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Scott Shirar

University of Alaska Museum of the North

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ARTICLES

Subsistence and Seasonality at a Late Prehistoric House Pit in Northwest Alaska

SCOTT SHIRAR

Abstract

In this report, I examine a house from a Late Prehistoric village site near the confluence of Maiyumerak Creek and the Noatak River in the Noatak National Preserve, Alaska. In 2006, several thousand artifacts and over 100,000 faunal remains were excavated from this approximately 500-year-old house. Faunal remains and subsistence-related artifacts associated with the living floor of the house were analyzed to assess diet and seasonal occupation. I also address how this house fits into previously proposed Late Prehistoric land- and resource-use models. The dietary reconstruction shows that both classes of data (artifacts and fauna) indicate a primary reliance upon terrestrial mammal resources, a secondary reliance upon bird and fish resources, and a limited reliance upon marine mammal resources. The seasonal analysis of the house indicates a late summer, fall, and/or winter occupation (July through February). The seasonal occupation, radiocarbon dates and evidence of coastal contact at this site illustrate current difficulties with testing hypothesized periods of coastal abandonment during this time period. Finally, this case illustrates that for any region and time period studies related to patterns of human settlement need to be comprehensive and incorporate multiple lines of evidence and large, robust region-specific data sets.

Introduction

How past human populations adapted to their environment is a central question in archaeology and has been since the inception of the discipline. Today, archaeologists explore this question through the specialized field of environmental archaeology, which focuses on the relationship of humans to biophysical systems they inhabit and how that relationship changes over time (e.g., Reitz et al. 1996). Environmental archaeology has often been studied from two main perspectives: how human behavior and material culture have been adapted to take advantage of local resources and, conversely, how changes in climate have altered the environment, causing changes in human culture and human behavior (Redman et al. 2004). Research in environmental archaeology often results in studies related to human diet, the seasonal exploitation of

resources, and regional land-use patterns, but also commonly focuses on taphonomic and methodological issues (Reitz et al. 1996). In this study, I addressed the traditional question of how humans adapted their behavior and material culture to take advantage of the local environment. I also discuss evidence for climatic fluctuations that may have influenced those behavioral choices and discuss the importance of combining multiple lines of evidence in archaeological interpretation on a site-specific and regional scale.

Generally speaking, the current interpretations of subsistence resource use for Late Prehistoric cultures in northwest Alaska are based on datasets formulated from subsistence-related artifacts (Giddings 1952:34-57; Giddings and Anderson 1986:35-57; Hickey 1977:54-78; see also DeAngelo 2001; Gilbert-Young 2004; Hall 1971). Meanwhile, a regional

scale understanding of Late Prehistoric settlement patterns for interior northwest Alaska has never been reached, largely due to the paucity of reliably dated sites that have been excavated but also because of the lack of robust faunal assemblages available for study. Despite a shortage of well-rounded data, hypotheses of Late Prehistoric settlement patterns have been introduced for northwest Alaska (Anderson 1983, 1988; Mason and Gerlach 1995; Minc and Smith 1989; Murray et al. 2003). Most recently Murray and colleagues (2003), based on ideas and data presented by Mason and Gerlach (1995), hypothesized that Late Prehistoric settlement and subsistence is directly tied to cycles of coastal storminess which made marine mammals, usually a reliable subsistence resource, scarce. This scarcity of marine resources forced human populations inland. Proxy data based on beach ridge development shows that cycles of storminess occurred on the coast of northwest Alaska during the Late Prehistoric time period (Mason and Gerlach 1995; Mason and Jordan 1993).

Closely tied to the topic of cultural response to resource availability and environment is site seasonality and its relationship to prehistoric settlement patterns in northwest Alaska. Here, I interpret the seasonal occupation of a Late Prehistoric house through an analysis of selected faunal remains, i.e. the presence of seasonally available species and the eruption stage of molars in juvenile caribou mandibles. How this seasonality interpretation fits into the context of a settlement model that hypothesizes periods of coastal abandonment, and whether the artifact and faunal assemblages and radiocarbon dates from this house support or contradict this model, is one part of this article. I also address how the seasonality interpretation for this house compares to the known pre-contact 19th century ethnographic patterns of land-use for the region.

From a methodological perspective, research concerning prehistoric subsistence practices and diet often focuses on studying hunting- and fishing-related implements. A contributing factor to the prevalence of artifact-based subsistence research is that many archaeological sites lack faunal preservation; nevertheless, scholars argue that these types of artifact-driven studies are limited in their explanatory

power due to a lack of research on associated faunal and floral remains (Mason and Gerlach 1995; Murray et al. 2003). Archaeological sites with excellent faunal preservation can significantly contribute to the understanding of subsistence resource use, diet and settlement patterns for an individual site, region and time period. This article examines whether the artifact and faunal assemblages lead to the same general interpretation of dietary resource use at the Maiyumerak Creek Site and then how the relationship between these data sets may be applied to subsistence studies more generally.

Archaeology of the Noatak River Drainage

The Noatak River valley is approximately 725 km long, yet the Maiyumerak Creek Site is only the fourth Late Prehistoric site in the valley formally excavated and the only one extensively radiocarbon dated. The first excavation of a Late Prehistoric site on the Noatak River was conducted at Kangiguksuk by Edwin S. Hall, Jr. during the mid 1960s (Hall 1971). The Kangiguksuk Site consists of a solitary house ruin that has been dated to the 16th century based on one dendrochronology sample and artifact typology. The typology portion of this dating technique consists of comparing artifacts from Kangiguksuk to those collected by Giddings (1952) at dendrochronologically dated sites in the Kobuk River valley which is the next drainage to the south.

Another Late Prehistoric excavation would not take place in the Noatak River valley until the mid-1990s at the Sapun Creek Site. Excavations at this site focused on a single house ruin (DeAngelo 2001). This house is believed to have been occupied during the same time period as Kangiguksuk, a supposition based entirely on artifact comparisons between the two sites.

The remains of two different house ruins at the Lake Kayak Site were excavated in the early 2000s and the report includes an analysis of the caribou fauna as well as descriptions of the pottery, artifacts, and structures (Gilbert-Young 2004). These two houses are believed to date between 1578 and 1760 CE based on artifact comparisons with the Kangiguksuk Site and the presence of a solitary Chinese trade bead that dates to the mid 18th century.

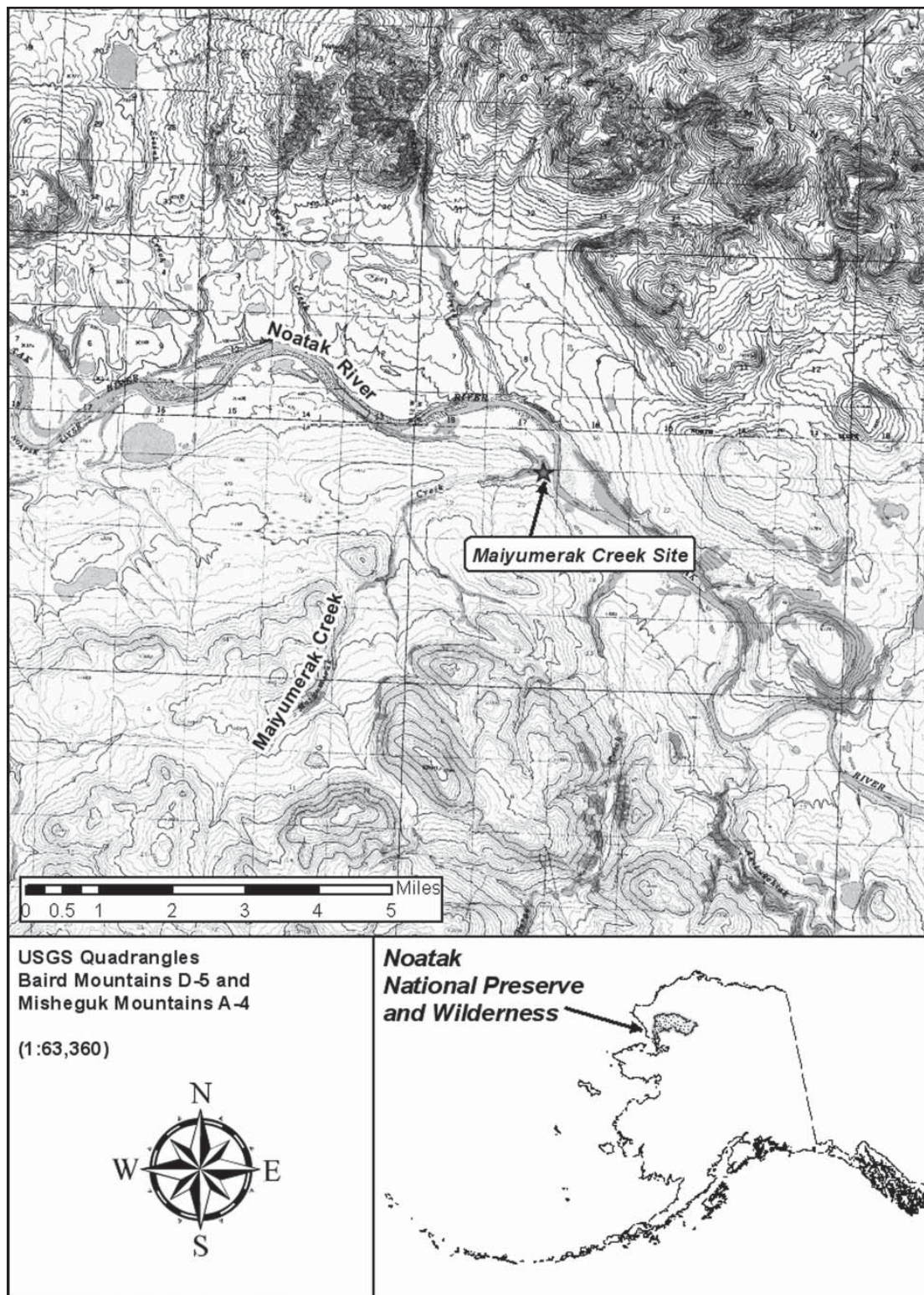


Figure 1. Location of the Maiyumerak Creek Site. Map produced by Molly Proue and derived from shapefiles provided by the Alaska Department of Natural Resources, Land Records Information Section and the National Park Service Data Store.

Currently, there is not a solid basis for interpreting a range of dates for when any of these three sites were occupied. The 16th century occupation at Kangiguksuk is based on a solitary dendrochronology sample and artifact comparisons with a Late Prehistoric site located 125 km away on the coast. Each of these three sites needs to be dated independently using either dendrochronology or radiocarbon before they can contribute to a regional understanding of land-use and settlement. An important final note on previous research in the region is that only Hall's work has gone through the peer review process and that was nearly forty years ago. The assemblages analyzed at each of these sites

need to be closely evaluated in terms of sampling, stratigraphy, taphonomic processes and analytical technique.

Site Location and Description

The Maiyumerak Creek Site is located near the confluence of Maiyumerak Creek and the Noatak River in the Noatak National Preserve in northwest Alaska (Figure 1). The site lies on the left bank of Maiyumerak Creek, 150 m west of the Noatak River, approximately 85 km northeast of the village of Noatak (Figure 2). Excavations in 2006 salvaged the remains of a badly eroded house pit (House Pit 8) carbon-dated to approximately 500 years ago.

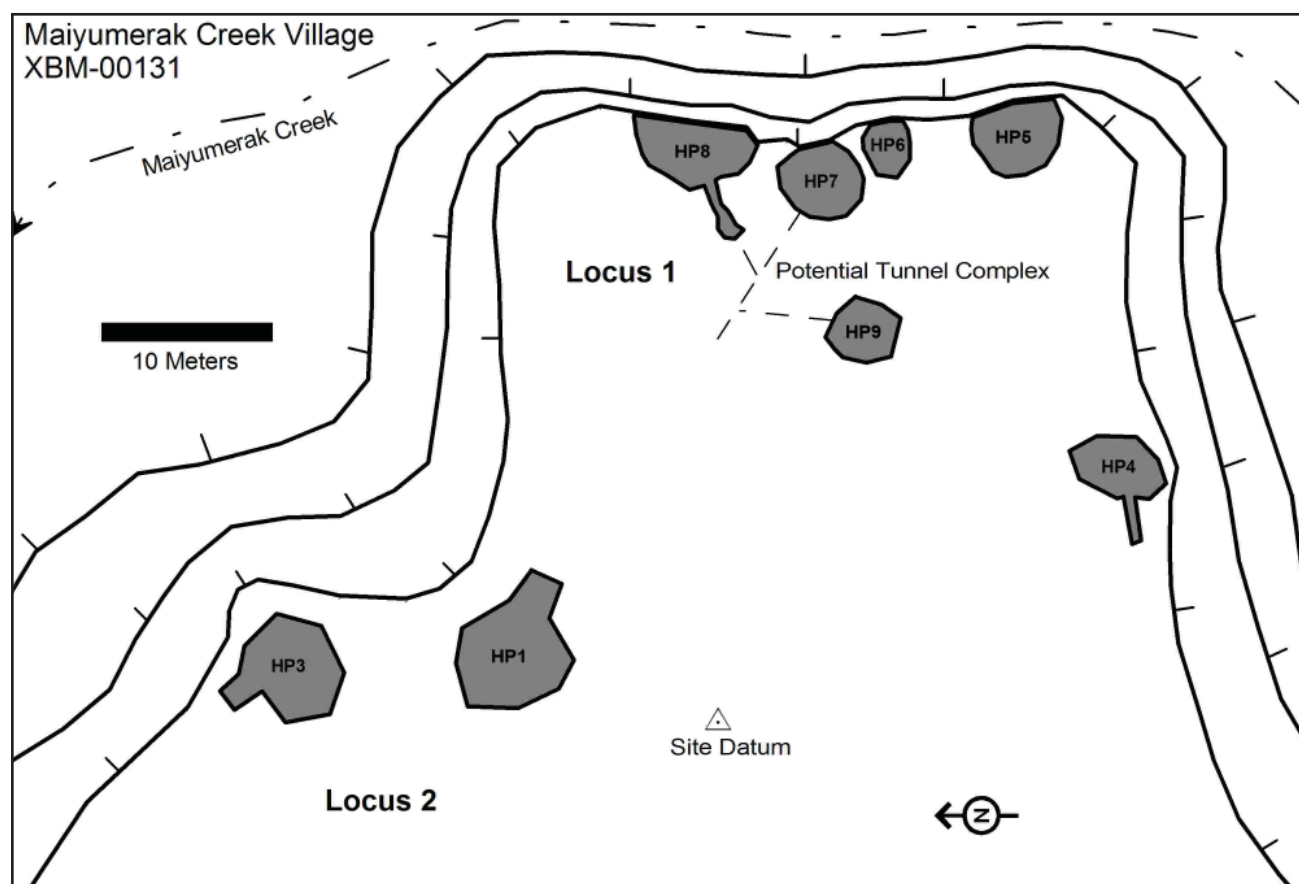


Figure 2. Surface depressions of houses at the Maiyumerak Creek Site.

Lower portions of the Noatak River valley offer a forested taiga environment while the middle and upper portions offer a mostly treeless tundra environment (Young 1974). Even though the middle portion of the river valley is largely treeless, some smaller tributaries (Maiyumerak Creek being one) support scattered populations of cottonwood trees (*Populus* sp.). Willow (*Salix* sp.) is prevalent along the middle portion of the river and likely played an important role in prehistoric site location decisions due to its use as firewood, the protection it provided, and its potential as an area to ambush game (Burch 1998:91-106, 2006:107). Other important plant resources in the region include: dwarf birch (*Betula* sp.), alder (*Alnus* sp.), blueberry (*Vaccinium* sp.), Labrador tea (*Ledum* sp.) and cranberries (*Vaccinium* sp.), among others too numerous to list (see Young 1974).

The middle portion of the valley offers a wide variety of terrestrial mammal, bird and fish species. At least 24 terrestrial mammal species are currently present throughout the year. Caribou (*Rangifer tarandus*) are present in large numbers in the spring and fall during their northerly and southerly migrations. Many mammal species are present year round and include brown bear (*Ursus horribilis*), Dall sheep (*Ovis dalli*), wolf (*Canis lupus*) and hare (*Lepus* sp.) (Gardner 1974).

More than 125 species of birds have been identified as living in the Noatak River valley during different times of year (Manuwal 1974). Some are in the region only seasonally while others are year-round residents. The list of birds is too long to include here, but consists of various types of waterfowl, song birds, raptors and shorebirds. Comparatively few fish are available along the middle portion of the river valley. At least ten species are known to be present in the middle and upper portions of the river and surrounding lakes consisting of different types of salmon and trout (*Salvelinus* sp.), burbot (*Lota lota*), grayling (*Thymallus thymallus*), northern pike (*Esox lucius*) and whitefish (*Coregonus* sp.) (Scanlon 2008:6-7).

House Stratigraphy and Sampling

Twenty-six 1 x 1 m test units were excavated in or around House Pit 8 (Figure 3). Test units within the main portion of the house were excavated in 50

x 50 cm quadrants according to natural stratigraphic levels. The three test units located within the entrance tunnel were also excavated according to natural levels but not in quadrants due to issues related to permafrost and limited time in the field. Artifact recovery procedures employed during the excavation of the house consisted of in-situ identification and dry screening. Formal tools and pottery were recorded in-situ while faunal remains and debitage were collected in bulk bags according to unit coordinates, quadrant and level. Deposit matrix was dry screened through 1/8 inch mesh in order to recover small cultural remains.

An essential aspect of this study is to demonstrate how the faunal remains and artifacts analyzed represent the occupation of House Pit 8—the primary line of evidence used to support this interpretation is site stratigraphy. House Pit 8 was excavated through four natural stratigraphic layers. The first layer (L-1) is the modern organic root mat which is dark brown aeolian silt with a high density of organic matter. L-1 contained a low density of artifacts that were likely introduced from adjacent cultural layers by natural disturbances. The second layer (L-2) is brown silt containing a high density of artifacts and faunal material. L-2 is a combination of house roof and house wall material that collapsed in on the house as it fell. The third layer (L-3) is dark grayish brown sandy silt with high ash content and a moderate amount of cultural material. L-3 represents house fill that was deposited during the occupation or occupations of the house. The fourth layer (L-4) is culturally sterile alluvium which consists of alternating deposits of grayish brown sand and silt.

L-2 and L-3 both contain cultural material associated with the occupation of House Pit 8. However, the remains collected from L-2 likely contain a mixture of midden material from at least two different houses (House Pits 7 and 8). Due to the probable mixture of material in the midden layer, this study includes only the faunal and artifactual material collected from the floor of House Pit 8. Based on this stratigraphic examination, the taphonomic history of House Pit 8 is relatively uncomplicated. Since the stratigraphic layer that is associated with the occupation of the house is the only one being

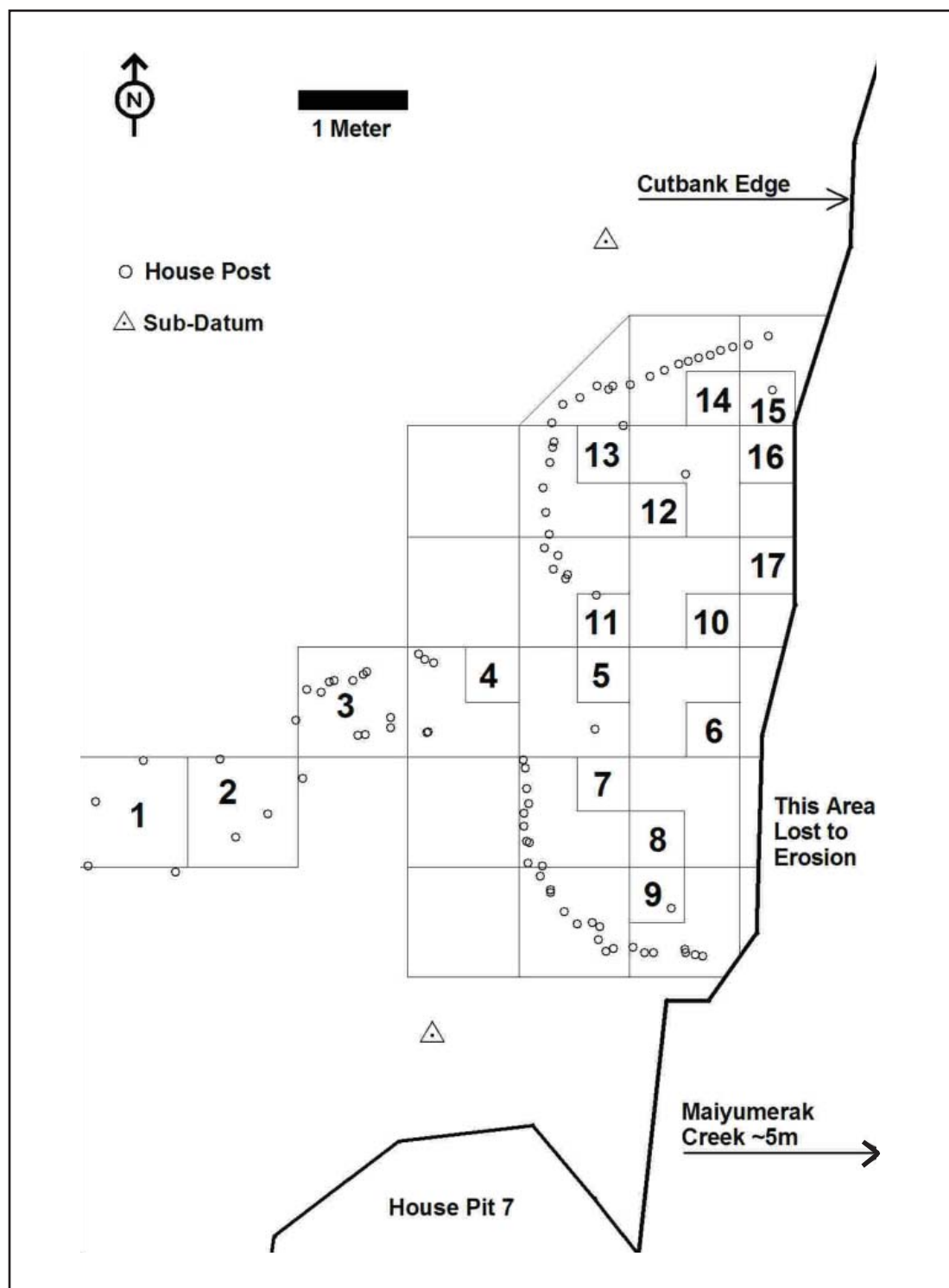


Figure 3. Seventeen sample units chosen from House Pit 8 for faunal analysis.

included in the analysis and no major disturbances were noted during excavation (outside of the obvious erosion), it is assumed that all of the faunal remains and artifacts included in the analysis are a result of cultural activities.

A horizontal sampling strategy was also implemented. Of the 26 1 x 1 m test units, nine do not fall completely inside of the house boundaries (and thus may contain both fill and midden) or were partial units that, due to erosion, did not contain a complete 50 x 50 cm quadrant. Of the 17 remaining test units, 14 were excavated in quadrants and three were not. Due to this slight inconsistency in excava-

tion methods, a combination of two probabilistic sampling schemes was employed when determining which remains to analyze.

First, systematic sampling was used with each test unit excavated in 50 x 50 cm quadrants. For each of these units the faunal remains from one of the four quadrants (an approximately 25 percent sample) was selected for analysis based on where that quadrant exists in relation to the house wall. After eliminating all of the quadrants that were either outside of the house or straddling the wall, one quadrant from each unit was chosen at random (samples 4-17, Figure 3).

Table 1. Radiocarbon dates associated with House Pit 8 at the Maiyumerak Creek Site.

Lab #	Material	C13/C12	Conventional ¹⁴ C Age	Calibrated ¹⁴ C Age	Provenience
Beta-76675	Unidentified Charcoal	-27.3	780±100 BP	CE 1031-1324(91.6%) CE 1345-1393(8.4%)	Cut of House Pit 8
Beta-223358	Caribou Bone	-19.5	280±40 BP	CE 1485-1668(95.2%) CE 1781-1797(4.4%) CE 1947-1950(0.4%)	Floor of House Pit 8
Beta-223359	Caribou Bone	-19.3	170±50 BP	CE 1652-1711(20.2%) CE 1716-1891(62.4%) CE 1909-1953(17.4%)	Floor of House Pit 8
Beta-228015	Caribou Bone	-20.2	280±40 BP	CE 1485-1668(95.2%) CE 1781-1797(4.4%) CE 1947-1950(0.4%)	Floor of House Pit 8
Beta-228016	Populus/Salix Charcoal	-26.5	520±40 BP	CE 1316-1355(22.0%) CE 1388-1447(78.0%)	Floor of House Pit 8

Second, simple random sampling was used with the three test units that were not excavated in quadrants. These three units were excavated within the tunnel of House Pit 8 (samples 1-3, Figure 3) and the excavation followed the natural boundary created by the wall posts. Due to this fact, all of the house fill material from these units is associated with the occupation of the house. Approximately 25 percent (calculated by volume) of the faunal remains from these three units were chosen by numbering bags and then picking numbers at random.

Radiocarbon Dates

Fifteen radiocarbon ages have been obtained for the Maiyumerak Creek Site. Most of these samples are associated with house pit features, and a variety of different areas of the site have been dated. This suite of radiocarbon ages shows that the site was occupied intermittently throughout the Late

Prehistoric time period, which in northwest Alaska is between 1200 and 1800 CE.

Five radiocarbon dates have been derived from materials collected in association with House Pit 8 and each one has been calibrated using the Calib ^{14}C Radiocarbon Calibration Program (Stuiver et al. 2006) using the IntCal04 atmospheric curve (Reimer et al. 2004) (Table 1). Three of these dates come from individual samples of three-point plotted caribou long bone fragments collected from the floor of the house (Beta-223358, Beta-223359, Beta-228015). A fourth radiocarbon date (Beta-228016) was derived from a charcoal sample also collected from the floor. A fifth date (Beta-76675) was run in 1994 on a charcoal sample collected from the eroding face of House Pit 8.

Of these five dates, both of the calibrated ^{14}C ages derived from charcoal overlap and all three of the calibrated ^{14}C ages derived from bone overlap; how-

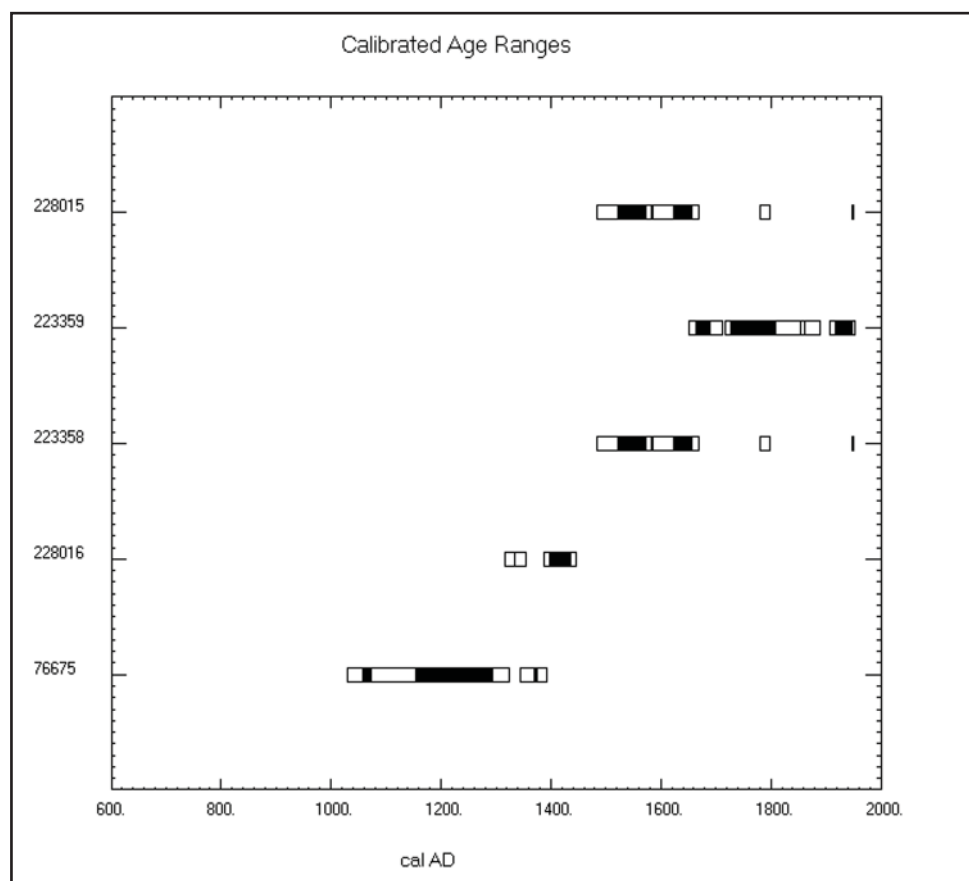


Figure 4. Calibrated age probability curve for each radiocarbon date from House Pit 8.

ever, neither of the two calibrated ages derived from charcoal overlap with any of the three calibrated ages derived from bone (Figure 4). At least two scenarios could account for the discrepancy of ages between the bone-derived dates and charcoal-derived dates. First, the house could have been reused for several years, perhaps even centuries; the materials dated could be from opposite ends of this time spectrum. Second, old wood could have been introduced into the house in a number of different ways and this old wood could be what the charcoal dates derive from. Bone dates were chosen over charcoal dates because the caribou bone provides a better contextual basis and a closer link to the human occupation of the house.

Diet Based on Faunal Remains

The key set of data used to evaluate diet based on the faunal assemblage is relative frequencies of taxa. For this study, relative frequencies are estimated using the number of identified specimens—calculated by counting the total number of bones and bone fragments present within the entire sample (Reitz and Wing 1999). The greatest strength of calculating number of identified specimens is that it is a simple

and straightforward method associated with fewer complications compared to other methods of relative frequency estimation. The biggest drawback to using the number of identified specimens is that it fails to take into account that different animals have different numbers of skeletal elements, sometimes resulting in misleading statistics. Like many zooarchaeological analytical techniques, calculating number of identified specimens is directly affected by taphonomic processes as well as excavation and sampling methods, making it important to clearly describe how the faunal assemblage was collected and sampled (Reitz and Wing 1999).

For this study, the number of identified specimens was first broken down by general animal classes and then according to family or genus and species where possible. Tables 2 and 3 present data resulting from the faunal analysis and break the number of identified specimens down according to different levels of taxonomic identifiability. In Table 2 “identified” refers to specimens that were able to be classified to the family, genus and/or species level and “unidentified” refers to specimens that could not be classified to at least the family level. The faunal data presented

Table 2. Number of identified species (NISP) calculations for the entire faunal sample.

	Identified		Unidentified		Total	
	NISP	%NISP	NISP	%NISP	NISP	%NISP
Terrestrial mammal	1,132	4.60	19,462	79.10	20,594	83.70
Marine mammal	3	0.01	0	0.00	3	0.01
Bird	412	1.67	683	2.78	1,095	4.45
Fish	663	2.70	1,394	5.67	2,057	8.37
Unidentified	0	0.00	854	3.47	854	3.47
Total	2,210	8.98	22,393	91.02	24,603	100.00

Table 3. NISP, %NISP, MNE, and %MNE for the identified faunal remains.

Common Name	Scientific Name	NISP	%NISP	MNE	%MNE
Caribou	<i>Rangifer tarandus</i>	1048	47.41	574	35.54
Burbot	<i>Lota lota</i>	458	20.72	452	27.99
Ptarmigan	<i>Lagopus</i> sp.	386	17.47	279	17.28
Grayling	<i>Thymallus thymallus</i>	184	8.33	181	11.21
Hare	<i>Lepus</i> sp.	43	1.95	42	2.60
Salmon	<i>Oncorhynchus</i> sp.	21	0.95	20	1.24
Hawk	<i>Accipitridae</i> (family)	21	0.95	19	1.18
Arctic Ground Squirrel	<i>Spermophilus parryii</i>	12	0.54	12	0.74
Marmot	<i>Marmota</i> sp.	9	0.41	8	0.50
Vole	<i>Microtus</i> sp. <i>Myodes</i> sp. <i>Phenacomys</i> sp.	6	0.27	6	0.37
Fox	<i>Alopex lagopus</i> <i>Vulpes fulva</i>	4	0.18	4	0.25
Wolverine	<i>Gulo gulo</i>	3	0.14	3	0.19
Common Raven	<i>Corvus corax</i>	3	0.14	3	0.19
Lemming	<i>Lemmus</i> sp. <i>Dicrostonyx</i> sp.	2	0.09	2	0.12
Small Seal	<i>Phoca</i> sp.	2	0.09	2	0.12
Brown Bear	<i>Ursus horribilis</i>	1	0.045	1	0.06
Wolf/Domestic Dog	<i>Canis lupus/familiaris</i>	1	0.045	1	0.06
Porcupine	<i>Erethizon dorsatum</i>	1	0.045	1	0.06
Mammoth (extinct)	<i>Mammuthus primigenius</i>	1	0.045	1	0.06
Weasel	<i>Mustela</i> sp.	1	0.045	1	0.06
Duck	<i>Anatidae</i> (family)	1	0.045	1	0.06
Gull	<i>Laridae</i> (family)	1	0.045	1	0.06
Stellar Sea Lion	<i>Eumetopias jubatus</i>	1	0.045	1	0.06
Total		2,210	100.00	1,615	100.00

in Table 2 show that the occupants of House Pit 8 relied primarily upon terrestrial mammals while fish and birds likely provided an important secondary resource base. Marine mammals make up a miniscule portion of the sample and did not contribute substantially to diet.

Fragmentation plays a role in the high representation of terrestrial mammals. Of 20,594 terrestrial mammal specimens only 1,132 (5.50 percent) were complete enough to be identified beyond the class level (Table 2). Many of the 19,462 unidentified terrestrial mammal fragments are small, splintered and

largely less than 2-3 cm in their longest dimension illustrating just how highly processed this assemblage is. The likely source of this tremendous amount of fragmentation is cultural in the form of marrow and grease extraction. This is supported by the fact that this faunal sample comes from the floor of a dwelling where, ethnographically, this extraction would take place during the lean winter months in order to add much needed calories to the diet (Burch 1998:104). The fact that fish and bird bone is identifiable to a much higher degree (32.23 and 37.62 percent respectively) also supports cultural bone fragmentation. If fragmentation was the result of natural taphonomic processes the remains from all four animal classes would experience a more similar degree of fragmentation. Tool making activities could also play a role in the high degree of fragmentation seen in the terrestrial mammal bone but due to the highly processed nature of the bone debris, grease and marrow extraction are more plausible explanations.

The issue of faunal fragmentation is further explored by looking at the minimum number of elements represented for each species. Minimum number of elements, based off the number of identified specimens, accounts for fragmentation by showing “the minimum number of different specimens referable to a given anatomical part used in classification” (Binford 1984:50). All of the same issues that can bias the number of identified specimens (i.e. different numbers of skeletal elements in different species, sampling techniques and taphonomic processes) can also bias the minimum number of elements; nevertheless, the latter is still an effective calculation for dealing with assemblage fragmentation because it illustrates the minimum number of whole elements that account for an assemblage (Binford 1984; Reitz and Wing 1999).

The minimum number of elements value for terrestrial mammals is 656, for fish it is 653, for birds it is 303, and for marine mammals it is 3 (Table 3). Once portion and body side data are taken into account terrestrial mammals still account for a majority of the assemblage and, after considering relative body size, they are certainly the most important dietary resource. Caribou, a large mammal, account for 574 of the 656 terrestrial mammal

elements and burbot and grayling—generally small to medium sized fish—account for 642 of the 653 fish elements.

The minimum number of elements calculation for caribou is the most important to assess because they account for the majority of remains. There is extreme fragmentation within the terrestrial mammal class and the assumption is made that most of the unidentified fragments are caribou. At least 574 elements must account for the 1,048 caribou specimens identified. This means that the *identified* caribou remains exhibit a moderate to high degree of fragmentation largely accounted for by ribs, humeri, radii + ulnas, femurs and tibias. The high degree of long bone fragmentation is consistent with marrow and grease extraction. The minimum number of elements calculations show that nearly every caribou body portion is represented in the sample. After considering fragmentation, body part representation, body size and available meat, my conclusion is that caribou played the most important role in diet at House Pit 8. The remaining terrestrial mammal species present have small relative abundances, and potentially provide limited amounts of food.

Burbot, a freshwater cod, predominates in the fish class and more than doubles the next most-represented fish. Based on the minimum number of elements and relative body size, burbot are the second most important dietary resource. Ptarmigan dominate the bird class and again, based on the minimum number of elements and relative body size, they were the third most important dietary resource exploited by the occupants of the house. Unlike the terrestrial mammal and bird classes, the fish class shows a second very well represented species—grayling. Grayling were likely an important dietary component but definitely follow behind caribou, burbot and ptarmigan. Marine mammals are only represented by three individual specimens making it difficult to argue that any marine mammal taxa played a significant dietary role here; however, the mere presence of marine mammal fauna does indicate a relationship to the coast. Lastly, the solitary mammoth remain found in House Pit 8 consisted of a water worn piece of fossil ivory that was likely picked up from one of the many gravel bars in the Noatak River valley.

Diet Based on Artifacts

Artifacts were classified and quantified according to function. Previous ethnographic and archaeological studies from the Arctic form the basis for this functional analysis (Burch 2006:232-254; Ford 1959:75-151; Giddings 1952:34-57; Nelson 1899:118-194). Artifacts are placed into one or more categories according to the types of animal resources they are associated with based on ethnohistoric observations of tools in use. An ivory fishing lure would be placed in the fish category since it is used for fishing. If a given artifact could conceivably be associated with more than one animal class then it was counted for each. Quantifying the subsistence-related artifacts in this manner allows for a comparison between the resource use conclusions drawn from material culture with those drawn from the faunal assemblage. This analysis focuses on procurement artifacts which are defined as those directly involved in obtaining subsistence resources and include projectile points (n=26),

harpoon tips/projectile points (n=1), leister prongs (n=1), fishing lures (n=1), gull hooks (n=2) and ice picks (n=1). Percentages of artifacts associated with each animal class are presented in Figure 5.

When assessing the data presented in Figure 5, it is important to think about the effect that human behavior—specifically artifact use life, discard and storage activities—can have on artifact assemblage formation (Schiffer 1972). It is reasonable to believe that some tools used for procuring game would be stored and used outside of a dwelling. Some subsistence-related artifacts used by the occupants of House Pit 8 are likely not included in this analysis because they were not discarded or stored inside of the house. Decisions regarding tool storage and caching play a role in determining what artifacts become curated within a given archaeological context. In terms of this functional analysis, it is important to take behavior like this into account and understand the biasing effect it can (and most likely does) have on the archaeological record.

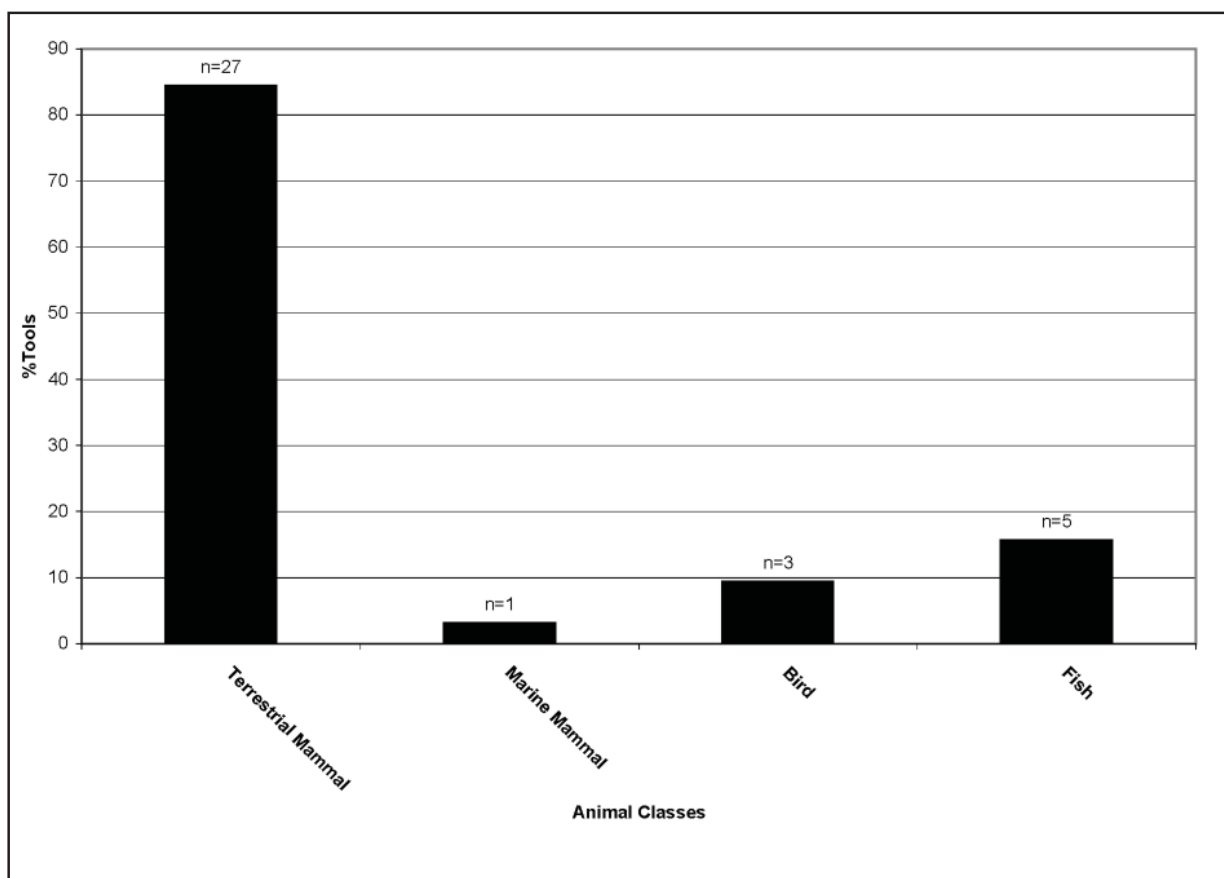


Figure 5. Percentages of procurement tools (n=32) associated with each animal class.

Figure 5 illustrates that the dietary needs of the occupants of House Pit 8 were primarily satisfied with terrestrial mammals. Fish and birds are represented in the artifact assemblage to a lesser degree, but certainly provided an important secondary resource base. Since only one artifact can be associated with marine mammal utilization, they are not considered as an important subsistence resource while the house was occupied.

Seasonality

The climate in interior northwest Alaska has a significant and direct impact on the seasonal distribution of natural resources. At the turn of the 19th century, the seasons along the middle portion of the Noatak River significantly influenced the kinds of resources available thus dictating where people were living at different times of the year (Burch 1998:91-106). Season-specific resources can be visible in the archaeological record which is of great utility to archaeologists when interpreting site seasonality and land-use. This study utilized two methods for inferring the seasonal occupation of House Pit 8: the presence/absence of seasonally available remains and rates of juvenile caribou tooth eruption. Overviews of these two methods are provided by Monks (1981).

Burbot and grayling are the two most common fish within the floor fill of House Pit 8. Neither of these species migrate nor are they considered anadromous; they are present in the Noatak River year round. Ethnographically, burbot and grayling were most heavily fished during the fall and/or winter seasons (Anderson et al. 1977:255-305; Burch 1998:101). The seasonal movement of burbot in the Noatak River is poorly understood and the location of grayling within a river system is not very predictable. Both fish are available in the region throughout most of the year and therefore cannot be linked to a specific season.

Salmon are the third most abundant fish in the sample and are an anadromous species. They hatch in the fresh waters of the Noatak River and then migrate out to sea. Upon reaching maturity they run back up the Noatak River, reproduce and die. Dolly Varden and salmon likely have similar skeletal elements, which is important to consider

because both species make seasonal runs up the Noatak River. The essential point here is the timing of these runs. If the runs do not overlap, then it is important to distinguish between the two because it will have significant implications for seasonal interpretation. Dolly Varden run up the Noatak River twice during the year, once in mid-summer and again in the fall (Scanlon 2008:22). Chum salmon run up the Noatak River beginning in mid-July and ending in early September (Eggers and Clark 2006: 2, 23-24). Based on this fisheries information, salmon and Dolly Varden are both available in the middle portion of the Noatak River between July and September.

Parmigan are the most common bird in the sample and are year round residents in the Noatak River valley, making it impossible to link them to a specific season (Burch 1998:87). Ducks, however, are migratory birds and are present in the study region in great numbers during the summer while completely absent during the winter. Ethnographically, migratory waterfowl exploitation is linked to the summer season when the birds are present in great abundance (Burch 1998:95). The presence of a single duck element indicates that House Pit 8 was occupied some time between May and September.

Hawks and gulls also exhibit seasonal movements within the study region. Generally hawks abandon the area during the winter months and gulls are only present when there is open water, meaning that both are only available as subsistence resources during the late spring, summer and early fall months. The presence of hawk and gull remains indicates that the house was occupied at some point between May and November. Ravens are in the region all year and cannot be linked to a specific season.

Caribou in the middle Noatak region today belong to the western Arctic caribou herd. Due to migration patterns, this herd is abundant in the region two times each year (i.e., spring and fall) making it impossible to use the presence and/or absence of caribou remains as a seasonal indicator (Burch 1998:86-87). The eruption stage of molars in juvenile caribou mandibles were used for inferring seasonal occupation. This technique consists of comparing the extent of tooth eruption in modern

specimens of a known age to archaeological specimens in order to ascertain the age of death (Gerlach 1989:319-343; Monks 1981; Spiess 1979:70-84). Once the age of death is determined a general season of death can be inferred based on an assumed month of birth.

Four juvenile mandibles with nested teeth were present within the faunal sample. Previous eruptions studies conducted by Spiess (1979:70-84) and Gerlach (1989:319-343) form the basis for the following eruption stages and age estimates. The season of death estimates are based on Gerlach (1989:339) since his study involved the western Arctic caribou herd. This analysis assumes a calving season in early June.

Two mandibles fell into the M3 erupting category which means they could have been killed during any season. Tooth height for both specimens is measured in order to try and discern if the animals were in the late or early stages of M3 eruption. The assumption is made that teeth with smaller measurements are in the early stages and teeth with larger measurements are in the later stages. A tooth height of 4.5 mm for one specimen shows that it is likely from a 15-20 month-old caribou, indicating a fall/winter kill (September through February). A measurement of 11.5 mm for the second specimen shows that it is likely from a 25-29 month-old caribou indicating a kill between late summer and early winter (July through November).

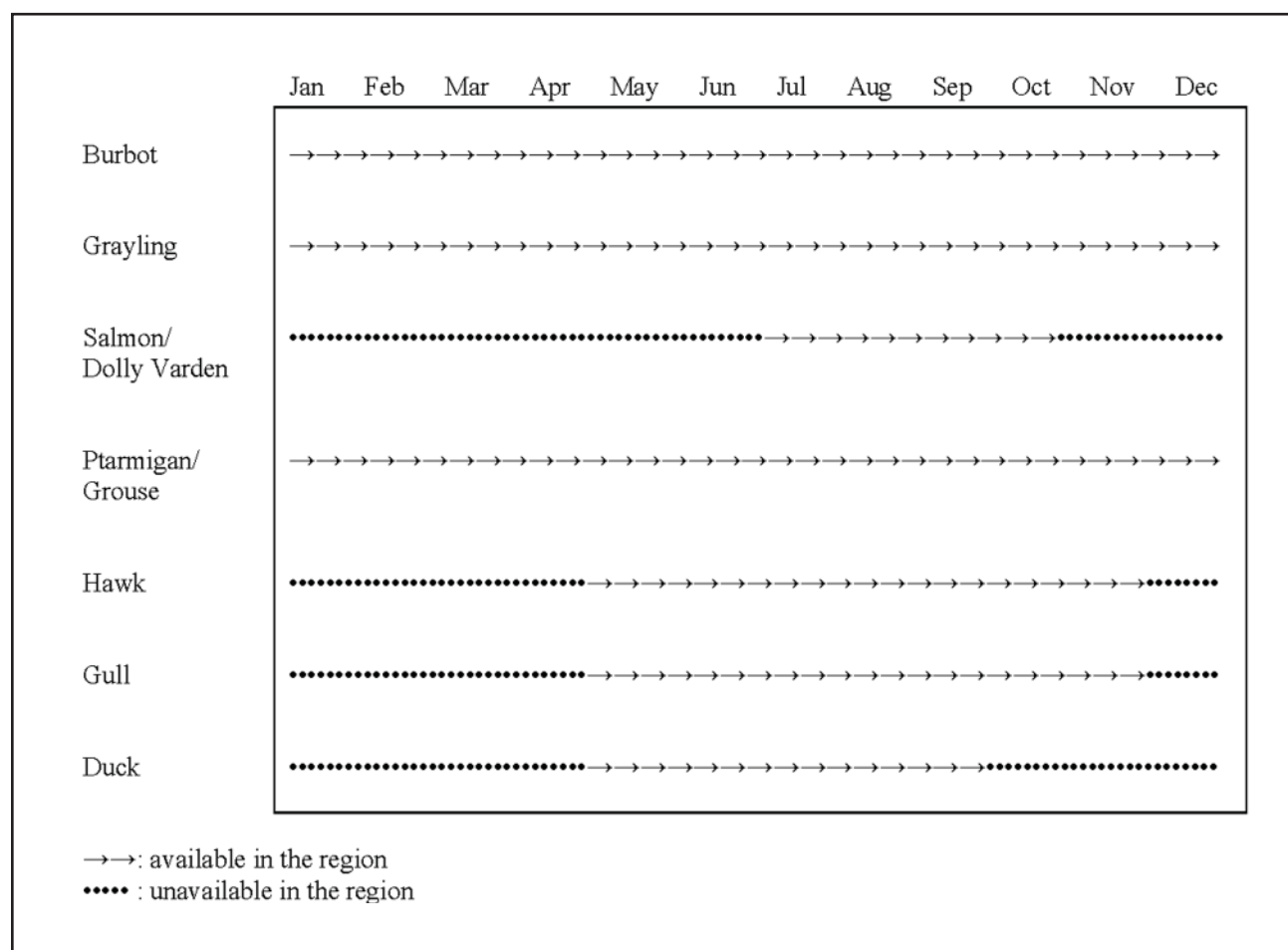


Figure 6. Seasonal availability of selected faunal remains from the floor of House pit 8.

Of the other two juvenile mandibles, one belongs to the M1 category and the other to the M2 category. The M1 mandible is easy to interpret because the age range is 3-5 months, meaning this animal was likely killed in the fall or early winter (September through November). The M2 is not so easily interpreted because the age range spans a six month period from summer to early fall. Tooth height was measured on this specimen to gauge the stage of M2 eruption. The top of M2 measured 7 mm above the bone indicating mid to late stage eruption and a late summer or early fall kill (July through September).

The presence/absence data as a whole shows that House Pit 8 could have been occupied during any portion of the year (Figure 6). Disregard the burbot, grayling and ptarmigan remains and the remaining taxa indicate a May through November occupation. Based on the mandibular eruption data the house was likely occupied sometime between July and February.

Combined, these two data sets show that occupation could have occurred throughout most of the year (May through February). However, I feel it is reasonable to consider House Pit 8 as a late summer, fall and/or winter domicile which equates to a July through February occupation. The remains that indicate a late spring/early summer occupation are the duck, gull and hawk. The duck could have been taken during multiple months between May and September and the gull and hawk could have been killed any time between May and November. Based on how these two data sets overlap, a July through February occupation of House Pit 8 is a more reasonable interpretation, which is also consistent with ethnographic descriptions of the region (Burch 1998:91-106).

Discussion and Conclusions

Several scholars have highlighted the importance of using local paleo-climate data in coordination with archaeological data when attempting to understand regional subsistence and settlement for the Late Prehistoric time period in northwest Alaska (Mason and Gerlach 1995; Murray et al. 2003). A recent hypothesis cites intervals of cold, stormy

coastal conditions making once reliable marine resources scarce, which would have forced populations to inland locales (Murray et al. 2003:101-102). Based on beach ridge formation along the northwest Alaskan coast at Cape Espenberg, "frequent and intense storms" occurred around A.D. 1400, A.D. 1550-1600 and A.D. 1700-1850 with more favorable coastal conditions prevailing around A.D. 1450-1550 and A.D. 1600-1700 (Mason and Gerlach 1995:109-110).

The primary question I address is how do the seasonality interpretation, artifact and faunal assemblages, and radiocarbon dates fit into the context of a settlement model that hypothesizes periods of coastal abandonment. The calibrated radiocarbon dates from House Pit 8 overlap with periods of storminess as well as with periods of calmer coastal conditions at Cape Espenberg. The House Pit 8 assemblages yielded sea mammal bones, sea mammal hunting equipment and ivory artifacts, the presence of which implies that these people either spent part of their year on the coast or were in contact with groups who did. Combine this with the fact that House Pit 8 was primarily occupied during the fall and winter, this leads to the conclusion that at the time the house was occupied people were employing a broad spectrum strategy to subsistence that included targeting inland as well as coastal resources.

While House Pit 8 does not support a model based on periods of coastal abandonment, this is still an important, open-ended question that cannot be easily answered through the investigation of a solitary house ruin. As more work is accomplished and more data is available (both archaeological and paleo-climatic) this model needs to be tested again. The study presented above begs the question of whether radiocarbon dating is of a scale fine enough to elucidate cycles of human occupation and abandonment. Large fluctuations in the calibration curve during the Late Prehistoric may be problematic in terms of elucidating 50 to 100 year periods of human occupation. This is a question that can only be addressed once an appropriately sized radiocarbon chronology is developed for sites in northwest Alaska occupied during the last 1000 years.

The interpretation of a July through February occupation for House Pit 8 correlates well with ethnographic accounts of the pre-contact (late 19th century) pattern of land-use (Burch 1998:91-106). These ethnographic accounts provide a basis for understanding how people utilized the landscape during the late prehistoric time period. During the fall (late-August through mid- to late-November), people would congregate along the banks of the Noatak River and families would build semi-subterranean houses. The most important factor in selecting house location was good access to caribou, although good fishing also played a key role (Burch 1998:99). As fall transitioned to winter people would remain in their houses along the river and live off their stored meat while continuing to hunt and fish. As the long winter season progressed this would become a more and more difficult task due to cold temperatures, thick ice and short daylight hours (Burch 1998:103).

Future research pertaining to prehistoric settlement patterns for the region should continue to draw on models formed from ethnographic sources, but should be expanded to include a broader array of site types. Future studies should include sites that more fully reflect the entirety of the seasonal round but should also include sites from a wider variety of time periods. Studies on climate-related settlement shifts in other regions of the world with more robust data sets (e.g. California, Greenland and Labrador) could form a methodological foundation for future studies of the Late Prehistoric time period in northwest Alaska (Boxt et al. 1999; Dugmore et al. 2007; Woollett 2007). Currently there is not sufficient archaeological or paleo-environmental data to make concrete correlations between local climatic fluctuations and settlement for the Late Prehistoric time period in northwest Alaska. Even though House Pit 8 at the Maiyumerak Creek Site does not directly support this hypothesis, a wider net should be cast in looking for broad periods of coastal abandonment. During less stormy periods people would likely continue to exploit interior resources as well as coastal ones, but during stormy intervals people may have turned wholly inland. If these types of patterns are to be seen in the record, archaeologists should begin by looking for gaps in site chronology on the coast

as a more productive strategy for testing this type of model.

Moving on from site seasonality and land-use, the reconstruction of the house occupants' diet reveals a primary focus on hunting terrestrial mammals, specifically, caribou. Fish and birds also played an important role in the diet of these people. Salmon were likely harvested as the run was finishing up in late summer and early fall, and as the season progressed into winter burbot and grayling were fished for through the ice. The house occupants were also adept at hunting birds and small mammals like ptarmigan and hare to supplement their diet. That being said, the most important subsistence activity for the occupants of this house was to acquire stores of caribou that would last as far through the winter as possible.

This dietary reconstruction is based on both faunal and artifact data sets with the belief that it would produce a more robust interpretation of subsistence resource-use. I also wanted to compare and contrast the resource-use conclusions drawn from each assemblage. The relative proportions of identified faunal remains (Figure 7) and procurement artifacts (Figure 5) associated with each of the four animal classes form the data sets for this comparison. These two charts show similar patterns and provide two independent lines of evidence regarding the types of resources utilized at the site. Both the faunal remains and the artifacts indicate a primary reliance on terrestrial mammals, with other animal classes comparatively under-represented. Thus, from this broad animal class perspective, there does not appear to be a great difference in subsistence resource use as reflected in the faunal remains and artifacts respectively, which indicates that sites lacking faunal preservation can still potentially yield reliable results concerning the general types of animals utilized.

Although this case study is situated in northwest Alaska, it addresses issues pertinent to regions throughout the world. On a broad level, this case illustrates the dynamic nature of human-environment interaction, highlighting the importance of using multiple lines of evidence and large, robust region-specific data sets to comprehensively address subsistence, seasonality and settlement questions. This is true not only for the Late Prehistoric in northwest Alaska but for any region and time period in the

world. Settlement and land-use patterns are complex and difficult to see in the archaeological record and, as previous scholars have noted, researchers need to address these topics using multiple, broad, oftentimes interdisciplinary data sets (Boxt et al. 1999:34; Dugmore et al. 2007:29; Woollett 2007:81). I emphasize the power of using combined lines of evidence for both individual site and regional interpretation.

Recent studies show that late Holocene (i.e., Late Prehistoric) climate change affected past human subsistence and settlement patterns at the regional level in places across the globe. More specifically, case studies from the North Atlantic have documented climate change related to the Little Ice Age and its impact on cultures centered in this region (Dugmore et al. 2007; Woollett 2007). Based on years of interdisciplinary research and myriad

data sets, Dugmore and colleagues (2007:30) argue that the downfall of the Norse Greenland settlement (11th to 16th century) occurred due to changing economic and cultural factors, but they do not deny that “cumulative changes in climate” likely played a role as well. In a study of 17th to 19th century post-contact Inuit culture in Labrador, Woollett (2007) argues that changes seen in settlement patterns (i.e. the movement of settlements inland) can be linked with a period of climatic stability during the Little Ice Age rather than with a prolonged cold period as previously hypothesized.

Along the Pacific coast, thousands of miles south of Alaska, an interdisciplinary study conducted during the 1990s (Boxt et al. 1999) had similar results to projects from the North Atlantic. Contrary to previously held beliefs that the climate

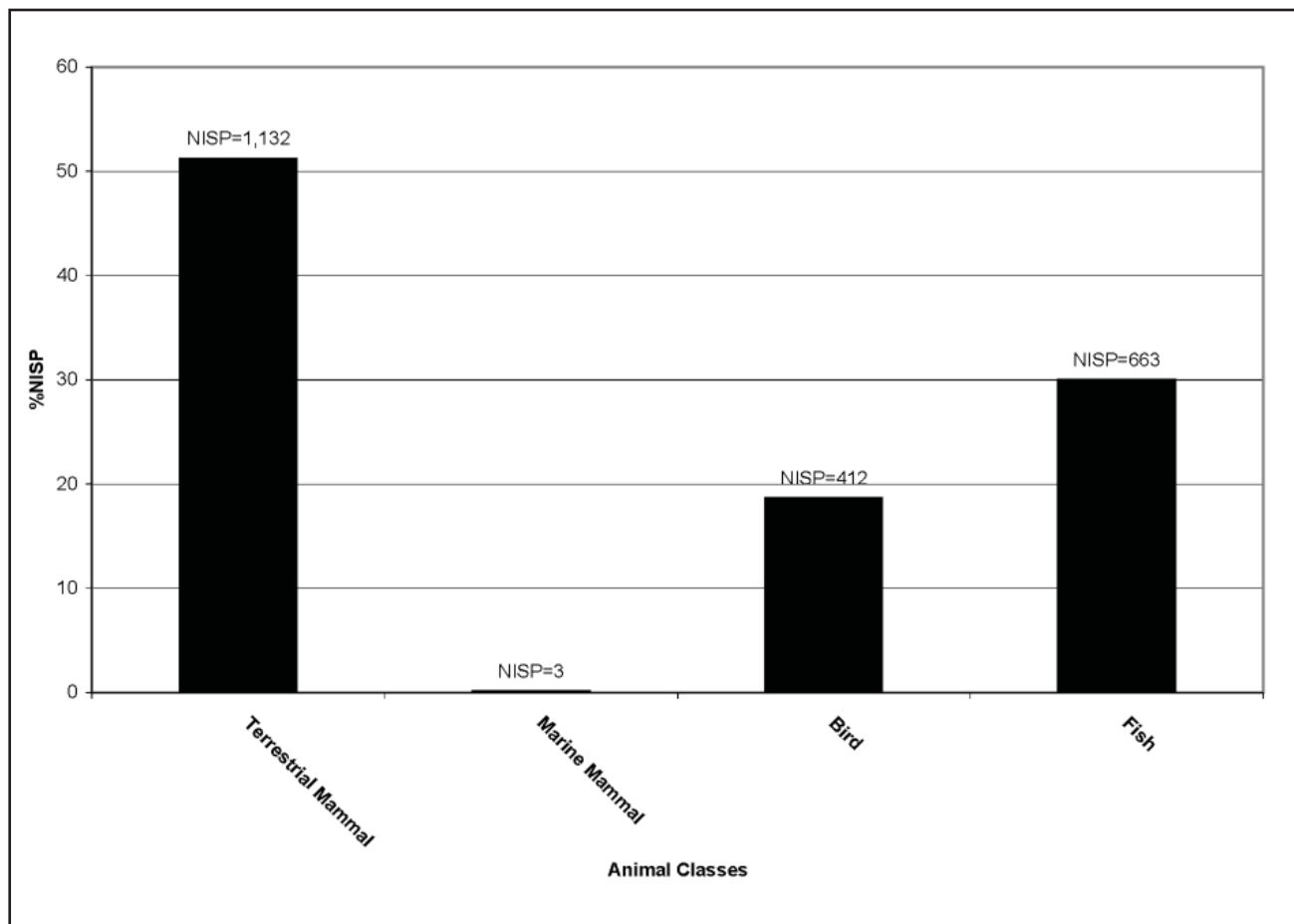


Figure 7. Number of identified specimens for the identified faunal remains (n=2,210).

has always been relatively stable, Bost and colleagues (1999) argue that the coast of southern California has seen dramatic climate fluctuations throughout the late Holocene resulting in culture change that includes: site abandonment, increased disease, malnutrition and increased warfare. The timing, severity and cultural impact of climate fluctuation on cultures centered near the Bering and Chukchi Seas in the North Pacific is not as well understood as their North Atlantic and southern Pacific counterparts for several reasons—most notably a lack of regional data for this time period. As work continues, and as appropriately sized regional data sets are accumulated (both archaeological and paleo-environmental), examining settlement patterns during the Late Prehistoric time period in northwest Alaska promises to be productive in terms of answering questions related to human response to environmental change. These are important issues not only for their relevance to archaeologists and

paleo-environmentalists but for their potential to address issues related to human adaptation to modern-day climate change.

Scott Shirar, Archaeology Department, University of Alaska Museum of the North, sjshirar@alaska.edu.

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Economic Diversification and Sustainable Development: The Role Non-timber Forest Products Play in the Monetization of Kayapó Livelihoods

LAURA C. ZANOTTI

Abstract

This paper analyzes the level of market integration of a relatively isolated Kayapó community. The goal is to understand how the commercial networks devoted to non-timber forest products are affecting one community by including cash-income into the economic life of communities previously dominated by non-monetary transactions but currently dominated by a mix of monetary and non-monetary practices. Non-timber forest product projects are a much lauded and much criticized form of sustainable forestry management. This case study analyses different non-timber forest product projects in Aukre, a village that is part of the Kayapó Indigenous Territories, Brazil. This article identifies ten criteria that the villagers use to evaluate cash-income opportunities and, considering these criteria, why community members consider non-timber forest product projects desirable. Desirable projects should provide maximum participation, offer alternative markets to intense extractive networks, and build long-term partnerships based on a common interest in maintaining the territorial integrity of the Kayapó's homeland. The evaluation of non-timber forest product projects is accompanied by an analysis of other types of cash income in the community, and a comparison of past and present economic opportunities to future possibilities. The results indicate the community of Aukre still values non-timber development projects within their community, despite a varied experience with timber and non-timber markets. However, their participation within these markets is based on several criteria, which community members perceive to be integral to project success.

Introduction: Non-Timber Forest Products and Kayapó Economies

During the last quarter of the 20th century the Kayapó from the Central Brazilian Amazon have been increasingly involved with commercial markets and cash-income opportunities, some of which entail the export of non-timber forest products. The case of the Kayapó is a local manifestation of a global phenomenon where forest management 1) increasingly relies on local institutions for good forest governance, and 2) employs multiple-use forestry strategies. Worldwide forestry management over the last ten to thirty years has followed a basic

trend where forest policies devolved away from the state to municipal and community rule (Charnley and Poe 2007; Morsello 2006). Brazil, as one of the most biologically diverse countries, has modified its forestry policy to mirror international trends in an effort to engage with the growing international interest in conservation and sustainable forestry (Toni 2003), thus fueling new opportunities for alliances, partnerships and markets among the growing number of actors in the Amazon region (Ros-Tonen et al. 2008).

Accordingly, non-timber forest products have emerged as a major commodity in sustainable forestry markets and are considered a solution to a two-pronged problem of poverty and deforestation (Nepstad and Schwartzman 1992; Peters et al. 1989; Wolleberg and Ingles 1998). The example of the Chico Mendes Rubber Extractive Reserve, Brazil, is a case in point where economic activities have been incorporated into conservation measures (Cardoso 2002; Fearnside 1989; Hecht 2007). On the other hand, scholars have approached non-timber forest product projects with caution, and documented several case studies where non-timber forest product markets have mixed social, ecological, and economic consequences (Boot and Gullison 1997; Sheil and Wunder 2002; Wollenberg 1998). Nevertheless, community-based resource management schemes that incorporate non-timber forest products have the possibility of coupling local users and market activities in a way that the local community is empowered, rather than fractured, by their market participation (Anderson and Ioris 1992; Dove 1993; Vaccaro et al. 2009).

This article examines the varied experiences the Kayapó community of Aukre has had with non-timber forest product markets and analyzes the positive and negative consequences of such projects. Non-timber forest product markets have been available to the community of Aukre through commercial venues, individual sales and community-NGO partnerships. Almost all of these projects have been based on Brazil nut (*Bertholletia excelsa*) markets. In addition to Brazil nut markets, the community of Aukre has a suite of economic activities that are available to community members. Because of Aukre's history with several markets, this case study also considers how non-timber forest product markets fit regarding other cash income opportunities. Despite several mixed experiences with markets and willingness to participate in many different types of economic activities, community members in Aukre still insist that non-timber forest product projects provide for sustainable development.

This article also considers why villagers of Aukre perceive non-timber forest product projects as highly desirable sources of cash-income. Community

members cite several reasons for their preference for non-timber forest product projects and have their own indicators for what constitutes a valuable market endeavor. These indicators of a viable market endeavor for community members are that it: (i) generates a long-term source of income; (ii) enables villagers to continue with their subsistence livelihoods; (iii) provides the maximum level of participation within the community; (iv) capitalizes on local land use and subsistence practices; (v) coordinates with social institutions already in place; (vi) promotes intervillage collaboration and cooperation; (vii) builds upon or further solidifies community-outsider partnerships; (viii) minimally alters the village landscape; (ix) trains community members so no outsiders need to live or reside in the village for long periods of time; and the (x) environmental impact does not interfere with subsistence and ceremonial needs. These indicators, when examined as a collection, indicate that community members are invested in cash-income opportunities that maintain the production and reproduction of ceremonial, subsistence and political life (Gordon 2006). However, Aukre faces many challenges to implement and maintain non-timber forest product projects. Non-timber forest product projects also can have unintentional consequences that affect intra-village and inter-village relationships. Regardless of non-timber forest product project shortcomings, communities indicate that the projects offer them several opportunities to engage with markets, outside institutions and other villages in meaningful ways.

Research Methods

This study is based on ethnographic research with the Kayapó and a selection of existing literature about the Kayapó's involvement with non-timber forest products. The Kayapó are an indigenous group in the Central Brazilian Amazon that command a set of federally demarcated protected areas collectively identified as the Kayapó Indigenous Territories that are located in the states of Pará and Mato Grosso. The Kayapó territory covers more than 10 million hectares of neotropical forest and naturally occurring, but sometimes anthropogenically modified, savannah and is roughly the size of Austria (Zimmerman