LATE HOLOCENE CHRONOLOGY OF THE NOATAK AND KOBUK RIVERS

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ABSTRACT

There have been few contributions to a late Holocene chronology for Northwest Alaska since Giddings' early dendrochronology work in the 1940s and 1950s, which helped define the "Arctic Woodland Culture" along the Kobuk River. This paper contributes thirty radiocarbon dates to a late Holocene site chronology for interior Northwest Alaska, which includes dates from five sites and fourteen semisubterranean houses. The accuracy of the existing chronology is evaluated by carbon dating five of the same houses that Giddings analyzed using dendrochronology.

INTRODUCTION

The Noatak and Kobuk rivers both drain portions of the Brooks Range into Hotham Inlet in Kotzebue Sound (Fig. 1). Today each river serves as an important travel corridor connecting the coastal and interior portions of Northwest Alaska; this was likely true prehistorically as well. Currently there is a general lack of chronological data for late Holocene (i.e., ad 1000–1900) archaeological sites along the Noatak River, with only a handful of sites investigated and no regional-scale analyses to date (DeAngelo 2001; Gilbert-Young 2004; Hall 1969, 1971; Shirar 2007, 2009). More data are available for late Holocene sites along the Kobuk River based on J. Louis Giddings' pioneering archaeological and dendrochronological work in the 1940s and 1950s, but there is little data for the Kobuk region (Anderson 1983, 1988; Giddings 1941, 1942, 1944, 1948, 1952; Hickey 1968, 1976, 1977, 1979). The lack of new chronological data for late Holocene sites of interior Northwest Alaska is addressed here with the addition of thirty radiocarbon dates from three sites in the Kobuk River valley (Ahteut, Ekseavik, and Ambler Island) and two sites in the Noatak River valley (Maiyumerak Creek and Lake Kaiyak) (Fig. 1).

Beyond contributing to a late Holocene site chronology for each of these river valleys, this paper evaluates the relationship between dendrochronology and radiocarbon dating to see if it is possible to directly compare dates derived from each method. Giddings' (1952) dendrochronology for sites in the Kobuk River valley is based on tree-rings from white spruce (*Picea glauca*), a species that is completely absent from the middle and upper portions of the Noatak. This circumstance makes it impossible to compare sites from each valley using dendrochronology alone. To remedy this situation, I tested the relationship between dendrochronology dates from the Kobuk and radiocarbon dates from the Noatak by radiocarbon dating five of the same Kobuk houses that Giddings previously dated using tree rings. If the calibrated radiocarbon dates from these houses at least partially overlap with the dendrochronology dates, then direct comparison of the two dating methods is a suitable technique for current and future research efforts. I also report on a test of the occupation dates of several sites and houses that Giddings determined using dendrochronology.

REGIONAL ECOLOGY

The Kobuk River exists largely within a boreal forest or taiga environment, while the Noatak River flows through a mostly treeless tundra environment, except in its lower portions. Despite the fact that trees are an abundant resource along the Kobuk and nearly absent along the Noatak, many of the same plant and animal species exist

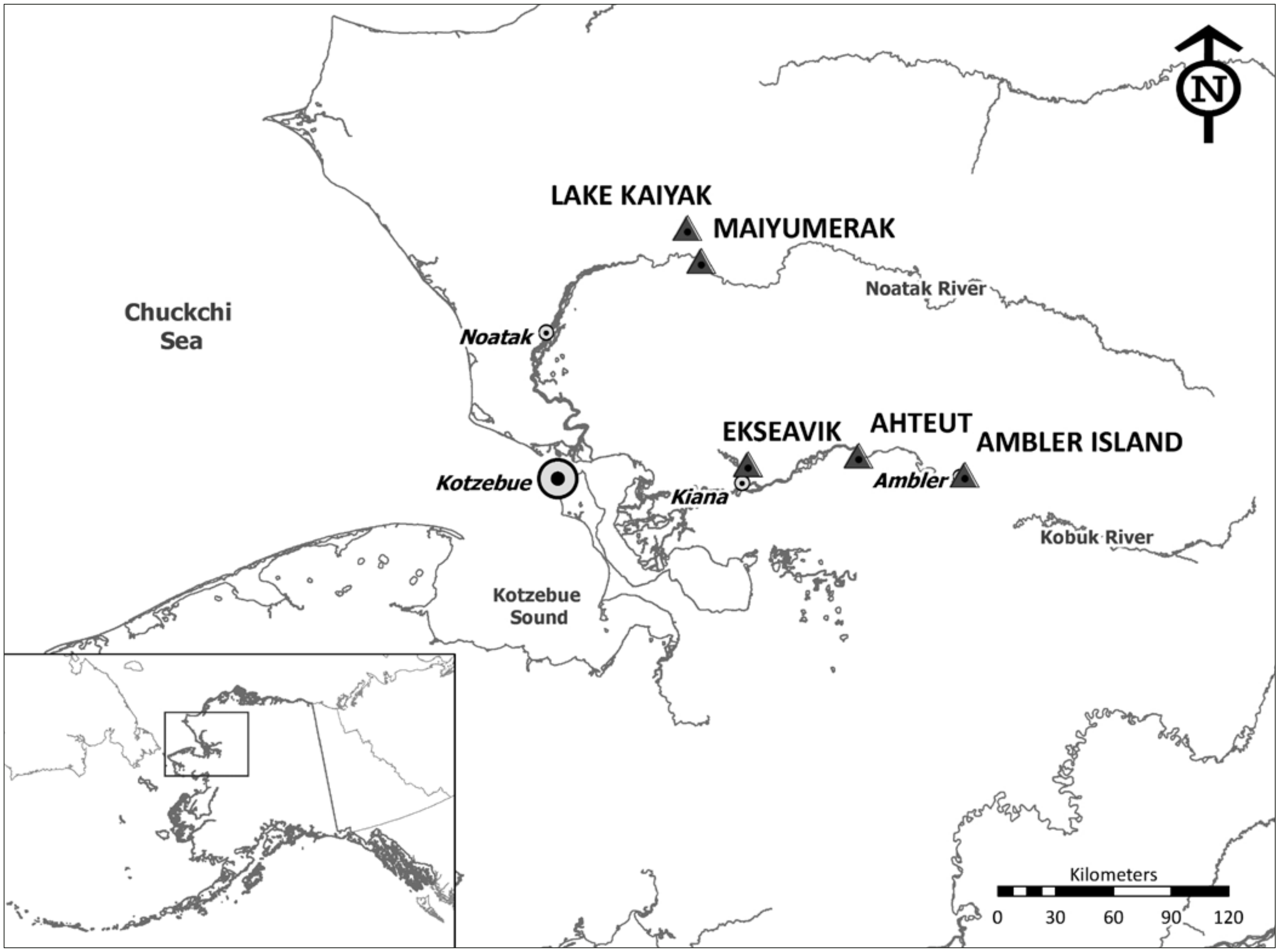

Figure 1. Map of Northwest Alaska showing the location of the Noatak and Kobuk River valleys and the location of each site discussed in the study. Map produced by Chris Houlette and edited by Sam Coffman.

in both valleys (Anderson et al. 1977; Gardner 1974; Kunz et al. 1984; Manuwal 1974; National Park Service 1986a, 1986b; Schroeder 1996; Young 1974). One key difference between the local ecology of each valley is the density, timing, and extent of salmon, trout, and sheefish runs. Large numbers of these fish spawn in the Kobuk River and its tributaries beginning in early summer through the fall. Ethnographically this abundance of fish is known to serve as the subsistence base throughout the year (Anderson et al. 1977; Burch 1998:158; Giddings 1956). Smaller numbers of fish make spawning runs to the upper Noatak River and for a shorter period of time during the summer. While still important ethnographically, fish were a less significant resource for this area when compared to caribou (Burch 1998:100–101).

Settlement, seasonality, land use, subsistence, and technological development in Northwest Alaska are directly related to fluctuations in climate and resource availability throughout the late Holocene. Several models of late Holocene climate fluctuation have been produced using proxy data specific to Northwest Alaska. These records are based on beach ridge development at coastal locations (Cape Espenberg and Cape Krusenstern), soil development at specific archaeological sites (Iyatayet and Onion Portage), expansion and contraction of the Great Kobuk Sand Dunes, and the tree-ring records for the Kobuk River valley and Seward Peninsula (D'Arrigo et al. 2005; Giddings 1941, 1942, 1944, 1948, 1952; Graumlich and Gerlach 1992; Graumlich and King 1997; Mann et al. 2002; Mason 1990; Mason and Gerlach 1995; Mason and Jordan 1991). The role of climate fluctuation in late Holocene cultural development, whether significant or not, cannot be fully realized until a robust chronology is achieved.

A current working hypothesis regarding settlement and subsistence states that intervals of cold, stormy coastal conditions in Northwest Alaska during the past one thousand years forced human populations to inland locales (Murray et al. 2003:101–102). The development of a radiocarbon chronology for the past millennium will permit this hypothesis to be tested as new sites and individual features are temporally linked to climate conditions. If climate fluctuations were significant enough to affect local ecology, then human settlement should presumably shift, which should also be reflected in artifact and faunal assemblages.

LATE HOLOCENE ARCHAEOLOGY OF NORTHWEST ALASKA

Some of the first archaeological research accomplished in Northwest Alaska was during the 1940s when J. Louis Giddings conducted excavations at five late Holocene sites, each located either inland near the Kobuk River or on the coast near the town of Kotzebue. House timbers were collected at each site and a 970-year tree-ring record was created, allowing for these sites to be precisely dated (Giddings 1941, 1942, 1944, 1948, 1952; Graumlich and King 1997; Nash 2000). Giddings then used these dates to assemble a chronology for the region (e.g., Giddings 1952). As Giddings defined it, the Arctic Woodland Culture advanced over 500 years through six periods: Ahteut (AD 1250), Ekseavik (AD 1400), Old Kotzebue (AD 1400), Intermediate Kotzebue (AD 1550), Ambler Island (AD 1730–1760), and the Historic Aspect (Giddings 1952:9). Giddings' monograph remains the primary source for late Holocene archaeological research in Northwest Alaska, and today sites are still discussed in terms of how they relate to Giddings' Arctic Woodland chronology.

Beyond testing at Kotzebue, Ahteut, Ekseavik, and Ambler Island, Giddings (1952) recorded several other late Holocene sites during his pioneering work along the Kobuk River. Work continued in the valley throughout the 1960s at the Onion Portage, Kayák, and Ivisahpat sites, but little work was accomplished during the 1970s (Anderson 1988; Giddings 1962; Hickey 1968, 1977). In the 1980s the National Park Service began managing portions of the Kobuk River valley resulting in numerous archaeological projects that identified several late Holocene sites (Kunz 1984 et al.; Shirar 2010, 2012). Since Giddings' early work, just five late Holocene sites have been dated using either radiocarbon or dendrochronology: Onion Portage, the Kayák site, the Ivisahpat site, AMR-220, and AMR-223 (Anderson 1988; Hickey 1968, 1977; Shirar 2010).

In the Noatak River valley, only four late Holocene sites have been systematically investigated. The first site excavated was Kangiguksuk in the 1960s (Hall 1971), followed by the Sapun Creek site in the 1990s (DeAngelo 2001), the Lake Kaiyak site, also in the 1990s (Gilbert-Young 2004), and the Maiyumerak Creek site in 2006 (Shirar 2007, 2009). Based on one dendrochronology sample and artifact comparisons to Giddings' Arctic Woodland sites, the occupations at Kangiguksuk and Sapun Creek are interpreted as sixteenth century. Given the small dendrochronology sample size and issues related to dating based on artifact style (see Murray et al. 2003), the temporal placement of these two sites is tentative. Two houses at the Lake Kaiyak site are radiocarbon dated. House 1 likely dates to the fifteenth or sixteenth century and House 2 could date anywhere between the 1400s and 1700s (Table 1). Seven features at the Maiyumerak Creek site are dated using radiocarbon and show that this site was occupied intermittently throughout much of the late Holocene (Table 1).

Our knowledge of how land use and settlement patterns relate to the late Holocene chronologies from the Noatak and Kobuk is incomplete. Giddings (1952:113) made seasonal interpretations for the sites he studied along the Kobuk River based on the artifact assemblages and noted that "people wintering on the middle river have at all times practiced a certain amount of sealing on the coast." Each of the four sites on the Noatak River are interpreted as spring, fall, and/or winter habitations. The late Holocene summer pattern is unknown, although each site does exhibit a small amount of sea mammal fauna and hunting equipment indicating ties to the coast (DeAngelo 2001; Gilbert-Young 2004; Hall 1971; Shirar 2007, 2009).

Ethnographically, people from the middle and upper Noatak River valley would travel to the coast during the summer to fish, hunt sea mammals, and trade before travelling back upriver in the early fall (Burch 1998:91–95). It makes sense to recover small amounts of sea mammal remains and related hunting gear at inland sites occupied by people who spent several months of each year on the coast. During the last millennium it is possible that people in Northwest Alaska followed a seasonal round similar to the eighteenth- and nineteenth-century ethnohistoric patterns described by Burch (1998, 2006). Before any meaningful conclusions can be drawn, this hypothesis needs

Table 1: Radiocarbon dates and associated information for late Holocene sites in interior Northwest Alaska

Lab #	Catalog Number[1]	Artifact Type	Material	$\delta^{13}C$	Conventional ^{14}C Age	2σ Calibrated Age Ranges[2]	Provenience	Dendrochronology Dates (# of samples)[3]
Beta-223358	NOAT 29822	N/A	caribou bone	19.5‰	280 ± 40 ^{14}C yrs BP	cal AD 1485–1668 (95.2%) cal AD 1781–1797 (4.4%) cal AD 1947–1950 (0.4%)	Maiyumerak House 8 (MY8)	N/A
Beta-228015	NOAT 29942	N/A	caribou bone	20.2‰	280 ± 40 ^{14}C yrs BP	cal AD 1485–1668 (95.2%) cal AD 1781–1797 (4.4%) cal AD 1947–1950 (0.4%)	Maiyumerak House 8 (MY8)	N/A
Beta-223359	NOAT 29941	N/A	caribou bone	19.3‰	170 ± 50 ^{14}C yrs BP	cal AD 1652–1711 (20.1%) cal AD 1716–1891 (62.4%) cal AD 1909–1953 (17.5%)	Maiyumerak House 8 (MY8)	N/A
Cams-142693	NOAT 29941	N/A	caribou bone	19.5‰	325 ± 40 ^{14}C yrs BP	cal AD 1468–1647	Maiyumerak House 8 (MY8)	N/A
Beta-76675	NOAT 3214	N/A	unidentified charcoal	27.3‰	780 ± 100 ^{14}C yrs BP	cal AD 1031–1355 (91.6%) cal AD 1345–1393 (8.4%)	Maiyumerak House 8 (MY8)	N/A
Beta-228016	NOAT 28090	N/A	*Populus* or *Salix* charcoal	26.5‰	520 ± 40 ^{14}C yrs BP	cal AD 1316–1355 (22.0%) cal AD 1388–1447 (78.0%)	Maiyumerak House 8 (MY8)	N/A
Cams-141646	UA 1-1947-124	metapodial scraper	caribou bone	19.3‰	615 ± 30 ^{14}C yrs BP	cal AD 1294–1401	Ekseavik House 11 (EK11)	AD 1279–1410 (43)[4]
Cams-141647	UA 1-1947-125	metapodial scraper	caribou bone	18.2‰	735 ± 20 ^{14}C yrs BP	cal AD 1256–1290	Ekseavik House 11 (EK11)	AD 1279–1410 (43)
Cams-141648	UA 1-1941-399	ice pick	caribou antler	17.8‰	710 ± 25 ^{14}C yrs BP	cal AD 1262–1300 (94.3%) cal AD 1369–1381 (5.7%)	Ekseavik House 1 (EK1)	AD 1365–1384 (4)
Cams-141649	UA 1-1941-1661	metapodial scraper	caribou bone	18.5‰	815 ± 30 ^{14}C yrs BP	cal AD 1170–1268	Ekseavik House 1 (EK1)	AD 1365–1384 (4)
Cams-141640	UA 1-1941-1716	metapodial scraper	caribou bone		830 ± 35 ^{14}C yrs BP	cal AD 1058–1064 (0.7%) cal AD 1067–1071 (0.5%) cal AD 1155–1272 (98.8%)	Ahteut House 10s (AH10s)	AD 1202–1242 (5) (AH3n)[5]
Cams-141641	UA 1-1941-1717	metapodial scraper	caribou bone	19.1‰	840 ± 35 ^{14}C yrs BP	cal AD 1052–1080 (4.9%) cal AD 1129–1132 (0.5%) cal AD 1153–1268 (94.6%)	Ahteut House 10s (AH10s)	AD 1202–1242 (5) (AH3n)
Cams-141642	UA 1-1941-2774	metapodial scraper	caribou bone	18.6‰	325 ± 30 ^{14}C yrs BP	cal AD 1480–1644	Ambler Island House 2 (AI2)	AD 1684–1754 (4)
Cams-141645	UA 1-1941-2893	awl	caribou bone	19.2‰	370 ± 25 ^{14}C yrs BP	cal AD 1449–1524 (60.5%) cal AD 1558–1631 (39.5%)	Ambler Island House 2 (AI2)	AD 1684–1754 (4)

Table 1 (continued)

Lab #	Catalog Number[1]	Artifact Type	Material	$\delta^{13}C$	Conventional ^{14}C Age	2σ Calibrated Age Ranges[2]	Provenience	Dendrochronology Dates (# of samples)[3]
Cams-141643	UA 1-1941-2775	metapodial scraper	caribou bone	17.3‰	265 ± 35 ^{14}C yrs BP	cal AD 1494–1601 (42.3%) cal AD 1616–1672 (46.4%) cal AD 1778–1799 (9.8%) cal AD 1942–1951 (1.5%)	Ambler Island House 11 (AI11)	AD 1761 (1)
Cams-141644	UA 1-1941-2815	metapodial scraper	caribou bone	18.1‰	390 ± 30 ^{14}C yrs BP	cal AD 1441–1523 (72.8%) cal AD 1559–1562 (0.6%) cal AD 1571–1630 (26.6%)	Ambler Island House 11 (AI11)	AD 1761 (1)
Beta-223360	NOAT 29725	N/A	caribou bone	20.4‰	360 ± 40 ^{14}C yrs BP	cal AD 1450–1532 (48.2%) cal AD 1536–1635 (51.8%)	Maiyumerak House 1	N/A
Beta-223361	NOAT 29479	N/A	caribou bone	19.5‰	130 ± 40 ^{14}C yrs BP	cal AD 1670–1780 (41.3%) cal AD 1798–1896 (41.6%) cal AD 1902–1944 (16.1%) cal AD 1950–1953 (1.0%)	Maiyumerak House 3	N/A
Beta-223362	NOAT 29793	N/A	caribou bone	18.8‰	470 ± 50 ^{14}C yrs BP	cal AD 1320–1350 (4.7%) cal AD 1391–1518 (91.5%) cal AD 1594–1618 (3.8%)	Maiyumerak House 4	N/A
Beta-223363	NOAT 29749	N/A	caribou bone	18.8‰	620 ± 40 ^{14}C yrs BP	cal AD 1288–1405	Maiyumerak House 6	N/A
Beta-223364	NOAT 29411	N/A	caribou bone	19.4‰	360 ± 40 ^{14}C yrs BP	cal AD 1450–1532 (48.2%) cal AD 1536–1635 (51.8%)	Maiyumerak House 7	N/A
Beta-223365	NOAT 29767	N/A	caribou bone	18.5‰	270 ± 40 ^{14}C yrs BP	cal AD 1486–1675 90.3%) cal AD 1769–1799 (8.2%) cal AD 1941–1951 (1.5%)	Maiyumerak House 9	N/A
Beta-223366	NOAT 29672	N/A	caribou bone	19.1‰	260 ± 40 ^{14}C yrs BP	cal AD 1491–1602 (38.8%) cal AD 1613–1681 (43.2%) cal AD 1739–1744 (0.5%) cal AD 1763–1802 (14.6%) cal AD 1938–1951 (2.9%)	Maiyumerak Locus 3	N/A
Beta-223367	NOAT 29313	N/A	caribou bone	19.3‰	270 ± 40 ^{14}C yrs BP	cal AD 1486–1675 (90.3%) cal AD 1769–1799 (8.2%) cal AD 1941–1951 (1.5%)	Maiyumerak Locus 3	N/A
Beta-223368	NOAT 29594	N/A	caribou bone	19.4‰	380 ± 40 ^{14}C yrs BP	cal AD 1442–1529 (58.1%) cal AD 1543–1634 (41.9%)	Maiyumerak Locus 3	N/A
Beta-223369	NOAT 29340	N/A	caribou bone	19.3‰	310 ± 40 ^{14}C yrs BP	cal AD 1472–1653	Maiyumerak Locus 3	N/A

(continued on next page)

Table 1 (continued)

Lab #	Catalog Number[1]	Artifact Type	Material	$\delta^{13}C$	Conventional ^{14}C Age	2σ Calibrated Age Ranges[2]	Provenience	Dendrochronology Dates (# of samples)[3]
Cams-141635	NOAT 5118	N/A	caribou bone	19.1‰	385 ± 30 ^{14}C yrs BP	cal AD 1443–1524 (68.8%) cal AD 1558–1564 (1.3%) cal AD 1569–1631 (29.9%)	Lake Kayak House 1	N/A
Cams-141638	NOAT 5719	N/A	caribou bone	19.0‰	400 ± 30 ^{14}C yrs BP	cal AD 1437–1522 (80.4%) cal AD 1574–1585 (1.9%) cal AD 1586–1625 (17.7%)	Lake Kayak House 1	N/A
Cams-141636	NOAT 5214-2	N/A	caribou bone	19.2‰	245 ± 30 ^{14}C yrs BP	cal AD 1523–1571 (9.9%) cal AD 1630–1681 (58.2%) cal AD 1739–1744 (0.4%) cal AD 1763–1802 (27.0%) cal AD 1938–1951 (4.5%)	Lake Kayak House 2	N/A
Cams-141637	NOAT 5214-95	N/A	caribou bone	20.0‰	405 ± 30 ^{14}C yrs BP	cal AD 1434–1521 (84.2%) cal AD 1575–1583 (1.3%) cal AD 1590–1623 (14.5%)	Lake Kayak House 2	N/A

1 NOAT catalog numbers are National Park Service and UA catalog numbers are University of Alaska Museum of the North.

2 All samples were calibrated using Calib ^{14}C Radiocarbon Calibration Program (Stuiver et al. 2006) using the IntCal09 atmospheric curve (Reimer et al. 2009). Percentages are the relative area associated with the given range of the calibration curve for each date.

3 From Giddings (1952:105–110). Number of samples refers to the total number of dendrochronology samples recovered from a given provenience. Not all samples were dated by Giddings.

4 Ekseavik House 11 dendrochronology dates incorporate both Giddings (1952) and revised dates from Graumlich and King (1997).

5 No dendrochronology exists for Ahteut House 10s. Giddings (1952:108) dated the Ahteut site based on five samples from House 3n.

further testing and analysis. Data are needed from more late Holocene sites, not only from the Noatak and Kobuk River valleys, but also from coastal areas such as Cape Krusenstern, Kotzebue Sound, and Cape Espenberg.

SITE LOCATIONS AND DESCRIPTIONS

This paper focuses on five sites, the Ahteut, Ekseavik, and Ambler Island sites from the Kobuk River valley and the Maiyumerak Creek and Lake Kaiyak sites from the Noatak River valley (Giddings 1952; Gilbert-Young 2004; Shirar 2007, 2009). The Ahteut site is located along the middle portion of the Kobuk River approximately 96 km above the village of Kiana and 80 km below the village of Ambler (Fig. 1). The site is large and has designated north and south components consisting of an estimated 100+ house pits. Giddings (1952:27–29) excavated eight houses from the south portion of the site and four from the north portion. The Ahteut site is the oldest of the three sites on the Kobuk and exhibited the least amount of wood preservation, presumably due to its older age and a lack of permafrost at the site. Because of this poor preservation, few suitable dendrochronological samples were collected. Giddings (1952:108) dated Ahteut based on only five samples, all recovered from House 3n. Based on these five tree-ring dates, which range between AD 1202 and 1250, Giddings estimated that the Ahteut site was occupied sometime around AD 1250.

The Ekseavik site is located approximately 13 km up the Squirrel River from its confluence with the Kobuk (Giddings 1952:25) (Fig. 1). The present-day village of Kiana is situated at this confluence, which is on the lower third of the river. Ekseavik consists of approximately twenty houses, eleven of which were fully excavated over the course of three field seasons (Giddings 1952:8). Most of the houses here were well preserved in permafrost and therefore yielded a total of ninety-nine tree-ring dates from seven different houses (H1, H2, H3, H7, H8, H9, and H11). Giddings calculated that these dates span approximately 125 years from the early AD 1300s to 1432, although subsequent work by Graumlich and King (1997) pushed the earliest date at Ekseavik back to AD 1279. The large number of samples available from Ekseavik allowed Giddings to more closely estimate the period of occupation for individual features; he concluded that the houses at this site were likely not occupied at the same time. Based on how the dendrochronological dates grouped together and the similarity of material culture among the houses, Giddings believed that Ekseavik was primarily occupied around AD 1400.

The Ambler Island site is situated on an island in the Kobuk River near the village of Ambler, next to the Ambler River confluence (Fig. 1) and consists of fifteen houses, all of which were excavated (Giddings 1952:13). This site lacked a substantial amount of preserved wood and only twenty-three tree-ring dates were obtained from eight different houses (H1, H2, H3, H4, H8, H11, H12, H15) (Giddings 1952). These dates span almost 175 years and Giddings (1952:108) described the data they provided as “rather scanty.” Based on how these twenty-three dates group, Giddings believed there were two periods of building at the site, which occurred between AD 1730 and 1760.

The Maiyumerak Creek site is located along the middle portion of the Noatak River near its confluence with Maiyumerak Creek (Fig. 1). This site exhibits wood preservation, but in most cases it is poor and consists of cottonwood posts, which would be difficult and time consuming to compare to Giddings’ white spruce tree-ring record. In all cases the temporal placement of the Maiyumerak Creek site has relied on radiocarbon dating and all seven houses (H1, H3, H4, H6, H7, H8, H9) at the site have been dated (Table 1). Of these seven houses, only House 8 has been formally excavated and therefore more associated radiocarbon dates exist for this house. Six radiocarbon dates have been derived from both bone (n = 4) and charcoal (n = 2) samples collected from House 8. These dates indicate that this house was occupied at some point between cal AD 1500 and 1700 (Shirar 2007, 2009).

The Lake Kaiyak site is located on the southeast shore of Lake Kaiyak along the Kugururok River, which is a main tributary of the Noatak River. The site consists of eight house features with some associated caches and was originally recorded in the 1960s. Vandalism was discovered at the site in 1995 and excavations were conducted in 1996 to mitigate damage in two of the houses (H1 and H2) (Gilbert-Young 2004). Poor preservation of house timbers at the site prevented dendrochronological analysis and relative dating techniques provided the initial temporal placement of the site (Gilbert-Young 2004:18–19). Four radiocarbon dates are now available for Lake Kaiyak: two from the House 1 floor and two from the House 2 floor. The four dates indicate that both of these houses were likely occupied between cal AD 1450 and 1650.

RADIOCARBON DATING AND DENDROCHRONOLOGY

Redating some of the same houses that Giddings dated using dendrochronology provides a second, independent line of evidence to bear on Giddings' original conclusions regarding site occupation. One main issue with using only dendrochronology is that it dates the life of the tree rather than the human occupation of a site or feature. Giddings (1952:106) addressed this issue, noting that the houses on the Kobuk River were built using drift wood rather than freshly cut green logs. This means the wood incorporated into these features died weeks or months prior to the actual construction of the house. Another key point is that many late Holocene village sites, especially the larger ones, were likely multicomponent, meaning houses were occupied at different times.

Further complicating dendrochronological interpretations is the fact that structural wood may have been recycled during multiple occupations of a site or during multiple phases of house construction over a long period of time. Giddings (1952:107) writes: "Where only one construction log is dated for a house, we can only assume that building took place after the death (bark date) of this specimen. Actually, the house may have been occupied for some time before this log was added to bolster sagging walls." To circumvent this issue Giddings (1952:107) tried to use "a large number of bark dates for the walls of a single house," allowing him to make a "closer estimate of occupation, possible reconstruction, and abandonment."

Radiocarbon samples were chosen for this study using a protocol specifically set up for sites believed to date to the last millennium in Northwest Alaska. This protocol consists of three steps and is based on previous research designed to produce radiocarbon chronologies (Rieth and Hunt 2008). The first step was to make sure that each sample came from a secure and appropriate archaeological context. Since this chronology is based on dating semi-subterranean houses, the ideal archaeological context for a sample is a house floor. When dating a sample with only a general house provenience, there is some risk that the sample was collected from the roof or wall fall, meaning it could be associated with a different period of occupation and not with the house at all.

The decision to date wood, charcoal, or bone depends on which of these materials is available. As an example, at the Kobuk sites, charcoal and unmodified fauna went largely uncollected; however, there are numerous bone and antler artifacts available for dating from each site. If more than one of these materials are present, then the types of species available affect which sample is chosen to date. For wood and charcoal, the "old wood" effect in the Arctic means that the driftwood used in house construction or as fuel may have died decades earlier. There are also long-lived species such as spruce where a date on heartwood could yield a date hundreds of years older than a date on a near-bark layer. When dating wood or charcoal, it is important to use samples of short-lived species such as willow (e.g., *Salix* spp.) or to date an outer wood layer when dealing with long-lived species (Arundale 1981; Dean 1978; Schiffer 1986).

Dating marine mammal bone can be problematic due to fractionation, which yields dates younger than they actually are. The marine reservoir effect is also a concern and yields dates older than they actually are (Arundale 1981). Researchers have found that dating bone samples with a low collagen yield as a result of poor preservation can also produce unreliable dates (van Klinken 1999; Weber et al. 2005). In lieu of a percent collagen figure, another way to assess the quality of bone and antler preservation is through an evaluation of stable carbon ($\delta^{13}C$), which is a standard figure reported with radiocarbon results (Nelson and Møhl 2003).

Each archaeological context (or each house) was dated a minimum of two times and from different samples when possible. Having at least two dates from each house increases the probability that one is an accurate date. If a suite of dates (two or more) from a given context are calibrated and still overlap, then this bolsters confidence that no outlying dates are included in the chronology (Rieth and Hunt 2008). This tactic is especially important for sites within the last one thousand years, where there are large fluctuations in the radiocarbon calibration curve and a single date can span several hundred nonconsecutive years.

A total of ten bone and antler samples collected from five separate houses representing the three sites within the Kobuk River valley were chosen for radiocarbon analysis (Table 1). During excavation there were no contextual distinctions made between house roof, wall fall, or floor in the five Kobuk River house features, meaning that samples had only a general house context, a common problem when working with older collections. Since the Kobuk River houses only have a general structure provenience, bone and/or antler artifacts were dated in order to strengthen the link to human occupation of the houses. The non-diagnostic artifacts that were dated include: eight caribou metapodial scrapers, one bone awl carved from a caribou metapodial, and an ice or root pick made from caribou antler (Fig. 2).

Sixteen dates exist for the Maiyumerak Creek site and all are included in the chronology (Table 1). Six of these dates are derived from House 8 samples of either charcoal (n = 2) or unmodified caribou bone (n = 4). Five of the six samples from House 8 were collected from the floor and fit with the protocol outlined above. After calibration, the two charcoal dates from House 8 are about 100 years earlier than the dates on caribou bone. This indicates that either the house was lived in for decades and that these dates are from the early years of the occupation or that old wood was used during house construction or subsequent rebuilding.

The other ten dates from Maiyumerak are all on unmodified caribou bone collected from house floors or from the lowest levels of a midden deposit (Maiyumerak Locus 3). There is one date from each of six houses. All ten dates were derived from well-preserved caribou bone or antler to avoid some of the pitfalls associated with dating old wood. Caribou bone is often plentiful at late Holocene sites in Northwest Alaska. Dates on this material do not need to be corrected for the marine reservoir effect.

Four radiocarbon dates are available from two different house features at the Lake Kaiyak site and are included in Table 1. Two of these dates are associated with House 1 and two from House 2. All four are from samples of unmodified caribou bone, which are independent elements recovered from the respective house floors.

RADIOCARBON RESULTS

Table 1 presents thirty radiocarbon dates from late Holocene sites in the Kobuk and Noatak valleys and five dendrochronology dates from the houses in the Kobuk valley dated by Giddings. Four of the fourteen houses listed in the table are directly associated with a range of dendrochronology dates. Giddings dated the Ahteut site based on five dendrochronology samples from House 3n, meaning that the radiocarbon dates for House 10s in Table 1 cannot be directly compared to Giddings dendrochronology. Generally speaking, most of the radiocarbon dates match up well with the dates derived from house timbers (Giddings 1952:105–110; Graumlich and King 1997). All four of the radiocarbon dates from the Ambler Island site, however, trend approximately 50 to 100 years older. This same trend is apparent with one of the four radiocarbon dates from Ekseavik. The percent of collagen recovered from the bone samples used in this study was not reported by the lab, but all of the dates run on bone are from terrestrial mammals with stable carbon values that indicate each sample was well preserved (Table 1).

There are several scenarios that could account for these differences. The first relates to the lack of contextual information for the dated artifacts. These houses could have been occupied periodically over the course of a century and thus seen episodes of abandonment and reoccupation associated with rebuilding and/or renovation events. The older dates could simply be a result of dating artifacts that are actually associated with an older occupation of the house. The radiocarbon results in Table 1 show that many late Holocene village sites, like Maiyumerak, are multicomponent and that not all of the houses were occupied during the same time period. These results also suggest that many of these late Holocene sites were likely occupied concurrently and do not necessarily represent sequential occupation, which illustrates the importance of dating individual features. This point is underscored with the fact that after radiocarbon dating, the occupations at Ahteut and Ekseavik were determined to be multicomponent and overlapping and cannot be viewed as strictly sequential.

These date discrepancies could also be a result of problems with dendrochronology and tree-ring sampling. There could have been older structural wood from some of these houses that was not preserved and therefore is not represented in Giddings' chronology. Several of the houses Giddings dated had as few as one house timber preserved well enough to provide a date. Small sample sizes like this can produce less than reliable chronologies, which is often a problem early in the dendrochronology sequencing process. Early dendrochronology sequences like this one, with small regional sample sizes, also have problems with the dropping or adding of rings. This happens when a tree either does not produce a ring or produces two rings for a given year, which can result in inaccurate dates (Baillie 1982:52; Stokes and Smiley 1996:13–18). Some of these sample size issues have been addressed in subsequent work by Graumlich and King (1997), but there is still more work that could be done to make this sequence more reliable.

Graumlich and King (1997) added new specimens from living trees to the Kobuk River valley sequence

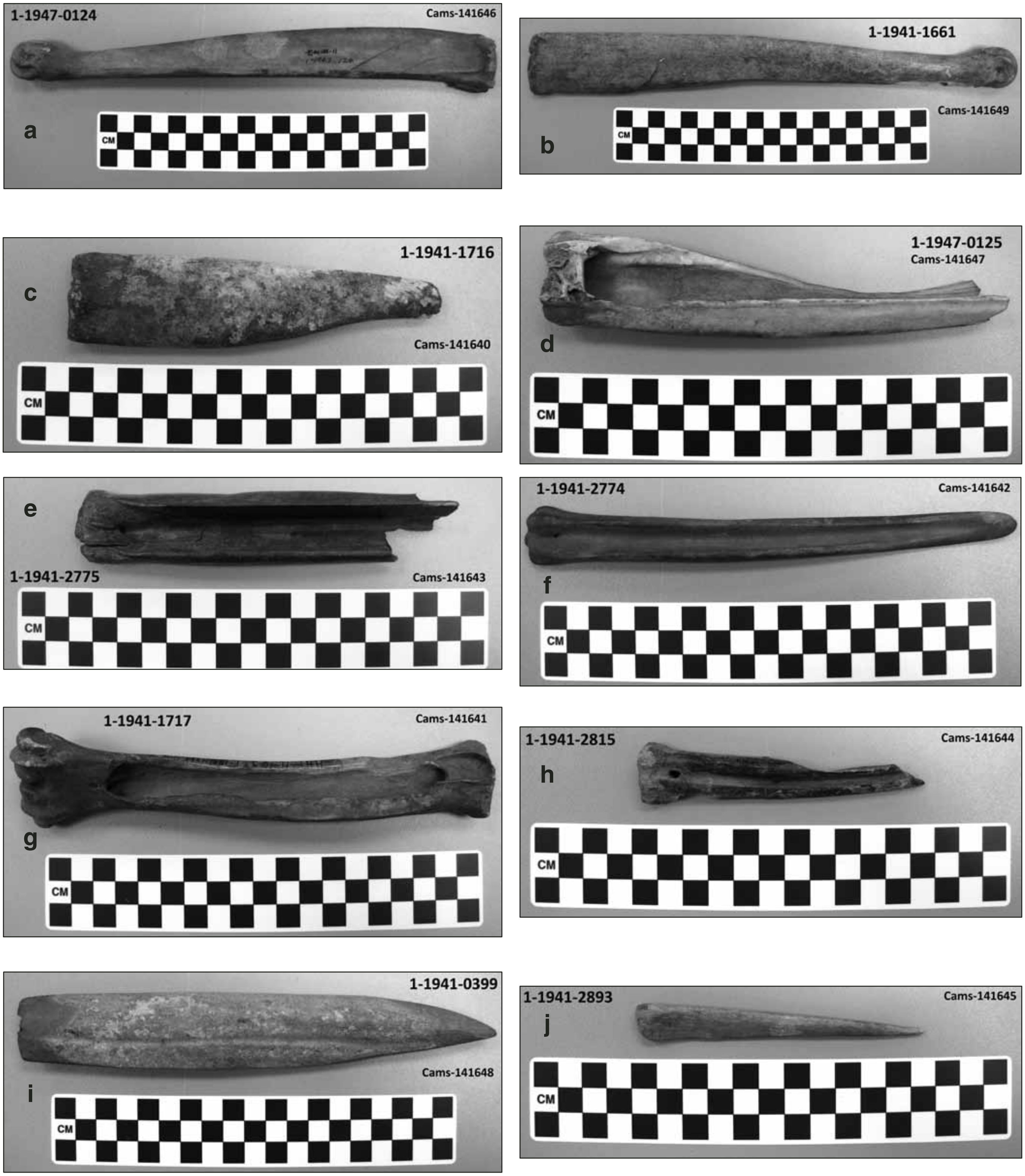

Figure 2. Artifacts used to date Kobuk River houses. Objects a through h are scrapers made from the metapodial bone of a caribou; i, ice pick of antler; j, caribou bone awl.

but also reanalyzed 102 of Giddings' 150+ archaeological specimens. Through this tree-ring reanalysis, the oldest date for Ekseavik House 11 was pushed back from AD 1300 to AD 1279. This alteration means that one of the radiocarbon dates now overlaps with the tree-ring dates. This provides an example of how important it will be to continue to refine and reanalyze Giddings' archaeological tree-ring samples and to sort out which samples come from which houses.

The issues related to dendrochronology and small sample size are well illustrated with the data presented in Table 1. House 11 at Ekseavik has 43 dendrochronology samples and these dates are nearly identical to the calibrated radiocarbon dates for this house. The three other houses from the Kobuk have four or less dendrochronology samples and the radiocarbon dates tend to range older than the dendrochronology dates. This demonstrates the importance of having a large dendrochronology sample size and cross-checking dates with radiocarbon whenever possible. These results indicate that there are older occupations in these houses that are not showing up in the dendrochronology either because of small sample size or because of rebuilding and reuse.

Even though not all of the radiocarbon dates overlap perfectly with the tree-ring dates, both data sets illustrate the same general site chronology. Fig. 3 presents the

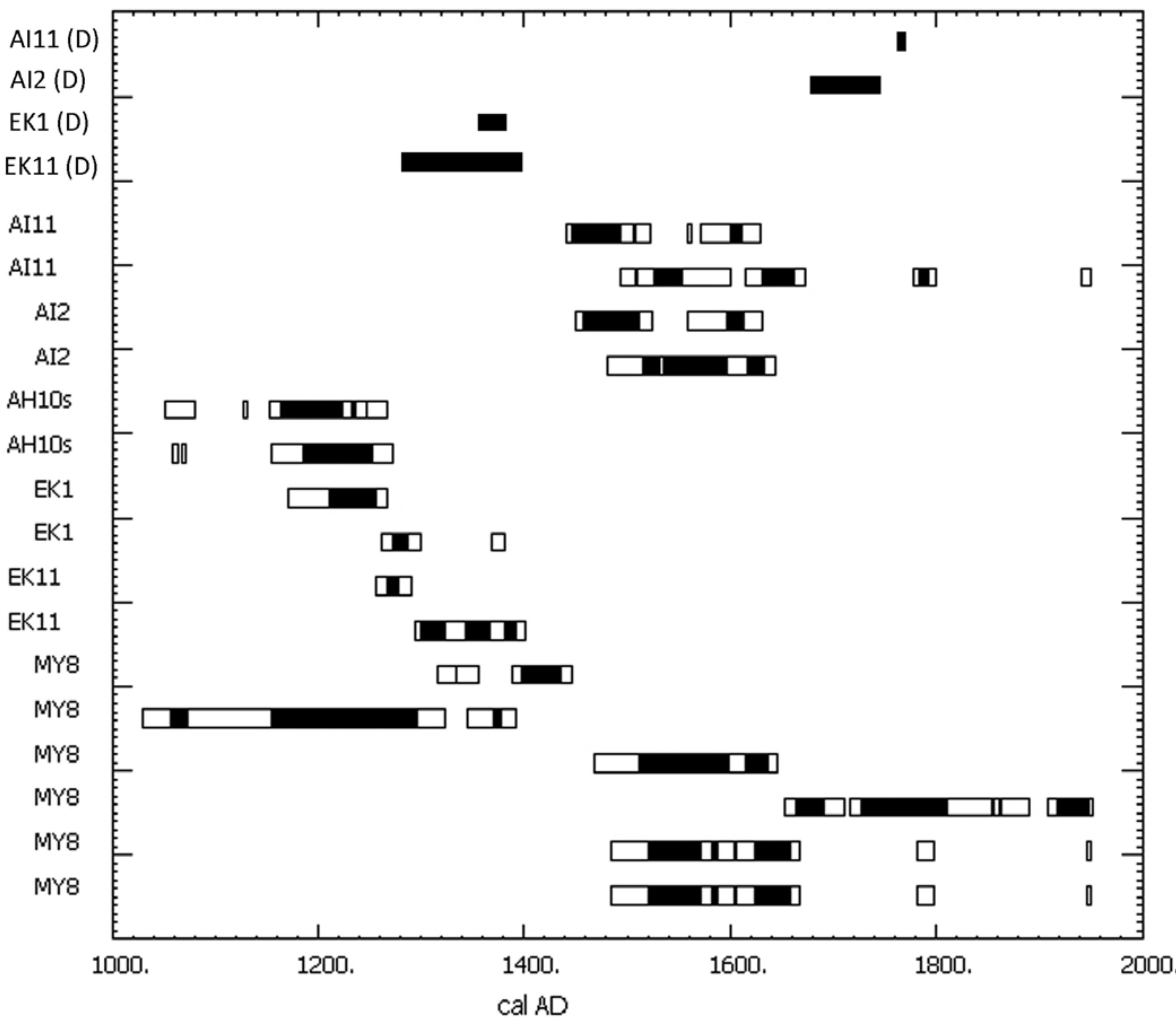

Figure 3. Dendrochronology dates and calibrated age probability curves for radiocarbon dates from Ambler Island, Ahteut, Ekseavik, and Maiyumerak Creek House 8. Radiocarbon dates calibrated with CALIB Radiocarbon Calibration Program (Stuiver et al. 2006) using the IntCal09 atmospheric curve (Reimer et al. 2009).

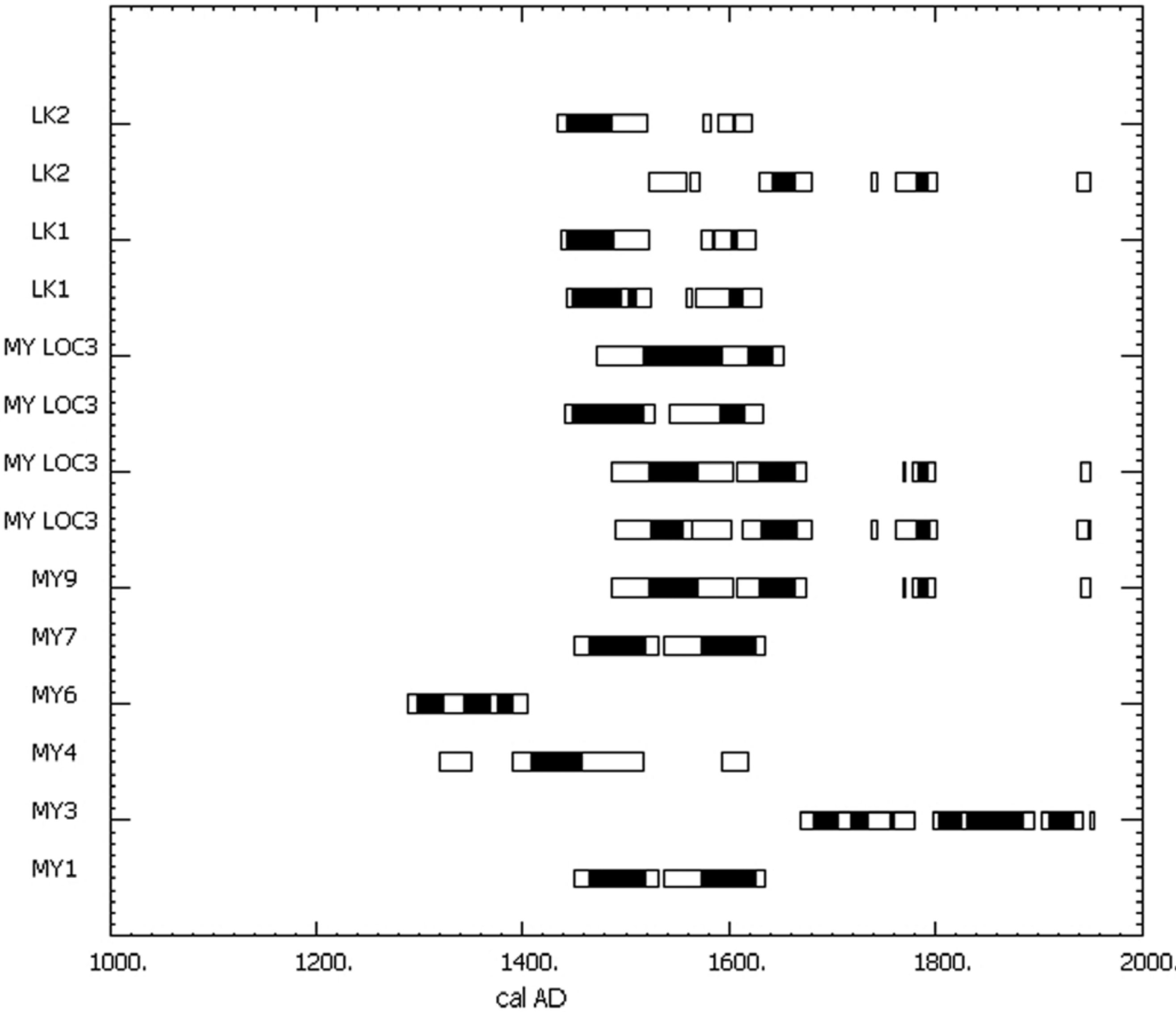

Figure 4. Calibrated age probability curves for radiocarbon dates of various houses and midden deposit at Maiyumerak Creek and Lake Kayak. Radiocarbon dates calibrated with CALIB Radiocarbon Calibration Program (Stuiver et al. 2006) using the IntCal09 atmospheric curve (Reimer et al. 2009).

radiocarbon results for House 8 at Maiyumerak and for the five Kobuk River houses along with the four dendrochronology dates. House 10s at the Ahteut site is the oldest feature and was likely occupied between cal AD 1100 and 1300. The two houses from the Ekseavik site were likely occupied between cal AD 1200 and 1400, followed by the two houses from the Ambler Island site, which were occupied between cal AD 1500 and 1700. The radiocarbon dates on caribou bone from House 8 at the Maiyumerak Creek site also indicate a cal AD 1500 to 1700 occupation, which overlaps with the dates from Ambler Island.

The dates on charcoal from House 8 are at least 50 to 100 years older than the dates on bone collagen, which is likely a result of dating old wood. Beta-76675, which produced the oldest date, was collected from the eroding bank during the initial discovery of the site and the wood species was never identified. Beta-228016 was identified as either willow or cottonwood and was collected from the floor of House 8. The date on this sample is within a couple of decades of the bone dates, which is well within the life span of either willow or cottonwood.

The six other houses that were dated at Maiyumerak Creek show that this site was occupied throughout much of the late Holocene between cal AD 1290 and 1900 (see Table 1 and Fig. 4). Four dates were run on samples from the extensive midden deposits in Locus 3 at Maiyumerak and all four overlap roughly between cal AD 1450 and 1650. The four dates from the two houses at Lake Kaiyak overlap between approximately cal AD 1450 and 1650.

CONCLUSIONS AND FUTURE RESEARCH

These thirty radiocarbon dates (Table 1) are a significant contribution to the archaeology of the region and represent a starting point in creating a robust late Holocene chronology for interior Northwest Alaska. The dates reported here generally support Giddings' initial interpretation of when the Ekseavik, Ahteut, and Ambler Island sites were occupied, but also refine his analysis and expand the period of occupation at each site. The radiocarbon results also make it clear that the late Holocene chronology of the region is complex, since many of these village sites, especially the large ones, were likely occupied simultaneously over the course of centuries.

Data presented in this paper show that it is appropriate to directly compare dates derived from both radiocarbon and dendrochronology. With radiocarbon dating, it is critical to follow protocols regarding sample selection in order to create the strongest possible link between the date(s) and when people occupied a house or used a feature. Features dated with a large number of dendrochronology samples more closely overlap radiocarbon results from the same feature, highlighting the importance of using large sample sizes with dendrochronology.

The fact that a site such as Maiyumerak Creek shows an occupational period over the course of six hundred years illustrates the importance of evaluating house features individually. Each house feature at Maiyumerak was dated at least once; while many of these dates fall between cal AD 1450 and 1650, there are dates that range as old as cal AD 1290 and as young as cal AD 1900. Generally, as many features as possible should be dated at late Holocene sites; ideally, each would be dated at least twice through a combination of both radiocarbon and dendrochronology, assuming a house exhibits good preservation and timbers are available for analysis.

The chronology presented here should be viewed as a preliminary attempt to better understand when and where people were living in interior Northwest Alaska during the last thousand years. As more dates are added and the chronology grows, interior sites and their assemblages can more readily be placed into context. Only when this context is properly established can archaeologists begin to understand the complexities of late Holocene settlement, land use, technology, and subsistence and how each relates to regional ecology and climate fluctuation during the last millennium.

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