut the goat. The same lithics such as chert, chalcedony, basalt, and quartz were found in Early Holocene sites, along with harpoons. Therefore, this could indicate flint knapping was done on the shoreline, and East Lake Turkana people were using local lithic sources, possibly using the North Island obsidian source also. Blades and flakes of chert and chalcedony are potential evidence that stone tools were being made on site and potentially used for gutting fish, mammals, and other cutting activities, such as harpoon manufacture.

DATA GATHERING

Field Data

The Holocene research team at Koobi Fora conducted surface survey transects through the Early Holocene sediments for the 2014 field season. The Holocene research team consisted of the following individuals: Dr. Emmanuel Ndiema (Koobi Fora Field School-co-director), Dr. Carolyn Dillian (Holocene Team co-director), Rahab Kinyanjui, Charles Murithi, Robin Humphreys, and myself. We did a judgmental survey in which the group only surveyed exposed Holocene sediments. First, on June 27, 2014 the group and I did a cross transect towards the southeast Middle Holocene deposits. We did this preliminary cross sectional survey before moving on to the high lake stands of the Early Holocene deposits, which is the focus of the group's goals as we are looking at the social and environmental interactions evident through artifacts such as obsidian, pottery, and bone harpoons. The purpose of the preliminary cross sectional transect focused on revealing the differences between the earlier fisher/hunter-gatherers in the Early Holocene (10,000 – 6,000 BP) and pastoralists' sites of the Middle Holocene (6000 - 3000 BP). We did not find any bone harpoons in the Middle Holocene sediment areas.

The next day, we began surface survey of the Early Holocene Galana Boi bed sediments. The group walked in a semi-straight line and looked for wavy line pottery, bone harpoons, fauna, or lithics such as obsidian. These items helped locate relevant sites to answer the Holocene research team's main objectives, which are to discover Early Holocene people's behavior in their environment and how the environment influenced their economic manufacture. At the start of a new transect, Dr. Ndiema or Rahab Kinyanjui would take the GPS coordinates from the handheld Garmin GPS Map 625 then

we began our survey. Once one of my group members found an artifact, everyone stops and spreads out to look in the area where the artifact was found. Pin flags were used to mark an artifact. After all artifacts are marked, two other students and I used the GPS to get coordinates of each artifact. Appendix A, figure 3 has a map of the Early Holocene transects that my group surveyed.

Ileret Bone Harpoon Site 1

On June 28, 2014, the Holocene team found a locale that we labeled Ileret Bone Harpoon Site 1 on a high lake stand in Early Holocene sediments. Seventeen bone harpoons were discovered on the surface and one was found in test pit excavations. Each bone harpoon had GPS coordinates recorded. On June 30th, test pit excavations began at Ileret. First, the team recorded three data points with the total station as permanent mapping points. Next, we set up a 1 x 1 m test pit and excavated in 10-cm spits. For test pit #1, the excavation has halted at 40 cm depth and 30 cm for test pit #2 when we got to sterile layers.

The two test pits for Ileret Bone Harpoon Site 1 were analyzed at camp on July 5, 2014. The sieve bags were put into groups by spit and depth. Lithics and fauna were broken up into groups and identified. For lithics, raw material was identified as chert, chalcedony, basalt, or quartz. In each category, we counted how many flakes, blades, angular fragments, and total amount. Fauna consisted of three categories, which were unidentifiable, mammal, and fish. Total fauna were also calculated. For catfish, twelve bones were found in test pit #1 and eleven in test pit #2.

The environment for Ileret Bone Harpoon Site 1 (IBHS1) was an Early Holocene high lake stand on a remnant beach 80 m above modern lake levels (Personal

communication, E. Ndiema: 6/28/14). The sediment had settled and consisted of coarse gravel and sand. Fish bone such as catfish, crocodile tooth, and shells were found on the surface. In the Early Holocene, the environment would be humid and warm, but when the group and I excavated the climate was windy and hot. The sediment for test pits #1 and #2 had coarse gravel and sand on top, then calcium carbonates as we hit depths of 30 cm.

Ileret Bone Harpoon Site 2

Another archaeological site was discovered on July 2, 2014. Ileret Bone Harpoon Site 2 is within the Early Holocene Galana Boi beds, which had high erosion that affected the context of the site. The stratigraphic layers eroded in a downward slope, thus the artifacts found are not *in situ* and were mixed from different time periods and layers. Therefore, the high variability of bone harpoons may have been caused by erosion mixing multiple occupations and, therefore, styles in one site. The surface collection of undecorated pottery, bone harpoons, chert, chalcedony, and ignimbrite potentially comes from multiple stratigraphic levels. Multiple social groups who manufactured stone tools, pottery, and bone harpoons in a different way are perhaps mixed together in one site. No excavations were conducted and all materials were from surface contexts.

FIELD ANALYSES

Attribute categories, artifact measurements, and photographs were taken during the 2014 Koobi Fora Field School. The first step was to identify relevant attributes on harpoons with the aid of my project group. John Yellen is the only archaeologist who has published on African bone points and put them into a typology (1998), though other scholars are currently conducting research on these artifacts (including Lori Dibble, Rutgers University). Yellen created a typology so he could categorize the bone harpoons found from African sites. Yellen discussed eight attributes that are found on bone harpoons (1998: 182). These influenced my own decisions about which attributes to focus on. My set of attributes differs moderately from Yellen's and fits my set of data, but the features listed in Yellen's typology are a great reference as his descriptions can be used as guidelines for my research. To begin explaining the bone harpoons, I started to create names for features on the bone harpoons. Once I began to measure them, I sorted the harpoon styles and features into types. To best see my descriptions see table 2 in the appendix.

Ileret Bone Harpoon Site 1: Bone Harpoon Findings

Within the site, 18 uniserial bone harpoons were found. All 18 had straight barbs and all had type 1 haft with carved cuts. The only difference showed up in the number of cuts making up the type 1 haft, as some harpoons had 1, 2, or 3. All harpoons were weathered and fragmented to an extent, so barb, tip, base, or body was broken. Bone harpoon #11 was unique as it had a different form. Bone harpoon #11's body had rounded edges down its length on one side. The rounded edge may be used for cutting. I believe that #11 was used to cut the scales from fish or used as a knife to cut items such as leather, and it may in fact not be a harpoon at all because the rounded edges down its

length do not look like the shape of a barb that would be used to strike into the skin of a fish.

Ileret Bone Harpoon Site 2: Bone Harpoon Findings

Five bone harpoons were found within this site. They fall into several distinctive types. Bone harpoons #1 and #5 had straight barbs. Bone harpoon #1 has type 1 haft and 2 carved cuts. Bone harpoon #3 had barbs that were hooked. Bone harpoon #4 was the only harpoon that had a type 3 haft, which means the body had opposing hook hafts. Bone harpoon #2 was too weathered to tell the barb shape as the barbs are now rounded edges. Bone harpoons #2, #3, and #5 do not have a haft. All are broken either at top, body, or base.

FURTHER INVESTIGATION: USING STATISTICAL RESULTS
OF THE BONE HARPOONS AND
THEORETICAL PERSPECTIVES
TO APPLY TO RESEARCH QUESTIONS

In the subsequent sections, I will do several basic statistical analyses on the attributes of the bone harpoons. The statistical analyses provide an understanding into the amount of similarity and/or variation within an assemblage. I will use the statistical analyses and the experimental reproduction of a harpoon to discuss the manufacture and the style of the harpoons from East Lake Turkana in reference to several insights from Wiessner, Ferguson, Shackley, and Yellen. I will apply the following theoretical perspectives about learning, identity, and objects to my set of artifacts and research questions.

1. Factors that influence style are group membership, manufacture of objects, and hunter-gatherer cultural identity (Shackley 2000 and Wiessner 1983).
2. If the raw material is more common, then it's possible the novices will be allowed to experiment with the manufacture of an item (Ferguson 2008).
3. The teaching method called scaffolding provides a setting where novices can be integrated into the craft production. Then the novices learn their culture's methods of production and the style is reflected in the product (Ferguson 2008).
4. Stylistic choices are influenced by behavior. People associate their way of manufacturing and/or decorating objects to others and decide to imitate, ignore, or comment on how the maker or bearer links to their own personal and social identities (Wiessner 1984).

5. The more steps needed to produce an object, the greater possibly the object will bear social information and symbolize social identity (Wiessner 1983).

Statistical Analyses

In order to find similarities and differences in Early Holocene bone harpoon morphology and manufacture, I ran statistical analysis for the barbs on bone harpoons found in Ileret. I used a Student *T* Test on two samples, one from Site 1 and one from Site 2. A *T* Test “enables us to pool all the information from both samples into a single statement of the probability that both could be selected from the same population” (Drennan 2010: 153). For the *T* Tests, I found two different ways to analyze the barbs on the bone harpoons. I ran the first test that would compare only the first barb, which would be the barb closest to the haft. There was no statistically significant difference between the two sites at the $p < .05$ level when calculating barb length, barb spacing, and barb divergence (see Table 6 in Appendix for vocabulary). That is, the harpoons from the two sites likely came from a single population of artifacts. In other words, there were no differences statistically between harpoon barbs from the analyzed sites.

For the second test, we used measurements for all the barbs for each harpoon at each of the two sites. In the outcome of the second test, barb length and barb spacing are significantly different at $p < .05$ when all barbs are included. Barb divergence is not statistically different. However, for the second test, some of the harpoons are contributing more than one data point. For the 2-tailed t-test of barb length, using all barbs means some lengths are counted twice for one harpoon as one harpoon may have multiple barbs of the same length. Thus, the test counting the first barb only is more accurate; therefore the test that used data from only the first barb will be applied to my

research questions. In the Appendix, Tables 3, 4, and 5 show the results for the statistical tests.

In conclusion, I am stating that the two sites are statistically indistinguishable based on the results of a *T* Test using measurements of the first barb. For the two sites, the barb length, barb spacing, and barb divergence were not statistically different at the $p < .05$ level.

Results

Question #1: Does Group Membership influence the Manufacture of Early Holocene Bone Harpoons in East Africa?

The statistical test of the first barb measurement data indicated no statistically significant difference between the two Ileret bone harpoon sites with reference to width, thickness, barb length, barb spacing, and barb divergence. This suggests that the people who manufactured these objects shared ideas about the proper form for a bone harpoon. People in the area were all making uniserially barbed harpoons. There seems to be a uniform manufacture method. The shapes of the barbs for IBHS 1 are all straight. For the haft style all harpoons are type 1 haft with carved cuts. Also, from IBHS 2, two bone harpoons had straight barbs and bone harpoon # 1 had type 1 haft (see Table 2 in Appendix for pictures of the body, barbs, and haft styles). Because of the consistent form, I am inclined to believe that the fishermen and women were making the bone harpoons in a group setting within each site and most likely shared ideas.

Group membership could possibly influence the manufacture of different tools and other objects. In order to acquire raw materials and produce the object, these bone harpoons required many stages of production, which presents a solid case for group

identity to influence the manufacturing of these bone harpoons. As Wiessner has suggested with the Kalahari San, items that demand many steps and decisions of manufacture often reflect group and/or individual identity. Group interactions influenced their manufacture (Wiessner 1983:260). Novices and young unskilled members of the group are taught to make objects a certain way and use the same designs as their teachers. My experimental archaeology project demonstrated the numerous decision points in producing a bone harpoon. After completing the stages of production, the identity is reflected in the manufacture. The teaching method “scaffolding” will impact group identity because the teacher will verbally and physically show the steps of manufacture, thus with each step the style of the object begins to be taught to the young ones. So group interaction will influence the manufacture then the style of the object will reflect the group identity.

Shackley’s (2000) study to find out Ishi’s identity by looking at his projectile points and comparing them to hunter-gatherer groups of north central California is similar to my study. Shackley’s work can help lead to concluding ideas about group learning, manufacture, and identity. When making stone tools, Ishi said the men would gather together in a group. Shackley writes the arrow points may have become standardized due to the men producing arrows at the same time (Shackley 2000). This is congruent with how Wiessner describes San women choosing bead designs, as the women will discuss designs with each other and talk about the level of skill expressed in the beadwork. The men would have discussed style and what design worked the best.

Since Early Holocene bone harpoons from IBHS 1 are the same in barb style and haft styles, I think group membership influenced the harpoon manufacture as the style

was standardized for my sample. As the results show in IBHS 1, members seem to have agreed that straight barbs, incised haft, and uniserial barbs were the most efficient way to catch aquatic animals. Also, the chert, chalcedony, basalt, and quartz from the IBHS 1 test pits indicate flint knapping was done on the site and East Lake Turkana people were using lithic sources from the riverbeds. Blades and flakes of chert and chalcedony are evidence that stone tools were being made on site and potentially used for gutting fish, mammals, and other cutting activities. All these activities were done on the lakeshore and illustrate group activity.

Since my bone harpoon data set focuses on a small area in the Eastern side of Lake Turkana, Yellen's (1998) work gives a broader view of harpoon style variation in the region of Lake Turkana as well as the whole of Africa. My East African harpoons differ from the range of variation that has been documented for these artifact types elsewhere in East Africa. Yellen found barbed bone points from sites ca. 10,000 BP and younger were found spread out from the Sahara Desert, the Sahel, the Nile, and the East African lakes. Yellen wrote, "typologically these points exhibit sufficient similarity in form and method of manufacture to be subsumed within a single African "tradition," yet there was typological regional variation" (Yellen 1998: 174). For example, Yellen reports the Holocene points are mostly uniserial, but for sites in the Northeast Turkana, barbed points may be uniserial (Fig. 4,7), biserial (Fig. 4, 2), or triserial (Fig. 4, 1). Barbed points also differ a little when comparing the East African and West African regions (Yellen 1998: 183). In West Africa from the site Araouane, the proximal most barbs can be set back as shown in (Fig 6, 23) or the barbs can form part of the tip and the barb's form is hooked. In East Africa, the barb's form is straight-sided as found from the site GaJj11

(Fig. 4,7). In the western region the distal barb will be located either close to the butt (Fig 4, 6) or as seen in Egypt away from the butt (Fig 5, 12) (Yellen 1998: 183). This variation suggests that group membership in different regions did influence manufacture. The Ileret bone harpoons from both sites are very similar to each other, and when placed within Yellen's larger context, this is even more apparent. This means that group membership and/or cultural identity plays a significant role in the manufacture of bone harpoons.

Question #2: Are Learning and Teaching Practices visible through Style in Early Holocene Bone Harpoons?

My replication experiment greatly aided my search in finding how the learning process for making bone harpoons worked in the Early Holocene. My experimental work and ethnoarchaeological studies gave me insight into the learning process of bone harpoons because learning and teaching practices are not directly visible in the Early Holocene points. Indeed, the teaching process influenced the steps I took during manufacture, which influenced the style of the product. I discovered the teaching method of scaffolding is similar to the way Cutts taught me during the experiment. The scaffolding method is hands-on to aid students in developing proper techniques; thus, at the end of teaching, the students can independently do the task. This teaching method creates an environment that allows the novices and children to be incorporated into craft production (Ferguson 2008: 52).

Ferguson's six factors that impact the learning process can also be applied to the Early Holocene. Since Early Holocene fisher/hunter-gatherers were mobile, they probably had access to different types of lithics. At IBHS 1, lithics such as chert, chalcedony, basalt, and quartz were found, along with harpoons. Therefore when raw

material such as bone is low in value and the materials are not scarce, then children and novices are likely allowed to experiment. As for raw material recycling techniques, stone tools such as hammerstones and flakes can be reused thus the skilled knappers may have given novices old tools to begin training. During my replication experiment, I used an unmodified knapped flake of chalcedony, so if the raw materials are plentiful then Early Holocene novices maybe were able to work along side their teachers as they made new bone harpoons. Social and contextual factors such as time, energy, and space are important when considering the learning process for hunter-gatherers. At IBHS 1, there was evidence that knapping may have been done on the shoreline. The fisher/hunter-gatherers might have made new bone harpoons or fixed a harpoon near where they hunted for fish.

Question #3: Does Early Holocene Bone Harpoon Style serve as a Marker of Group and Personal Identity in East Africa?

Yes, bone harpoon style reveals group and personal identity, yet the evidence leans for group identity as a marker and not personal/individual identity. First, I will discuss how Wiessner's (1983,1984) work helps answer the question of finding how style serves as a marker of group and personal identity. Then I will show how the statistics of the two Early Holocene sites demonstrates how bone harpoon style reveals group identity. I found that the bone harpoons represent identity in that people in the same area all do the same kinds of things with the same kind of resources available. Thus, I am looking at identity more broadly. Lastly, I will explain how other factors such as learning and teaching and species of fish can assist bone harpoons in being markers of identity.

Does bone harpoon style serve as a marker of group and personal identity? After comparing the lowermost barb only for each harpoon at each site, there was no statistically significant difference between the two sites at the $p < .05$ level. Also, when width, thickness, barb length, barb spacing, and barb divergence are measured there was no difference statistically between the two sites. The distance between the two sites is not great since each site is found in Ileret. Since there is no difference concerning size of harpoons, these Early Holocene peoples were making the bone harpoons in the same way. All the bone harpoons are uniserial, thus producers of the bone harpoons would compare the way they manufactured and decorated their artifacts with peers and decide if they want to copy or ignore a new style. The two Ileret sites have a homogenous bone harpoon assemblage. This supports my idea that Early Holocene peoples shared ideas about style and maybe about identities. Bone harpoons from both sites had type 1 hafts. The steps of manufacture may be a marker of group identity. The multiple steps taken during the experimental replication of a bone harpoon and as Wiessner suggests, the more stages the items goes through, then the individual and/or group identity can emerge (Wiessner 1983). The uniserial shape could be a marker of group identity for the two sites as in 'this is the way WE make things,' which is different from the way others make things. In regards to shape of barbs and body of harpoon, Yellen reported on the variation of assemblages around East Africa and has documented hooked barbs, yet IBHS 1 and 2's majority is straight barbs (Yellen 1998: 183). For example, the harpoons in figure 4 of this paper show biserial and/or triserial barb sequences that are not found at IBHS 1 or 2. Yellen has reported biserial and triserial types of harpoons in East Africa, but the Ileret assemblage only has uniserial.

The Early Holocene peoples were hunter-gatherers like the Kalahari San and the harpoon was a key subsistence tool like the arrows points were for the San. The San projectile points are used to hunt game and the meat is shared throughout the community and is about 45% of the San peoples diet (Wiessner 1983: 261). Projectile points carry style markers so that other groups can identify the arrows. This is important for hunting as the San use them as boundary maintenance (Wiessner 1983: 261). Since meat sharing has a big social role in the community, the arrow has a positive social role and is treasured. Hunters give their arrows to others to fulfill socioeconomic ties. Another hunting tool such as bone harpoons can play a similar role as the San projectile point. The stylistic information carried by items such as arrow points and bone harpoons can identify individuals and groups. This is useful when Early Holocene people are hunting as they can recognize the style of a bone harpoon and recognize which group it came from. Since I cannot talk with the Early Holocene peoples, I have studied style through the bone harpoons only. Maybe the bone harpoons were not made specifically as identity markers as Wiessner's beaded headbands were, but the bone harpoons' similarities can be related to other areas and not just explicitly identity.

The similarities of the bone harpoons can also be related to the resource availability, species of fish, environment, and learning and teaching. The research presented here was collected in the Koobi Fora region. The similarities between the bone harpoons collected may be due to all living in the same environment. Resource availability relates to style as the Early Holocene people living in the same environment would probably have used the resources available to them. From ethnographic work and from archaeological finds, we know the Early Holocene people fished for mudfish. The

Early Holocene fishers may have crafted their harpoons a certain shape to best catch a mudfish. The style of the harpoon could be based on the kind of prey the Early Holocene fishermen wanted to catch.

CONCLUSION

This research was focused on three main research questions: (1) Does group membership influence the manufacture of Holocene bone harpoons in East Africa (2) Are learning and teaching practices visible through style in Early Holocene bone harpoons? (3) Does Early Holocene bone harpoon style serve as a marker of group and personal identity in East Africa? When applying my data from Ileret, Kenya to all three research questions, the simple answer is yes. This study's data and artifacts from archaeological fieldwork and statistical analysis of bone harpoons found in the region of East Lake Turkana, Kenya contributed to knowledge of how Early Holocene peoples manufactured their bone harpoons and how group membership impacted the production. This set of bone harpoon styles very likely could express social information about group identity. The style of a bone harpoon can reveal information about the region's resource availability and environment. It is important to note that while the bone harpoons found do express stylistic decisions made by the Early Holocene peoples during a transitional period between 10,000 to 6,000 BP, I do not have the exact dates for the bone harpoons. Therefore, the styles found most likely lasted for at least a few hundred years during the Early Holocene period. Thus, we cannot eliminate the factor of chronological change from potential explanations.

For question 1, group membership does influence the manufacture of bone harpoons. For the harpoons in IBHS 1 and 2, Early Holocene peoples were making uniserially barbed harpoons with straight barbs and type 1 haft with carved cuts. Since Early Holocene people in the Koobi Fora region were all making similar harpoons, these fisher hunter-gatherers were clearly communicating about the appropriate shape of a

harpoon within each site. In this cultural setting, the members of the group decided on the uniserial shape. Yellen's work on African bone harpoons shows how regions around Africa have uniserial, biserial, and triserial bone points. Thus, there are clearly different options for designing an effective harpoon. Depending on which group of people the bone harpoons came from, that group for a variety of reasons would make their own version. Group membership and the way people perceive their identity in a group carries and affects messages about style. Bone harpoons are cultural materials and go through stages of change. If the manufacture process of a harpoon alters, then, as a result, the style changes. When an item such as bone harpoons goes through many transformational stages, there's a higher chance that the bone harpoons provide social information. As Wiessner has attested for the Kalahari San, every stage gives an opportunity to bear social expression (Wiessner 1983: 259). Therefore within a group, if the fisher hunter-gatherers change their morphological and design styles over a period of time then manufacture time and process will change as well.

For question 2, learning practices are visible through style for Early Holocene bone harpoons. By making a bone harpoon myself, I was able to understand a process of manufacture and what choices fisher hunter-gatherers needed to make in order to produce a bone harpoon. During the replicative experiment, I discovered teaching practices are visible through style after I had someone show me the steps for making a bone harpoon. By doing each step, the student and teacher are making a decision about the style of the harpoon. Decisions revolve around choosing how big or small the body of the harpoon should be or what shape barbs should be. After the replication experiment, I think the teaching method of "scaffolding" (Ferguson 2008) is the technique most likely used to

teach unskilled Early Holocene peoples. Therefore, I think the teacher would need to verbally and physically show the student how to make a bone harpoon in order to not waste raw materials such as bone. The importance of raw materials is significant as these materials determine how often and when an unskilled person can begin to learn. Raw materials can tell archaeologists about the learning process. For a bone harpoon, a person needs to have mature motor skills because the manufacture of harpoons is advanced. From my research, Early Holocene peoples had enough raw materials to teach novices and they may have gathered together by the lakeshore to make the harpoons in a group. Raw material may have come from large fish or from medium-sized mammals. However, the excavated faunal sample is dominated by fish and gives preliminary evidence that fish bone was likely chosen as raw material.

For question 3, bone harpoon style does serve as a marker of group identity. The uniserial shape for both sites may indicate a group attitude of 'this is the way WE make things.' The similar style of barbs and hafts from both sites could come from the species of fish in the area. A certain barb shape might have been more effective to catch Nile perch or mudfish. The Early Holocene peoples may have thought the uniserial shape caught fish more effectively than a biserial or triserial shape. Thus, reflecting group identity. Depending on the type of fish, the bone harpoon style reveals group identity because the Early Holocene peoples may have made decisions of style based on resource availability, species of fish, and environment. Also, learning and teaching played a role in style because the bone harpoons were manufactured in a group setting where the fisher/hunter-gatherers all made a choice on which styles they should use.

QUESTIONS FOR FUTURE RESEARCH

There are several questions that were outside the scope of this project, but that I would like to explore if the opportunity for future research occurred:

1. What species was used to make the bone harpoons?

It's unknown whether fish or mammal bone was used. I want to find a way to test the bone harpoons found at IBHS 1 and 2 to see what kind of animal the harpoons were made from. DNA tests may be appropriate.

2. I want to explore different areas to see what types of bone harpoons are found.

The areas I would like to survey are the west side of Lake Turkana and Ethiopia and I would like to do test excavations.

3. Why is fish bone decomposing at the abandoned bomas?

The bomas are the homes to the local Dassanech people of Ileret. The surveys of abandoned bomas yielded no evidence of fish bone, but the Dassanech certainly do hunt fish. Therefore, the fish bone must be decomposing at a rapid rate so that the evidence disappears, before we arrive to survey the sites. The Danssanech are very mobile throughout the year so the lack of evidence of bone harpoons and fish bone can be explained by mobility. The bone harpoons and other lithics are spread across the landscape. Mobility affects the Early Holocene peoples as well because they were hunter-gathers and moved often to different areas.

4. I would like to explore sites from different time periods in the region of Koobi Fora.

I would like to compare earlier and later bone harpoons styles to my Ileret bone harpoon styles.

5. I would like to do more fieldwork in Ileret to gain a larger sample size.

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1998 Barbed Bone Points: Tradition and Continuity in Saharan and sub-Saharan Africa. *The African Archaeological Review* 15(3): 173-198.

APPENDIX A: FIGURES AND TABLES



Figure 3: East African Sites

FIGURE 1: Map of Koobi Fora, Kenya

Citation: Kidder, James

2011 "The Human Fossil Record Part 7: The Rise of Early Homo."
BIOLOGOS, 2007.

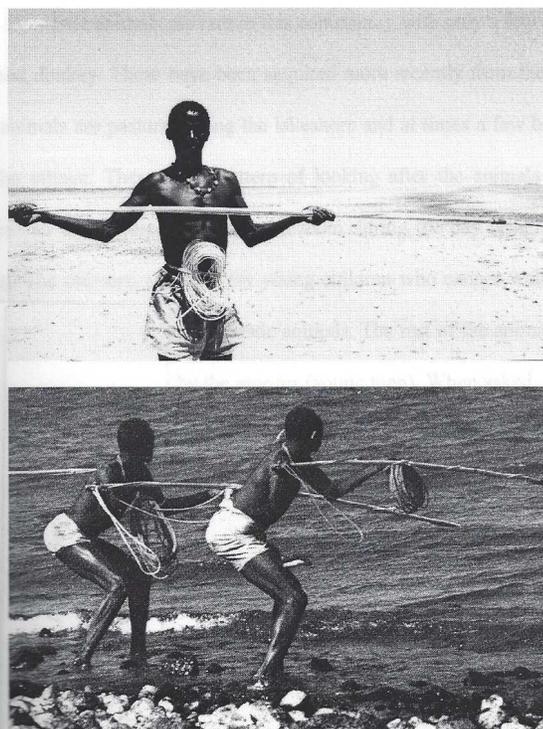


Plate 2.13: Fishermen using the harpoon method (top-*gal dies*, bottom-El-molo).

FIGURE 2: Picture of El-molo men fishing in East Africa.

Citation: Kiura, Purity.

2005 An ethnoarchaeology and stable isotope study on the diets of three modern groups of people in northern Kenya. Dissertation.

Graduate school-New Brunswick Rutgers,
The State University of New Jersey.

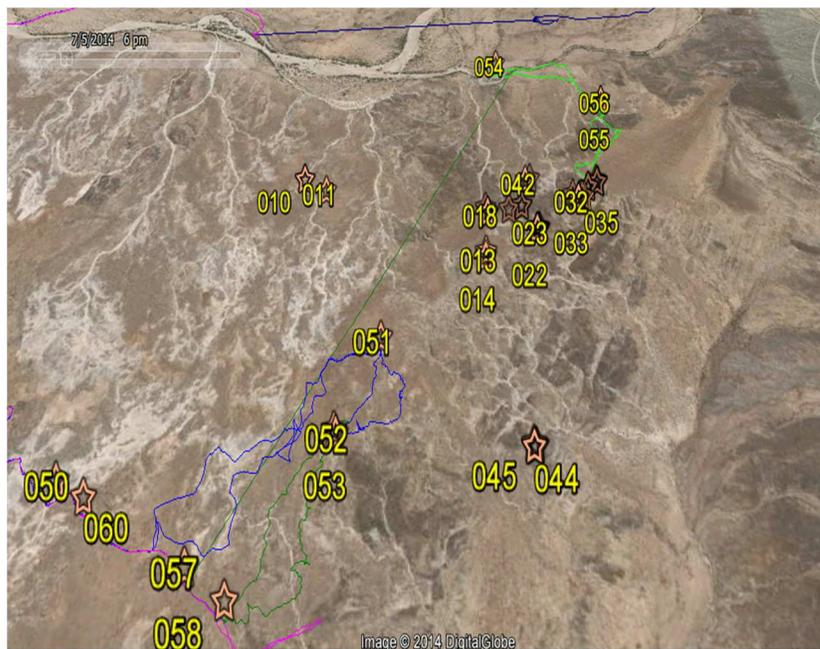


FIGURE 3: The transect map (numbers represent navigational points)
Citation: produced by Dr. Emmanuel Ndiema

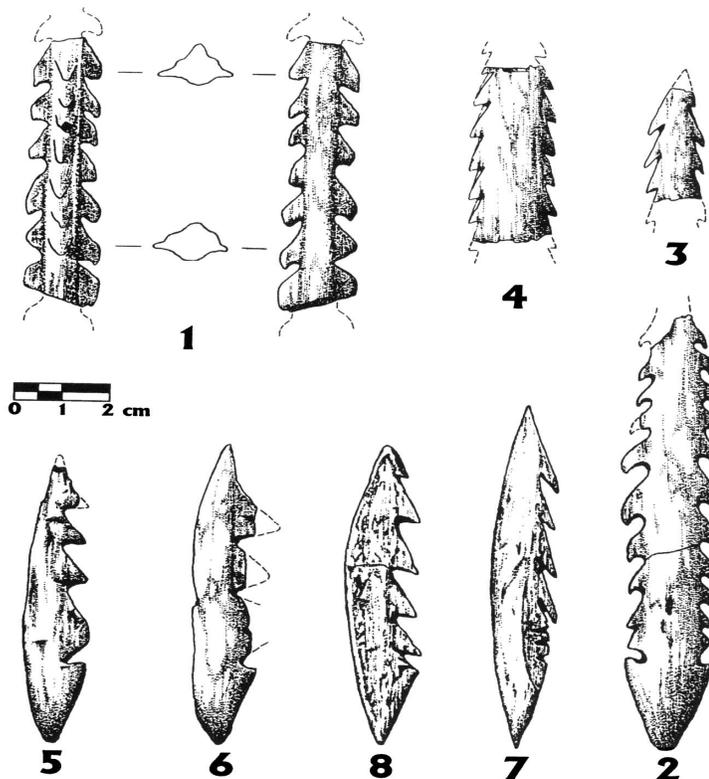


Figure 4: Location/Sites of African barbed bone points in drawings.

1, GaJj11 (Lake Turkana, Kenya); 2, GaJj11;

3, Lowasera (Lake Turkana, Kenya);

4, Araouane (Mali); 5 and 6, Atabara region (Sudan); 7, GaJj11;

8, Lotha-gam (Lake Turkana, Kenya); 9, Lowasera;

10, Catfish Cave (Egypt); 11, Araouane;

Citation: Yellen, John E.

1998 Barbed Bone Points: Tradition and Continuity in Saharan and sub-Saharan Africa. *The African Archaeological Review* 15(3): 173-198.

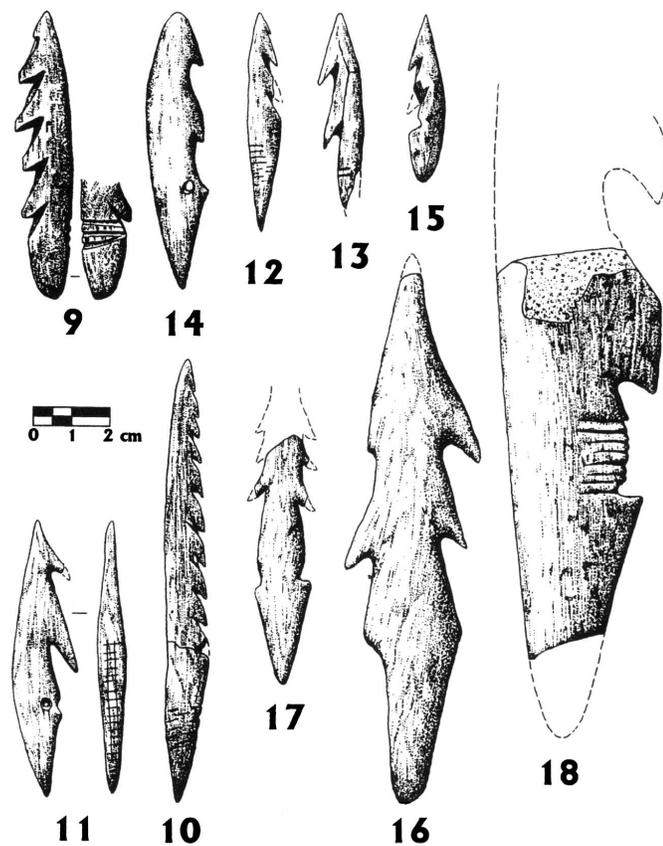


Figure 5: Location/Sites of African barbed bone points in drawings.
 12, Catfish Cave; 13, Lowasera; 14, Araouane; 15, Lowasera;
 16, Shaheinab (Khartoum Sudan); 17, Tamaya Mellet (Niger);
 18, Hospital Site (Khartoum, Sudan)

Citation: Yellen, John E.

1998 Barbed Bone Points: Tradition and Continuity in Saharan and sub-Saharan Africa. *The African Archaeological Review* 15(3): 173-198

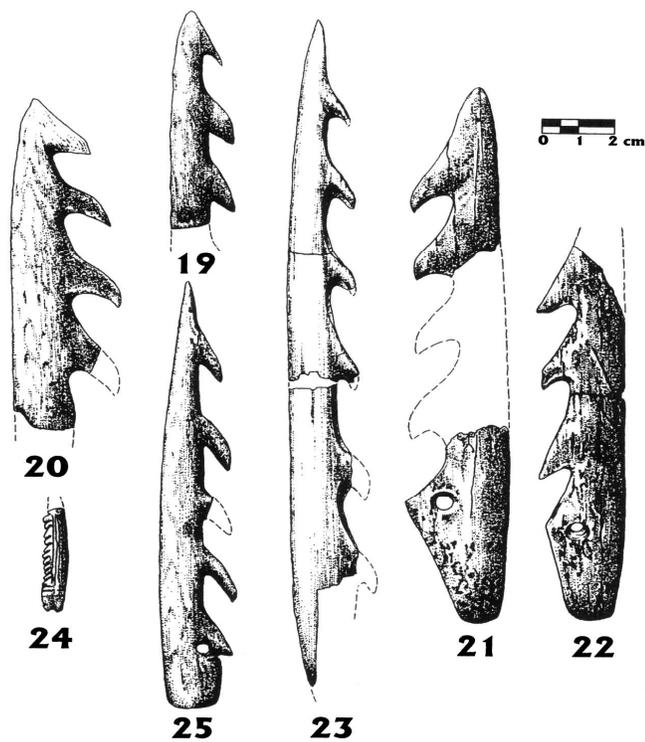


Figure 6: Location/Sites of African barbed bone points in drawings.
 19 and 20, Hospital Site; 21 and 22, Shaheinab; 23, Araouane;
 24, Lowasera; 25, Araouane; 26 and 27, Kebara (Israel);
 28 and 29, Abri Morin (France); 30 and 31, Ontario (Canada);
 32, Fayum (Egypt); 33, Tatoralt (Morocco); 34-40, Ishango (Zaire);
 41-46, Katanda (Zaire); 47, Fayum; 48, White Paintings Shelter (Botswana).
 Citation: Yellen, John E.
 1998 Barbed Bone Points: Tradition and Continuity in Saharan and
 sub-Saharan Africa. *The African Archaeological Review* 15(3): 173-198

Table 2: Ileret Bone Harpoon attributes, pages 60-62.

Attribute on Bone Harpoon	Definition	Illustration
Barb	<p>Connected to body of harpoon.</p> <p>Two types:</p> <p>Type 1- Straight</p> <p>Type 2- Hooked</p>	
Crook	<p>The incision between the tip of the barb and the body of the barb.</p>	

Top of harpoon	Highest point on the harpoon, which will enter the aquatic animal first.	
Base of harpoon	Lowest point on harpoon with barb tip pointing toward the base	
Numbering of barbs	Barbs are numbered starting at the base increasing upward toward the top of the harpoon.	
Haft	<p>At the base of harpoon there will be a carved incision used to attach the bone harpoon to the spear.</p> <p>There are three different types of hafting found at Ileret: Type 1- Carved cut mark only on one side of the bone harpoon Type 2- Cut line which circles the base of the bone harpoon Type 3 - hafting has the shape of two opposing barbs which connect in the middle.</p>	

		
Uniserial	Barbs are only found on one side of the body of the harpoon.	

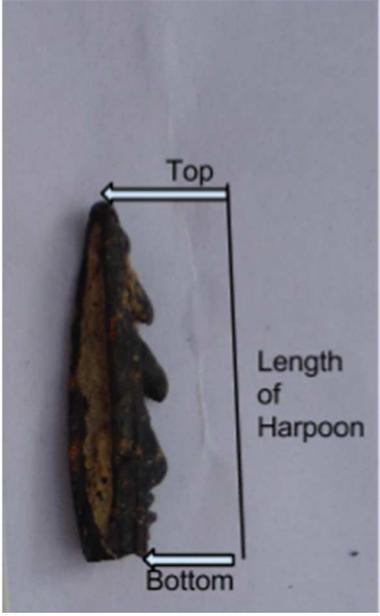
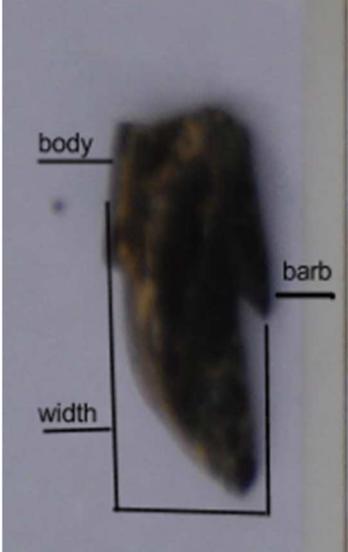
Table 3: Ileret Bone Harpoon Site 1

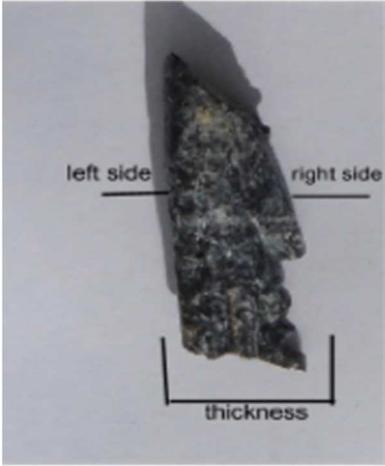
Harpoon ID#	Harpoon Thickness (cm)	Harpoon Width (cm)	Harpoon Length (cm)	# of Harpoons	Barb length (cm)			Barb spacing (cm)							Barb Divergence (cm)			Haft type	Haft #	Uni/Bi serial	
					1	2	3	1-2	2-3	3-4	4-5	5-6	6-7	1	2	3					
1	0.80	2.20	2.70	1															0	0	Uniserial
2	0.80	1.10	2.30	1															0	0	Uniserial
3	0.65	1.20	1.85	1	0.95														1	1	Uniserial
4	0.90	1.00	5.56	0															0	0	n/a
5	0.50	1.15	3.20	2	1.20	1.10													1	2	Uniserial
6	0.60	1.20	4.70	2	1.10	0.90													1	2	Uniserial
7	0.70	1.10	3.80	0															1	2	Uniserial
8	0.60	1.10	4.20	4	1.40														0	0	Uniserial
9	0.50	1.00	1.90	0															0	0	Uniserial
10	0.60	1.20	2.70	1															1	2	Uniserial
11	0.40	1.10	4.30	0															0	0	Uniserial
12	0.60	0.90	3.15	3	1.30	1.50	0.90	1.00											0	0	Uniserial
13	0.60	1.20	3.10	1															0	0	Uniserial
14	0.50	1.00	3.70	0															1	3	Uniserial
15	0.60	1.20	2.60	2	1.20														0	0	Uniserial
16	0.70	1.30	3.60	1															1	2	Uniserial
17	1.10	1.20	3.50	0															0	0	Uniserial
18	0.60	0.70	1.90	0															1	2	Uniserial
mean	0.65	1.16	3.26		1.19	1.50	n/a	0.97	1.00	n/a	n/a	n/a	n/a	n/a	0.13	0.117	n/a				
median	0.60	1.13	3.18		1.20	1.50	n/a	0.90	1.00	n/a	n/a	n/a	n/a	n/a	0.1	0.1	n/a				
std. dev.	0.16	0.30	1.02		0.16	n/a	n/a	0.12	n/a	n/a	n/a	n/a	n/a	n/a	0.061	0.029	n/a				

Table 4: Ileret Bone Harpoon Site 2

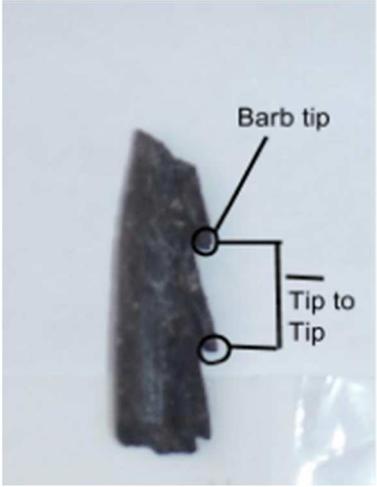
Harpoon ID#	Harpoon Thickness (cm)	Harpoon Width (cm)	Harpoon Length (cm)	# of Barbs	Barb length (cm)							Barb spacing (cm)							Barb Divergence (cm)			Haft type	Haft #	Uni/Bi serial							
					1	2	3	1-2	2-3	3-4	4-5	5-6	6-7	1	2	3	1	2	3												
1	0.60	0.90	3.30	3	0.80	0.90	0.70	0.50	0.70																	1	2	Uniserial			
2	0.50	0.90	4.60	0	0.40	0.50	0.40	0.35	0.35	0.25																			0	0	Uniserial
3	0.60	1.30	3.00	2	1.10			1.05																					0	0	Uniserial
4	0.20	1.30	4.30	0																									3	1	Uniserial
5	0.50	1.25	2.00	0																									0	0	Uniserial
mean	0.48	1.13	3.44		0.95	0.90	0.70	0.65	0.60	0.40	0.35	0.35	0.25	0.3	0.175	1.1													0.8	0.6	
median	0.50	1.25	3.30		0.95	0.90	0.70	0.50	0.60	0.40	0.35	0.35	0.25	0.3	0.175	1.1													0	0	
std. dev.	0.16	0.21	1.05		0.21	n/a	n/a	0.35	0.14	n/a	n/a	n/a	n/a	n/a	0.035	n/a													1.3	0.894	

Table 6: Bone Harpoon dimension measurements, pages 69-72.

Dimension of measurement	Methods	Illustrations
Length	<p>The top of harpoon is the highest point on the harpoon, which enters the aquatic animal first. The base of the harpoon is the lowest point on harpoon with barb top pointing toward the base. To gauge length, I measured from the top of the harpoon to the base of the harpoon.</p>	
Width	<p>For the width of the harpoon, I measured the widest point on barb to the widest point on the body. If barb not present then the widest point on the body will be measured.</p>	

Thickness	<p>The thickness measurement is a 90-degree angle from maximum width or thickest point of body on the left hand side to thickest point of body on the right hand side.</p>	 <p>A photograph of a dark, textured harpoon body. A horizontal line with arrows at both ends spans the width of the body, labeled 'left side' on the left and 'right side' on the right. A vertical bracket at the bottom indicates the thickness, labeled 'thickness'.</p>
Barb length	<p>A barb is connected to body of harpoon. There are two types of barbs, which are type 1-straight and type 2-hook. □The barbs are numbered starting at the base and increasing upward toward the top of the harpoon. The length of barb is measured from the tip of the barb to the cook.</p>	 <p>A photograph of a light-colored harpoon with several barbs. A black dot marks the 'crook' at the top. A purple line indicates the 'barb length' from the tip of a barb to the crook. A red line indicates the 'tip' of a barb.</p>

<p>Length of barb: Type 1</p>		<p>Type 1: straight barb</p> 
<p>Length of barb: Type 2</p>		<p>Type 2: hooked barb</p> 

<p>Tip to Tip (called barb spacing in statistics table)</p>	<p>On a bone harpoon, the barbs are separated due to the style of the barbs, thus I measured the distance from each barb tip to the next barb tip. I called this dimension Tip to Tip measurement: tip of barb to tip of adjacent barb is measured starting from the tip of barb 1. Measured to determine the density of barbs on the harpoon.</p>	
<p>Barb divergence</p>	<p>Another measurement for the barb is barb divergence, which is tip of barb to the body of the harpoon.</p>	