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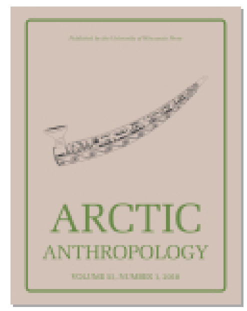

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Iyatayet Revisited: A Report on Renewed Investigations of a Stratified Middle-to-Late Holocene Coastal Campsite in Norton Sound, Alaska[1]

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Abstract. The multicomponent middle-to-late Holocene coastal site of Iyatayet, at Cape Denbigh, Alaska, originally excavated by J. L. Giddings in the early 1950s, was key to developing a culture-historical sequence for northwest Alaska. We revisited the site in 2012 and 2013 to collect data to refine the occupation chronology and to test models of maritime-resource intensification. Our results show the Denbigh Flint complex occupations at Iyatayet are younger and briefer than previously believed. Gaps of 1,000 years separate the Denbigh, Norton, and Thule occupations, suggesting reduced use of eastern Norton Sound during these periods. Artifacts and faunal remains from each component indicate reduced mobility and increased focus on marine resources following the Denbigh period, but Norton occupants hunted the same suite of marine prey as the later Thule, demonstrating they were was equally proficient at foraging from the sea.

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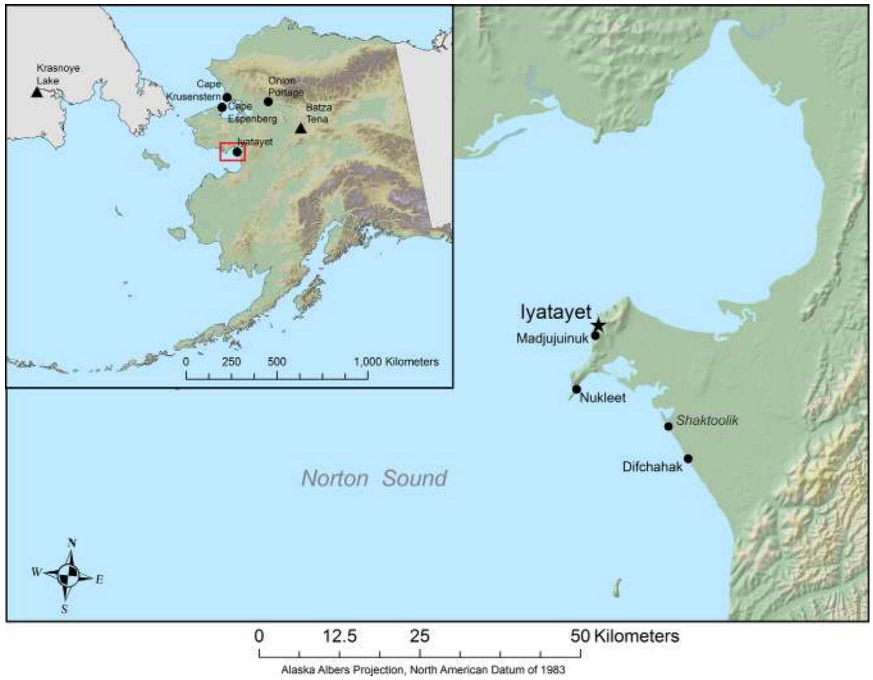

Figure 1. A map of Alaska (inset) and Norton Sound showing the location of Cape Denbigh and Iyatayet in relation to key regional and local sites mentioned in the text, including the Batza Téna and Krasnoye Lake obsidian sources.

The site of Iyatayet (NOB-002) is one of the most important archaeological sites in northwest Alaska. Located on Cape Denbigh, in Norton Sound, just south of the Seward Peninsula (Fig. 1), Iyatayet has intermittently served as a settlement for maritime hunter-gatherers for at least 4,000 years. Originally excavated by J. Louis Giddings (1951, 1964) between 1948 and 1952, Iyatayet is the type site for the Denbigh Flint complex and the Norton tradition and provided valuable information about the Nukleet phase of the Thule tradition. Iyatayet was designated a National Historic Landmark in 1961, yet prior to our return to the site, no renewed excavations and little additional research with the collections have been conducted here (but see Mason and Gerlach 1995; Murray et al. 2003). While Giddings's work at Iyatayet resulted in the discovery of new archaeological traditions, more than 70 years of theoretical and methodological developments in archaeology present an opportunity to reassess interpretations, answer lingering questions, and to pose new questions that were not in the scope of the original research.

The role Iyatayet played in shaping our understanding of mid-to-late Holocene culture history in Alaska is enormous but equally important is the information this site holds for understanding how and why subsistence and economic strategies change through time. Along with Onion Portage (Anderson 1988), Iyatayet is one of the few known deeply stratified sites in northwest Alaska, and its coastal context makes it unique for studying the evolution of maritime adaptations in this region. Alaskan archaeologists have routinely characterized the development of arctic maritime adaptations within a progressive evolutionary framework indicating an increased focus on, and refinement of, marine-mammal hunting and fishing practices through time (Ackerman 1998; Dumond 1975; Giddings and Anderson 1986). The people of the Denbigh Flint complex, a regional variant of the Arctic Small Tool tradition (ASTt) (Irving 1957)—appearing about 4,500–5,000 years ago—were the first to routinely exploit marine resources in northwest Alaska (Anderson 1984). However, researchers consistently interpret the Denbigh economy as terrestrial-based caribou hunting, with only occasional seasonal use of coastal resources, namely seals, taken from the near-shore zone (Ackerman 1998:247; Dumond 1982; Giddings 1964; Giddings and Anderson 1986). Some even characterize the ASTt maritime adaptation as "a transitional stage of seasonal dabbling in coastal exploitation" (Workman and McCartney 1998:368).

Archaeologists typically consider the Norton tradition subsistence economy as increasingly marine focused, with an emphasis on seals to the north and fish in the south (Dumond 2016;

Lutz 1982), but still a mixed maritime/terrestrial economy not dramatically different from Denbigh (Ackerman 1998). It is only with the arrival of the Northern Maritime/Thule tradition, beginning after 2,000 years ago, that many researchers argue a full mastery of the marine economy is achieved (Ackerman 1998; Anderson 1984; Bockstoce 1973; Dumond 1975; Mason and Gerlach 1995).

Renewed investigations into the nature and origins of ASTt maritime foraging strategies have called into question the generality of this progressive development. For example, ASTt groups in the eastern Arctic show a much greater emphasis on marine resources than in Alaska (Grønnow 1994; Melgaard 2004) and were apparently exploiting whales by 4,000 years ago (Seersholm et al. 2016). In Alaska, current research has demonstrated that ASTt people appear first along the coast and that these maritime habitats exhibit greater resource stability and large-mammal biomass than adjacent interior tundra ecosystems (Tremayne 2015; Tremayne and Winterhalder 2017). As such, they argue that marine resources played a larger role in the ASTt economy and colonization of the North American Arctic than has generally been postulated. Likewise, we lack sufficient data to suggest the Norton were inferior maritime hunters to the later Northern Maritime cultures. What we require to test the merits of this model is careful comparative analyses of faunal remains and associated technology from a number of regional case studies. Iyatayet is an ideal site to serve as one such case study.

If there was a progressive development of maritime adaptations through time in northwest Alaska, then we should find evidence for marine-resource intensification, increased sedentism, and increased technological complexity in the archaeological record. To test these hypotheses, our research plan at Iyatayet targeted organic materials amenable to radiocarbon dating to improve the site chronology, a sizable sample of faunal remains to document the types of prey taken, and a sample of technological artifacts—both organic and stone—to assess changes in hunting and mobility strategies. The following sections provide a brief overview of the physical environment of the site, Giddings's excavations, our research methods (for both field and laboratory work), and the results of these investigations. We conclude with a discussion of the findings and their implications for a progressive evolutionary model for the development of maritime adaptations in northwest Alaska.

Background

Iyatayet is located in a small, relatively sheltered cove midway between the northern and southern extent of Cape Denbigh (Fig. 1). The site spans more than 150 m up both sides of a small creek, which provides a year-round source of freshwater and access to both marine and terrestrial resources. Seals, beluga, and fish are all accessible from the Iyatayet cove, while caribou seasonally frequent the hills above the site. As one of the only freshwater sources on Cape Denbigh, this location would have been a draw for anyone visiting this part of Norton Sound making it a reasonable proxy for the occupation of the entire region. According to our local Iñupiat collaborators, Iyatayet has excellent "tomcod" fishing, and the nearby communities continue to use the area for subsistence pursuits.

Figure 2. Image of Iyatayet north terrace from the beach. Photograph by A. Tremayne.

Most of the prehistoric deposits at Iyatayet occur across the top of a terrace that runs approximately 15 m above current sea level along the northeast side of the creek (Fig. 2). Artifacts are found in relatively undisturbed, stratified deposits buried atop the terrace and in mixed deposits along the hill slope and base. Studies on site formation processes suggest periods where sediment accumulated rapidly through slope wash, aeolian deposition, and possibly inundation from creek flood events following the earliest period of occupation (Hopkins and Giddings 1953; Mason and Gerlach 1995). Iyatayet is also a case study in postdepositional processes as solifluction has created complex folding of layers, in some cases leading to reversals of the stratigraphic sequence (Hopkins and Giddings 1953).

Giddings's (1951, 1955, 1964) research at Iyatayet was primarily concerned with developing a culture-historical sequence for northwest Alaska. The original investigation was of a Thule-age occupation, which Giddings referred to as Nukleet, after the type site on the southern tip of

Cape Denbigh (Fig. 1), but it was the Norton and, in particular, the Denbigh materials found in the deepest layers that most captured his attention. The mix of "Old World" microblades associated with an apparent "fluted" spear point led Giddings to believe he had found one of the oldest sites in Alaska, and potentially, a transitional site of the first people to colonize the New World (Giddings 1951, 1967; Mason and Gerlach 1995). Soon thereafter, it became evident that the Denbigh assemblage was part of a much younger and widespread arctic technological culture, christened by Irving (1957) as the Arctic Small Tool tradition (ASTt). Accepting this younger age for the Denbigh Flint complex, Giddings turned his research towards understanding the origins of Eskimo culture.

Giddings's (1951, 1964) singular focus on culture history led to an exceptionally detailed description of the stone-tool technologies and assessment of the stratigraphy found at Iyarayet (Hopkins and Giddings 1953). However, the lack of screens and systematic removal of "overburden" resulted in a sample biased toward formal tools from each component and a lack of small artifacts such as lithic debitage. By Giddings (1964:194) own account he "left behind dozens of these minuscule flakes, for each larger . . . flake collected." Additionally, Iñupiat assistants identified the faunal remains on site, but discarded them soon after, leaving no way to confirm their findings. To compound the excavation biases, much of the early laboratory results are also unreliable or ambiguous. For example, Willard Libby himself conducted the radiocarbon dating in the 1950s on samples that combined charcoal, "charred twigs and mud" (Giddings 1964:245). Unsurprisingly, the results of these early assays lack the precision and accuracy of modern Accelerator Mass Spectrometry (AMS) technology commonly used today leading to a lasting debate about the earliest age of the Denbigh component at this site, and, in turn, the ASTt in Alaska (Harritt 1998; Prentiss et al. 2015; Slaughter 2005; Tremayne 2015).

Methods

Excavation Methods

In 2012 and 2013, our team excavated 12 50×50 cm shovel tests and eight formal 1×1 m units. We placed shovel tests in undisturbed areas and along the edges of the original excavations to determine the extent of previous excavation blocks and to sample intact deposits. We subsequently excavated 1×1 m units adjacent to positive shovel tests (Fig. 3) with hand trowels by natural stratigraphic layer in 50 cm quadrants. We screened all material in the sod and upper levels through ¼ inch (6.4 mm) and the deeper Norton and Denbigh components through ⅛ inch (3.18 mm) mesh. All identified tools and charcoal samples were three-point provenienced, whereas we collected all debitage, ceramic sherds, and faunal remains by level and quadrant. We employed a total station to map the topography of the site and record the relationship between our 2012–2013 units and Giddings's excavations (Fig. 3).

Analytical Methods

Charcoal samples collected for radiocarbon dating were prepared using a microscope and razor blade to remove rootlets and soil. We submitted bone samples directly to the radiocarbon dating facilities for preparation and collagen extraction. Dates were calibrated using OxCal 4.2 software (Bronk Ramsey and Lee 2013) and the IntCal13 atmospheric curve (Reimer et al. 2013). All marine-based samples were calibrated using the 2013 marine curve (Reimer et al. 2013) with a Δr of 477±60 years (Pearce et al. 2016). OxCal 4.2 allows researchers to estimate the percent of marine contribution to the sample. Fully aquatic mammals were given a 100% marine contribution, while the dated pottery residue (Crane and Griffin 1964) was assigned a 50±10% marine contribution. Recent work by Farrell and colleagues (2014) has demonstrated that Thule people used ceramic pots exclusively for cooking sea mammals and fish at the Nunalleq site, but lipid analysis has not confirmed this for the Iyatayet samples. The canid sample was assigned a value of 75% percent marine because the $\delta^{13}C$ isotope value indicates marine-based organisms comprised a large part of the animal's diet, but we assume dogs consumed other foods besides seals or fish. We suggest some caution in accepting calibrated ages of all of the marine-based samples as we still lack a local reservoir correction value for this part of Alaska. Start and end dates for each archaeological component were modeled using OxCal 4.2 *Phase* function (Bronk Ramsey and Lee 2013). The models use all of the available dates and take into consideration marine-reservoir corrections for marine-based samples.

Stone tools were classified through comparisons to the original Iyatayet assemblages (Giddings 1964), as well as those from Cape Krusenstern (Giddings and Anderson 1986) and Onion Portage (Anderson 1988). The analysis primarily follows methods outlined by Andrefsky (2005). To source obsidian, we employed a portable XRF machine and compared with the Alaska Obsidian Database (Rasic 2016; Reuther et al. 2011) following methods described in Phillips and Speakman (2009). Tremayne (2017) completed a detailed lithic analysis, and we refer readers to that report for additional results and interpretation.

Our faunal analysis used the comparative skeletal collection at the University of California,

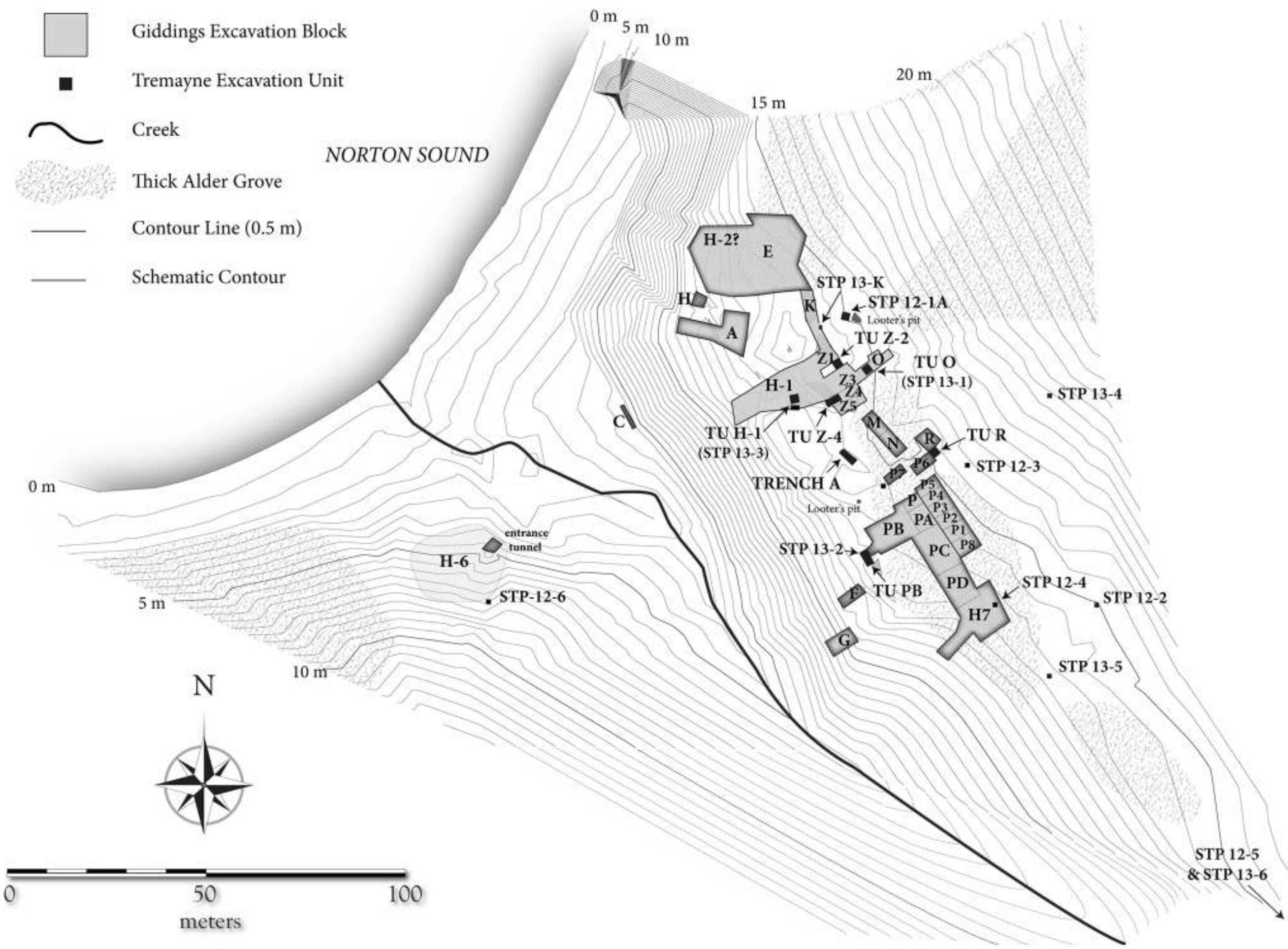

Figure 3. Iyatayet site map showing recent tests in relation to Giddings's excavation blocks.

Davis, Zooarchaeology Lab, following methods outlined by Lyman (1994, 2008). We classified identified specimens to the lowest taxonomic level possible; element, portion, side, epiphyseal fusion, spiral fractures, cut marks, animal-gnawing marks, and thermal damage were recorded. We then used these results to generate the number of identified specimens (NISP) and derive the minimum number of elements (MNE) and minimum number of individuals (MNI) per taxon (see Tremayne 2015b).

Excavation Results and Site Chronology

Stratigraphy and Definition of Components

The 2012 and 2013 excavations produced over 12,000 artifacts from a total area of 15 m^2 of testing. Based on our field observations and Giddings' excavation maps and narratives (Giddings 1964:119–137), we estimate he dug 60 6×10 ft blocks and three 20×20 ft blocks during the 1948–1952 field seasons, which equates to about 5,444 ft^2 or 500 m^2 of excavated area. The 15 m^2 we dug in 2012–2013 represents approximately 3% of the total area excavated. While our tests were small by comparison, our methods allowed us to collect an incredible amount of data with relatively limited disturbance of the site.

Our testing revealed that Giddings (1964) stratigraphic descriptions were generally accurate across the site. The Nukleet levels at Iyatayet, outside of the houses that Giddings excavated, are primarily within and just below the sod layer. Diagnostic tools, including antler arrowheads and crudely made pottery sherds, denoted the Nukleet occupations. The separation between Nukleet and Norton components was not always clear, and some levels are apparently mixed. The Norton deposits begin approximately 30 cm below surface (BS) and extend as deep as 120 cm BS. The Denbigh level varies in depth from 100 cm BS to as

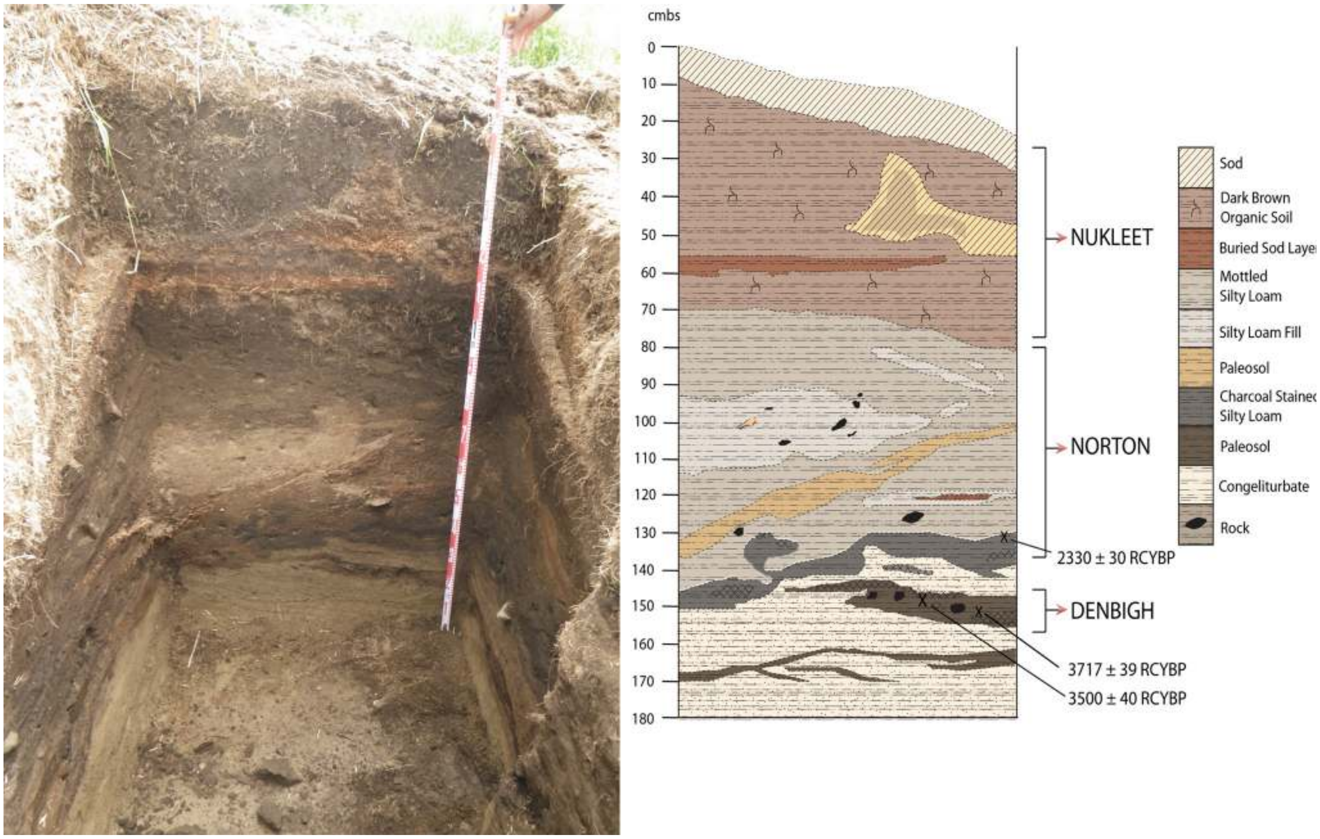

Figure 4. A photograph and profile illustration of the east wall from Unit PB.

deep as 200 cm near the edge of the terrace slope (Fig. 4). Where encountered, the Denbigh level is a thin 5–10 cm layer with extensive charcoal flecking and often an abundance of fire-cracked rocks.

The Denbigh stratigraphic layer is difficult to detect or absent in most areas of the site we tested. Giddings took great pains to illustrate the parts of the site where the Denbigh layer was undisturbed *in-situ* and capped by culturally sterile "sand," which was crucial for defining the component. This ideal stratigraphic sequence occurred only in Unit Z4 (Fig. 5) (see Giddings 1964:133 for comparison). We did relocate the Denbigh component in units R1 and PB as well (see site map in Fig. 3); however, the sterile sandy-silt layer was less than one cm thick. In other units, strata associated with Denbigh were never definitively located despite the occasional occurrence of diagnostic artifacts, including H-1, Z2, STP-1A, STP-O, and Trench A (supplemental Figs. 2–6).

Radiocarbon Dates

Our project produced 19 new AMS radiocarbon dates: seven in Denbigh contexts, ten from Norton levels, and two from the later Nukleet period (Table 1). Combining these 19 new dates with an additional AMS dated birch-bark basket fragment from the Denbigh component (Tremayne and Rasic 2016), three AMS dates from Nukleet tools (Murray et al. 2003), the original 21 dates (Giddings 1964), and three conventional assays from ceramic residue samples (Crane and Griffin 1964), we greatly increased chronological resolution for each archaeological culture.

Our updated chronology for Iyatayet demonstrates that each component dates within recognized time span for each cultural tradition. However, the Denbigh occupations at this site are much younger than Giddings (1955, 1964) surmised. Giddings's oldest date of 5063±313 BP (3870±370 BC) (all AD/BC dates are calibrated), and the age he favored, is unreliable and should not serve as the basal date for the Denbigh complex at Iyatayet. We relocated a hearth in the profile of Giddings's excavation Block R—the excavation block that produced the oldest date—and collected two samples that date to 3431±32 BP (1740±60 BC) and 3460±40 BP (1790±60 BC) (Table 1). The oldest AMS date we obtained from Denbigh contexts was 3717±39 BP (2100±60 BC)—1,700 years

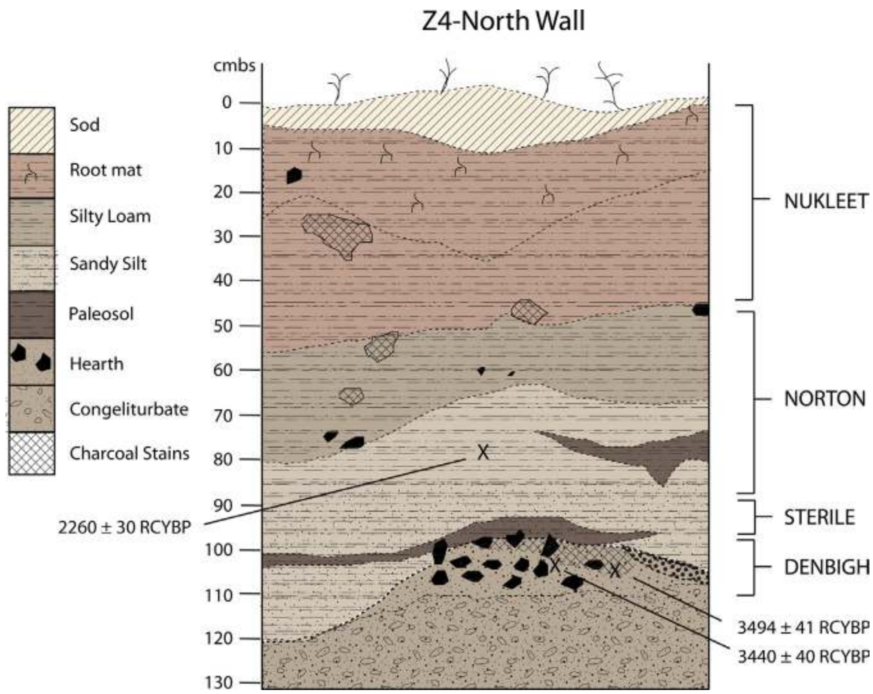

Figure 5. Profile of the north wall of Unit Z4.

later in time. Combined, the new AMS dates suggest Denbigh occupations occurred between 2150–1510 BC.

While conventional dating methods from the 1950s are generally accurate, the overall level of uncertainty is much higher than dates produced using AMS methods. A useful way to understand the statistical probability that the dates fall within a specific timeframe is to display the calibrated age in summed probabilities density plots (Williams 2012). We generated four plots using all the available radiocarbon dates at Iyatayet (Fig. 6A), with marine samples removed (Fig. 6B), with only AMS dates (Fig. 6C), and with only AMS dates on terrestrial samples (Fig. 6D). The resulting plots are nearly identical in terms of the peaks, but the plots that use only AMS dates show clearly three main periods of occupation. Consequently, our analysis of all available radiocarbon dates suggests the probability that people were at Iyatayet more than 5,000 years ago is statistically unlikely.

Using only AMS dates, the modeled start date for the Denbigh occupations at Iyatayet is 2310±290 BC; a date we consider most accurate. The modeled estimate when all dates are included is 2810±760 BC (Table 1), which is still significantly younger than Giddings's (1964) proposed start date of 3440±520 BC, although uncertainty is very high. The modeled end date for the Denbigh, using all of the dates, suggests they abandoned the site by 1480±150 BC. Based on our current radiocarbon evidence, the Denbigh occupations spanned a period of about 800 years.

The modeled start date for the Norton culture indicates they did not occupy the site until around 430±80 BC at the earliest. If the mean estimates are correct, there was nearly a 1,000-year gap between the Denbigh and Norton occupations. In addition, our research indicates the Norton occupation span at Iyatayet was only about 500 years, with a modeled end date of AD 100±110.

The new AMS dates recovered from the upper deposits indicate that the Nukleet occupation was also shorter than previous studies surmised (Gerlach and Mason 1992; Murray et al. 2003). Using only terrestrial AMS dates, the modeled start date of the Nukleet occupation is AD 1150±110 (Table 1). Four of the Nukleet samples have at least a partial marine isotopic signature. The conventionally run assays on residue from "Barrow Plain" and "Barrow Curvilinear" Thule-ceramics (Crane and Griffin 1964) produced ages of 960±100 BP (AD 1420±120) and 1050±110 BP (AD 1350±120). Gerlach and Mason (1992) calibrated these dates using only the atmospheric curve, which placed these ceramic vessels in the Birnirk phase of the Thule tradition. Here, we consider the likelihood that at least some of the organic residues adhering to these vessels were derived from marine-mammal fats or fish oil (Farrell et al. 2014), and conservatively calibrate these dates using a 50% contribution of the mixed marine curve in OxCal

Table 1. Summary of Iyatayet radiocarbon dates from all three components, with modeled start and end dates. All dates were calibrated at 1 sigma using OxCal 4.2 (Bronk Ramsey and Lee 2013). Marine dates calibrated using a ΔR of 477±60. *Suspect dates.

Lab Number	^{14}C Date	σ	Mean Cal BP	2σ	Cal Age Range (2σ)	δ13	Material	Excavation Unit	Notes	Reference
NUKLEET										
M 1260a	960	100	530	120	AD 1210–1670	NA	Residue	NR	50% marine	Crane and Griffin 1964
M 1260b	1050	110	610	120	AD 1050–1620	NA	Residue	NR	50% marine	Crane and Griffin 1964
Beta-157235	510	40	540	40	AD 1310–1450	–20.6	Caribou antler	H1	AMS	Murray et al. 2003
Beta-157234	630	40	610	40	AD 1280–1410	–20.6	Caribou antler	F	AMS	Murray et al. 2003
Beta-157233	1440	40	560	50	AD 1280–1500	–14.8	Walrus Ivory	E	AMS; 100% marine	Murray et al. 2003
AA101353	749	41	690	30	AD 1200–1390	–18.1	Caribou collagen	Trench A-W	AMS	Tremayne 2015b
Beta-328287	1140	30	500	90	AD 1290–1640	–15.1	Canid collagen	Slope	AMS; 75% marine	Tremayne 2015b
Modeled Start			**680**	**70**	**AD 1150–1390**					
Modeled End			**500**	**60**	**AD 1320–1570**					
NORTON										
C-506	1460	200	1390	210	AD 130–980	NA	Charcoal	Cut PA		Giddings 1964:244
C-562	2016	215	2010	260	750 BC– AD 530	NA	Charcoal	House 7		Giddings 1964:245
P-13a	2420	270	2490	330	1220 BC–AD 120	NA	Charcoal	House 7	base timbers	Giddings 1964:245
P-13b	2530	330	2630	400	1500 BC–AD 90	NA	Charcoal	House 7	base timbers	Giddings 1964:245
P-13c	2130	260	2150	320	810 BC–AD 400	NA	Charcoal	House 7	base timbers	Giddings 1964:245
P-13 AVG	**2360**	**170**	**2420**	**210**	**840–40 BC**	**NA**	**Charcoal**	House 7	**Avg. 3 dates**	**Giddings 1964:245**

(Continued)

Table 1. *(Continued)*

Lab Number	^{14}C Date	σ	Mean Cal BP	2σ	Cal Age Range (2σ)	δ13	Material	Excavation Unit	Notes	Reference
P-13d	2213	110	2220	150	270 BC–AD 150	NA	Charcoal	House 7	CO_2 det.	Giddings 1964:245
M-1260c	2720	130	2370	200	800–40 BC	NA	Residue	NR	50% marine	Crane and Griffin 1964
AA102993	1962	39	1910	40	50 BC–AD 130	–25.4	Charcoal	STP-5	AMS	Tremayne 2015b
AA102989	2274	39	2260	60	410–200 BC	–26.2	Charcoal	Trench A-E	AMS	Tremayne 2015b
AA102987	2160	39	2180	80	370–90 BC	–24.6	Charcoal	Trench A-W	AMS	Tremayne 2015b
Beta-328284	2250	30	2250	60	400–200 BC	–23.8	Charcoal	STP-1A	AMS	Tremayne 2015b
Beta-328285	2070	30	2040	50	180–1 BC	–22.9	Charcoal	STP-1A	AMS	Tremayne 2015b
Beta-328286	2260	30	2260	60	400–200 BC	–23.4	Charcoal	STP-1A	AMS	Tremayne 2015b
AA101352	2322	35	2330	50	490–230 BC	–25.3	Charcoal	STP-1A	AMS	Tremayne 2015b
AA101351	2901	48	2070	100	340 BC–AD 70	–14.6	Walrus collagen	Trench A-W	AMS; 100% marine	Tremayne 2015b
Beta-422596	2330	30	2350	30	490–260 BC	–23.9	Charcoal	PB	AMS	Tremayne 2015b
Beta-422597	2260	30	2260	60	400–200 BC	–28.2	Birch Bark	Z4	AMS	Tremayne 2015b
Modeled Start			**2390**	**50**	**560–370 BC**					
Modeled End			**1890**	**80**	**100 BC–AD 220**					
DENBIGH										
P-102a	3290	290	3560	380	2440–890 BC	NA	Charcoal	Cut R		Giddings 1964:246
P-102b	3320	200	3580	260	2200–1110 BC	NA	Charcoal	Cut R		Giddings 1964:246
P-102AVG	**3310**	**200**	**3570**	**260**	**2150–1080 BC**	**NA**	**Charcoal**	**Cut R**	**Avg. 2 dates**	**Giddings 1964:246**
P-104a	3240	280	3500	360	2280–830 BC	NA	Soil and Peat	Cut Z-5B	Geoarch	Giddings 1964:245
P-104b	2730	300	2870	370	1650–180 BC	NA	Soil and Peat	Cut Z-5B	Geoarch	Giddings 1964:245
P-104c	3030	280	3230	340	2020–540 BC	NA	Soil and Peat	Cut Z-5B	Geoarch	Giddings 1964:245
P-104AVG	**3000**	**170**	**3170**	**200**	**1620–830 BC**	**NA**	**Soil and Peat**	**Cut Z-5B**	**Avg. 3 dates**	**Giddings 1964:245**

(Continued)

Table 1. *(Continued)*

Lab Number	^{14}C Date	σ	Mean Cal BP	2σ	Cal Age Range (2σ)	δ13	Material	Excavation Unit	Notes	Reference
P-108a	2880	280	3050	340	1760–390 BC	NA	Soil and Peat	Cut Z-5B	Geoarch	Giddings 1964:245
P-108b	3280	300	3550	390	2410–840 BC	NA	Soil and Peat	Cut Z-5B	Geoarch	Giddings 1964:245
P-108AVG	**3080**	**210**	**3270**	**260**	**1880–820 BC**	**NA**	**Soil and Peat**	**Cut Z-5B**	**Avg. 3 dates**	**Giddings 1964:245**
P-105	4040	280	4540	390	3370–1780 BC	NA	Soil and Peat	Cut Z-5B	Geoarch	Giddings 1964:245
P-103a	3430	280	3750	370	2570–1050 BC	NA	Charcoal and Mud	Cut Z-5D		Giddings 1964:245
P-103b	3520	290	3870	380	2850–1130 BC	NA	Charcoal and Mud	Cut Z-5D		Giddings 1964:245
P-103AVG	**3480**	**200**	**3790**	**260**	**2460–1320 BC**	**NA**	**Charcoal and Mud**	**Cut Z-5D**	**Avg. 2 dates**	**Giddings 1964:245**
C-792a	3477	310	3820	410	2840–1040 BC	NA	Charcoal and Mud	Cut Z-5B		Giddings 1964:245
C-792b	3541	315	3900	420	2870–1130 BC	NA	Charcoal and Mud	Cut Z-5B		Giddings 1964:245
C-792AVG	**3509**	**230**	**3840**	**300**	**2490–1290 BC**	**NA**	**Charcoal**	**Cut Z-5B**	**Avg. 2 dates**	**Giddings 1964:245**
W-298	3974	600	4510	760	4050–1040 BC	NA	Charcoal	Cut Z-5A	Date suspect	Giddings 1964:246
C-793a*	4253	290	4830	390	3640–2130 BC	NA	Charcoal	Cut R	Date suspect	Giddings 1964:245
C-793b*	5063	315	5820	370	4590–3030 BC	NA	Charcoal	Cut R	Date suspect	Giddings 1964:245
C-793* AVG	**4655**	**214**	**5320**	**270**	**3650–2880 BC**	**NA**	**Charcoal**	**Cut R**	**Avg. 2 dates**	**Giddings 1964:245**

(Continued)

Table 1. *(Continued)*

Lab Number	**^{14}C Date**	**σ**	**Mean Cal BP**	**2σ**	**Cal Age Range (2σ)**	**δ13**	**Material**	**Excavation Unit**	**Notes**	**Reference**
Beta-319843	3300	30	3525	40	1650–1500 BC	–27.3	Birch Bark	NR	AMS	Tremayne and Rasic 2016
AA102988	3431	32	3690	55	1880–1640 BC	–24.5	Charcoal	Unit R1	AMS	Tremayne 2015b
Beta-422595	3460	30	3740	60	1890–1690 BC	–25.6	Charcoal	Unit R1	AMS	Tremayne 2015b
AA102992	3494	41	3765	55	1930–1690 BC	–24.9	Charcoal	Unit Z4	AMS	Tremayne 2015b
15C/0640	3440	40	3710	60	1890–1650 BC	NA	Charcoal	Unit Z4	AMS	Tremayne 2015b
AA102990	3717	39	4060	60	2280–1980 BC	–24.4	Charcoal	Unit PB	AMS	Tremayne 2015b
15C/0639	3500	40	3770	60	1940–1690 BC	NA	Charcoal	Unit PB	AMS	Tremayne 2015b
Modeled Start			4750	430	3570–2050 BC					All dates
Modeled End			3390	160	1670–1110 BC					All dates
Modeled Start			**4070**	**170**	**2310–1940 BC**					Suspect dates rejected
Modeled End			**3480**	**90**	**1690–1340 BC**					Suspect dates rejected

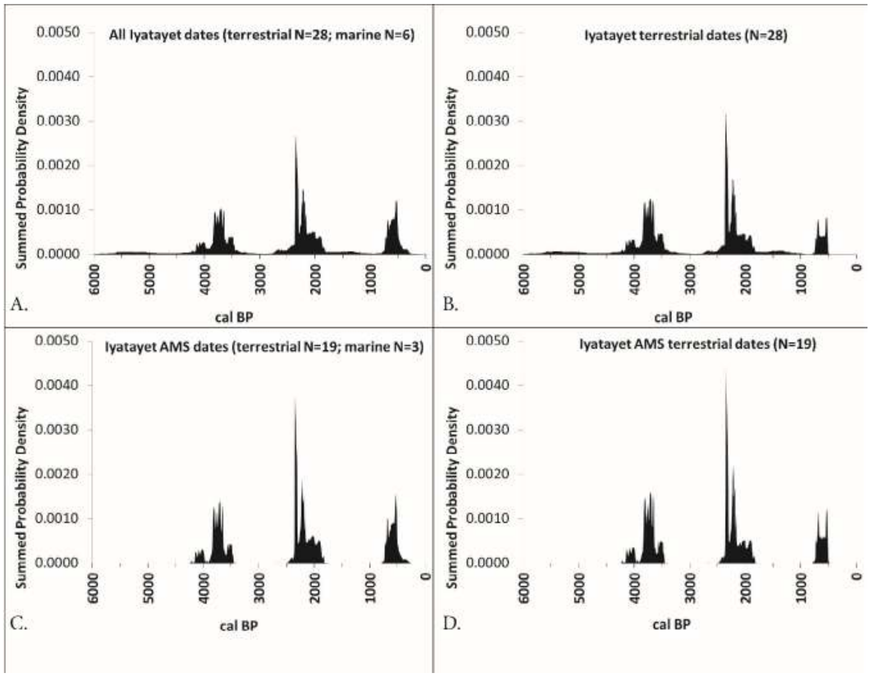

Figure 6. Summed probability density plots using: A. All dates including those from Giddings; B. All terrestrial dates; C. All AMS dates; D. Only AMS terrestrial dates.

(Bronk Ramsey and Lee 2013). The calibrated age now falls within the range predicted by the AMS dates (Table 1). Murray et al. (2003:94) also calibrated a 1440±40 BP date on a Thule, walrus-ivory harpoon head using only the atmospheric curve resulting in an age estimate that is about 900 years too old; while they discuss the marine-reservoir effect as a problematic issue, they did not recalibrate the date using a marine correction factor. Using the Marine13 curve (Reimer et al. 2013) and ΔR of 477±60 years, a calibrated age of AD 1390±50 is produced (Table 1). Using all of the calibrated dates, taking into account the marine-reservoir effect, the model predicts the Nukleet occupation spans about 200 years, beginning at AD 1270±70 and lasting until AD 1450±60 (Table 1).

Artifact Analysis Results

We recovered a total of 12,301 artifacts from the excavations at Iyatayet in 2012 and 2013: 9,836 pieces of stone debitage, 1,534 bone fragments, 514 ceramic sherds, 263 stone tools, 97 charcoal samples, 20 wood samples, 13 osseous tools, four formed wood artifacts, and two pieces of preserved leather (Table 2). Using stratigraphic position, diagnostic artifacts, and radiocarbon-date provenience, we were able to assign 78% of the assemblage to a cultural affiliation; the remaining 22% of the artifacts are from mixed or uncertain contexts. Broken down by cultural complex, 3% of the artifacts are Denbigh, 67% are Norton, and 8% are Nukleet. The following presents a summary of the artifacts recovered from each component with comparisons to Giddings's (1964) findings.

Stone Tools

We recovered 63 Denbigh stone tools during the 2012 and 2013 excavations (see Fig. 7a–ac for examples); however, 22 were found in mixed deposits. Evidence of mixing was not surprising, as Giddings (1964:188) observed that many objects of the "Flint" culture were likely displaced by Norton "diggings," and in some cases, Denbigh tools were recycled by the younger culture. We also recovered diagnostic Denbigh tools (e.g., microblades) in Norton levels, which confirms this assertion. Combining the Denbigh tool assemblage presented by Giddings (1964) with the artifacts collected in 2012–2013 (see Tremayne 2015b, Plates 1–10), we identify 34 unique tool forms represented at Iyatayet (Supplemental Data Table 1). Burins and burin spalls (Fig. 7h,i,t,u) constitute the majority (47%), followed by blade and microblade technologies (Fig. 7v–z) (23%); bifacially worked points, end blades, and side blades (Fig. 7a–g) (25%); and unifacially worked flake knives (Fig. 7aa–ac) (5%). Recognizing that Denbigh flintknappers produced a large proportion of the expedient tools, end

Table 2. Summary of artifact classes and counts recovered from Iyatayet in the 2012–2013 field seasons.

Artifact	Denbigh	Norton	Nukleet	Undetermined	Total	Percent
Stone tools	63	158	16	26	263	2.1
Debitage	323	6,824	442	2,245	9,834	79.9
Ceramic	0	231	173	110	514	4.2
Osseous tools	0	11	2	0	13	0.1
Leather	0	1	1	0	2	0.02
Fauna	24	926	347	223	1,520	12.4
Wood/Bark tools	0	1	3	0	4	0.03
Charcoal samples	19	91	4	17	131	1.1
Wood/Seed samples	0	9	10	1	20	0.2
Total	**429**	**8,252**	**998**	**2,622**	**12,301**	**100**
Percent	**3.5**	**67.1**	**8.1**	**21.3**	**100.0**	

blades, and side blades on blade and microblade blanks, we concur with Giddings (1964) that blade technology accounts for about 50% of the tools produced by Denbigh people at Iyatayet. Groundstone implements, all recovered by Giddings (1964), consist of 17 polished basalt creasers, two whetstones/abraders, and one hammerstone.

The 2012–2013 excavations recovered 158 specimens from 49 different Norton tradition tool types (Supplemental Data Table 2). Giddings (1964) reported on 2,087 Norton stone tools, which also grouped into 49 tool types (see Fig. 7ae–at for examples). Combined, these two assemblages comprise 55 unique tool types. The most common class of stone tools recovered from the Norton layers are bifaces (60%). These bifaces consist of knives, a variety of projectile-point forms, side blades, drills, and scrapers (Fig. 7ae–am). We did not recover nearly the relative frequency of uniface tools in the Norton levels as Giddings (1964) listed. A major difference in Denbigh and Norton technology was that about 23% of the Norton lithic assemblage is groundstone tools (Fig. 7ap–at). The most common forms in this class are slate blades or knives. As Giddings observed, these slate tools appear flaked along the edges and only minimally ground, appearing rather crude when compared to the finely honed Thule slate knives. Other groundstone tools found in 2012–2013 included abraders, whetstones, a hammerstone, a carefully shaped maul, and eight notched net sinkers (see Tremayne 2015b). Giddings found 224 net sinkers in the Norton levels, which support interpretations that Norton people were adept at net fishing (Bockstoce 1973; Lutz 1982). We found no net weights in the Denbigh levels.

The Nukleet levels produced only 15 formal tools (Supplemental Data Table 3), but we do not consider our sample representative, as we did not have access to collections excavated from the Nukeet houses. Giddings (1964) does not describe how many tools he recovered from the Nukleet levels at Iyatayet in his report. Instead, he based his treatment of the Nukleet culture on his excavations at the type site (NOB-00001) found on the south end of Cape Denbigh (see Fig. 1). Thus, we need to do more work to compare between the Norton and Nukleet lithic assemblages found at Iyatayet.

Lithic Debitage

Our excavations yielded 9,828 pieces of debitage produced from of a variety of lithic raw materials. Most of these were from Norton levels (n=6,824; 70%), followed by those from mixed Norton/Denbigh or Norton/Nukleet deposits (n=2,245; 23%). Only 3% (n=323) of the recovered debitage could be reliably assigned to Denbigh contexts. Nukleet debitage (n=460) comprises the remaining 4% (Supplemental Data Table 4). See Tremayne (2017) for a detailed analysis of the debitage collection.

Lithic Raw-Material Diversity

Giddings (1964:147) surmised that Norton primarily produced stone tools from "local basalt," while the Denbigh people produced tools almost exclusively on high-quality stone imported, presumably, from the Brooks Range (Giddings 1964:242). Our results generally confirm Giddings's findings. Grouping raw materials at the broadest level, the Denbigh people made greater

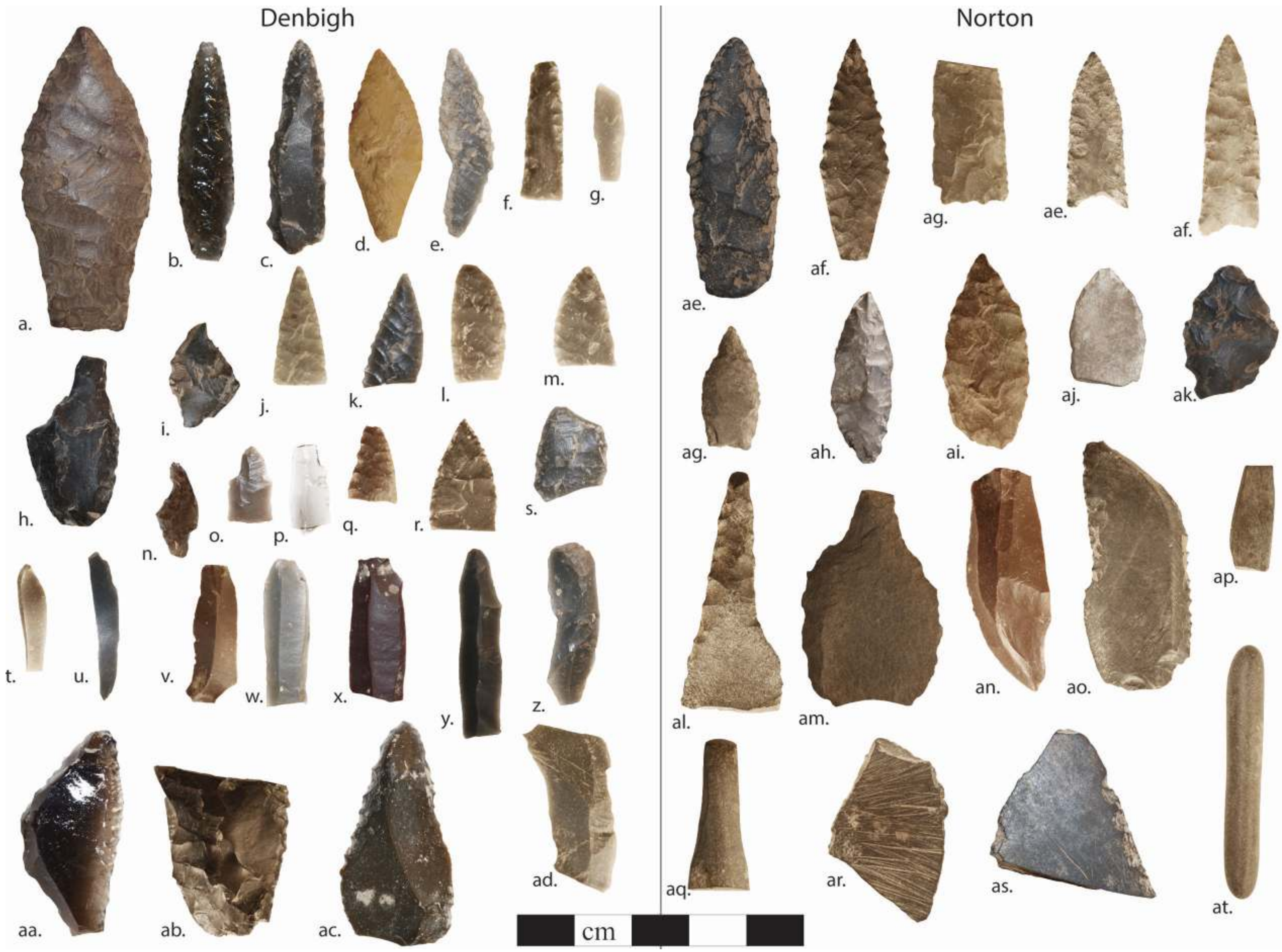

Figure 7. **Section of Denbigh and Norton stone tools collected in 2012–2013: a–g) end and side blades; h–i, n–p) burins and burinated microblades; j–m, q, s) side blade fragments; t, u) burin spalls, v–z) microblades; aa–ad) flake tools; ae–ak) Norton projectile points; al, am, aq) drills; an, ao) flake tools; ap) burinated groover; ar, as) ground slate; at) pebble tool.**

Table 3. Raw-material diversity among the three components.

Raw Material	Denbigh	%	Norton	%	Nukleet	%	Total
Basalt	98	5.2	3,648	50.2	185	38.4	3,931
Chert	1,466	77.7	3,097	42.6	220	45.6	4,783
Jasper	161	8.5	145	2.0	12	2.5	318
Obsidian	137	7.3	99	1.4	10	2.1	246
Quartz	6	0.3	45	0.6	2	0.4	53
Sedimentary	2	0.1	77	1.1	22	4.6	101
Silicified slate	5	0.3	44	0.6	7	1.5	56
Slate	7	0.4	42	0.6	10	2.1	59
Other	4	0.2	62	0.9	14	2.9	80
Total	**1,886**	**100.0**	**7,267**	**100.0**	**482**	**100.0**	**9,635**

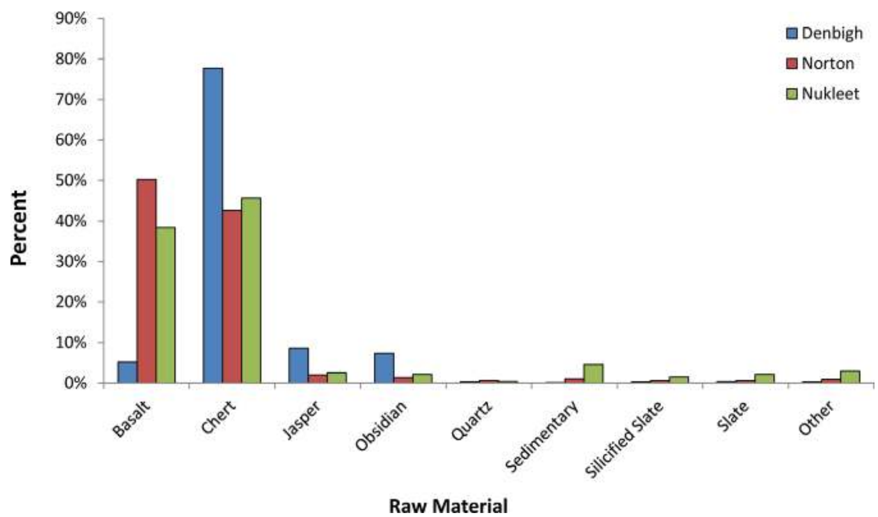

Figure 8. Raw-material diversity by culture grouped by general category.

use of cryptocrystalline silicates and obsidian for their stone-tool production than other materials (Fig. 8). Eighty-six percent of Denbigh tools and debitage are chert, chalcedony, and brown jasper, while 7% are obsidian (Table 3). Notably, local basalt comprises only 5.2% of the Denbigh assemblage, and less than 1% is slate or silicified slate. The remaining objects are made of quartz, quartzite, sandstone, and schist. The Norton assemblage, conversely, splits evenly between the use of local basalt (50%) and imported chert and obsidian (46%) (Fig. 8). The remaining 4% of the Norton raw material is made up of 1% slate or silicified slate, 1% quartz, and 2% local metamorphic and sedimentary rocks.

The 2013 excavations at Iyatayet produced 123 obsidian artifacts, including seven tools and five flakes from Denbigh deposits, one tool and 93 flakes from the Norton levels, and nine obsidian flakes from the upper Nukleet occupation. Two tools and 29 obsidian flakes are from mixed or disturbed contexts. We used a portable XRF analysis to investigate the source of 81 of the 123 obsidian artifacts, the remaining being too small. Sixty-seven were traced to the Batza Téna (Group B) source located in interior Alaska along the Koyukuk River (Clark and Clark 1993); 12 sourced to the Krasnoye Lake (Group S1) source located along the Anadyr River in the Chukotka region of Russia (Cook 1995; Grebennikov et al. 2018); and two were indeterminate assays (Supplemental Data Table 5). Broken down temporally, all of the Denbigh obsidian in our sample was from Batza Téna; the Norton assemblage had 32 pieces from Batza

Téna and four from Krasnoye Lake; and the Nukleet levels produced six from Batza Téna and two from Krasnoye Lake. The mixed deposits produced 16 Batza Téna and five Krasnoye Lake flakes, along with the two pieces from the unassigned source.

While the presence of the Batza Téna source obsidian is not surprising, considering the relative proximity of Cape Denbigh to the source (375 km), the Krasnoye Lake obsidian is noteworthy because it documents travel and trade from over 1,150 km away and across the Bering Strait during Norton and Thule periods. However, Krasnoye Lake obsidian has been identified in other Denbigh sites (Cook 1995; Rasic 2016), including a site at Cape Espenberg dating to 3880±40 BP (2360±70 BC) (Tremayne 2015a). These findings demonstrate travel and trade across the Bering Strait were a relatively common, if not routine, practice during Denbigh, Norton, and Thule periods.

Ceramics

The excavations at Iyatayet in 2012–2013 recovered 514 ceramic sherds. Preliminary examination of the sherds, following Griffin and Wilmeth (1964), indicates a mix of both Norton and Thule pottery types, with 44% percent likely being Norton based on sherd thickness, decoration, and context, and 33% are likely Nukleet in origin. The remaining 21% is undetermined. Most of the fragments in both Norton and Nukleet contexts are plainware. Fifteen (6%) of the Norton fragments are check stamped, and another three (1.3%) have linear stamping and unusual incised patterns, but only one Thule sherd has decorative curvilinear stamping. Additional work is needed to confirm these preliminary findings.

Organic Tools

Overall, organic artifacts are rare at Iyatayet, but a few areas of the site had excellent organic preservation in Nukleet and Norton levels. We recovered seven Nukleet and ten Norton organic tools; the latter primarily from the Trench A (see Fig. 3). Of particular interest are two harpoon heads from the Norton levels of a unique form not reported previously (Fig. 9b, c). We ascribed these pieces to the Norton tradition based on stratigraphic position and the associated charcoal radiocarbon date of 2274±40 BP (310±60 BC). Typically, Norton harpoon heads are crude in design—especially when compared to exquisitely crafted Northern Maritime forms. Norton harpoons generally lack decoration and slots for stone insets. However, the forms we found prove Norton people carefully shaped and incised with delicate line decoration some of their harpoon heads (Fig. 9b). For complete descriptions of the Norton (Fig. 9a–i) and Nukleet organic tools we recovered, see Tremayne (2015b:183–184).

Fauna

The 2012–2013 excavations yielded 1,520 bone fragments. Of these, 96 were from a mixed context or the eroded slope, which were excluded from the subsequent analysis. Bones recovered from the slope are likely Nukleet, but we cannot be certain because of extensive erosion and slumping. Of the remaining 1,424 fragments, 24 came from a Denbigh context, 1,053 from the Norton levels, and 347 from Nukleet deposits.

Of the 24 bones from verifiable Denbigh contexts, 12 are calcined, and all were poorly preserved. We added to our analysis 16 additional Denbigh bone fragments collected by Giddings and stored at the University of Pennsylvania. From this combined assemblage of 38 bone specimens, it was possible to identify ten seal specimens and 28 unidentified mammal fragments (Supplemental Data Table 6). Of the 24 fragments collected in 2013, 16 are unidentified mammal bone, one is part of a seal rib, and another is a seal femoral fragment. Cortical porosity suggests the other six pieces are probably sea mammal. In Giddings's collection, 11 are unidentified mammal, with one possible small terrestrial mammal. A rib (with cut mark), an occipital condyle fragment, and a calcined phalanx comprise the identified small seal specimens.

The Norton faunal collection was comparatively robust (n=1,053) (Supplemental Data Table 6). Indeed, three units from the 2012–2013 excavations had nearly as many bones as Giddings (1964) reported for the entirety of his excavation. Norton levels yielded a sample of small fish (Actinopterygii), ptarmigan (*Lagopus* sp.) and goose (Anserini), caribou (*Rangifer tarandus*), probable dog (*Canis lupus familiaris*), and fox (*Vulpes* sp.). Marine mammals dominate the NISP at 86.5%, with small seal accounting for 72.7% of the identified specimens (Fig. 10). In all, there are at least five marine-mammal species represented: small seal (cf. *Pusa hispida*), bearded seal (*Erignathus barbatus*), walrus (*Odobenus rosmarus*), beluga (*Delphinapterus leucus*), and an unidentified large whale (Cetacea) (Fig. 10). Caribou and large terrestrial mammal represent about 5.4% of the NISP in the Norton sample.

A total of 347 specimens comprise the Nukleet faunal assemblage (Supplemental Data Table 6). Both large and small seals (59.3% NISP) dominate the mammal bones. There is a slight increase in the relative percentage of large or bearded seal compared to the Norton assemblage, but the MNI suggests only one or two individuals are represented in each sample. Caribou and large terrestrial mammal specimens represent about

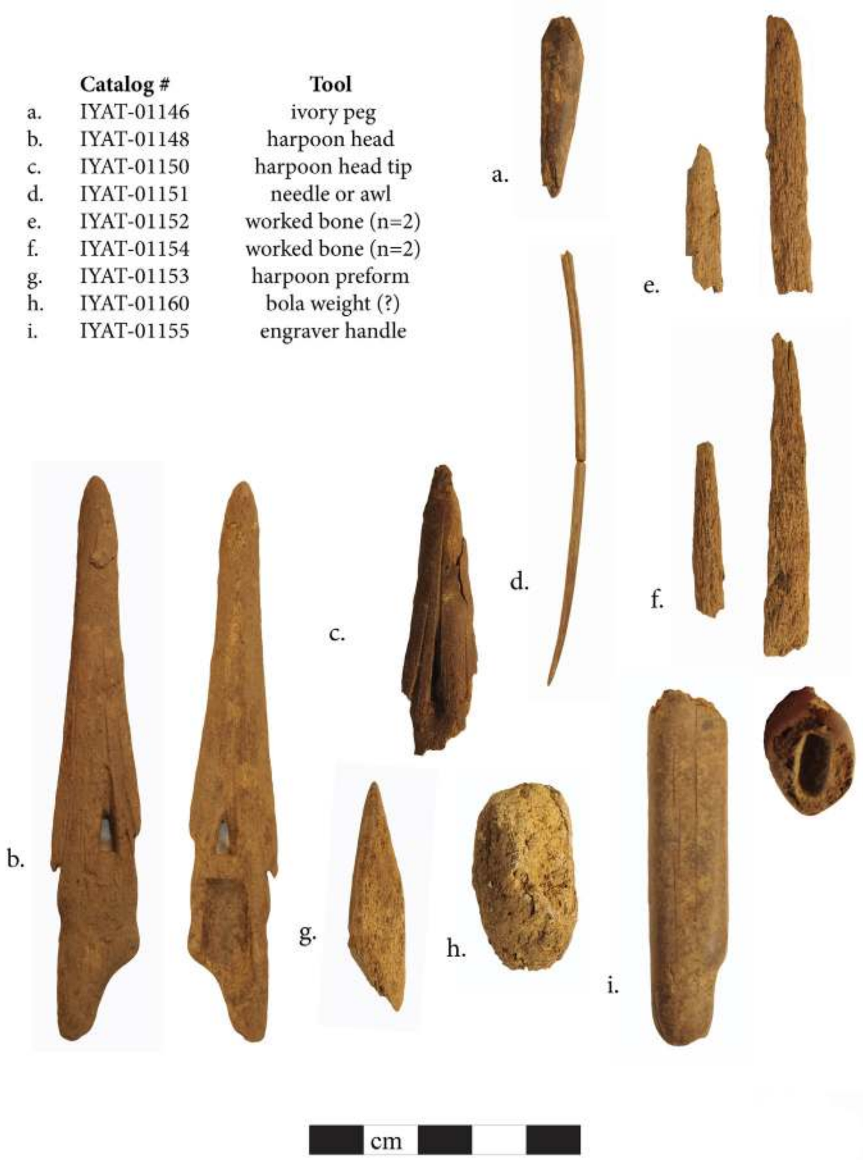

Figure 9. A selection of organic Norton tools collected from Iyatayet in 2013.

25.2% of the assemblage. These results confirm Giddings (1964:113) observation of an increase in the relative percentage of caribou bones in the Nukleet levels (see Supplemental Data Table 7 for comparison). Finally, we also recovered small samples of fox and dog remains, along with one grizzly bear (*Ursus arctos*) tooth in the Nukleet component. The nonmammalian specimens comprise 5.1% of the NISP and consist of one Gadid (likely saffron cod), two ptarmigan, and one duck. Screen size may have affected the number of fish bones recovered in this level. Based on the size of mammal specimens from the Norton level, the larger screen size likely did not affect the counts of Nukleet mammal bones recovered.

Discussion

To reevaluate Iyatayet and better understand its cultural and ecological context, it was imperative to identify each component clearly. During this process, we found the site-formation processes at Iyatayet proposed by Hopkins and Giddings (1953) are present and indeed complex. Most of Giddings's excavations concentrated on a slightly depressed or flat area of the terrace on the north side of the creek, where the Denbigh deposits were closer to the surface. The distribution of Denbigh materials recovered in our tests shows that most of this oldest component was concentrated atop the terrace, which Giddings exuberantly

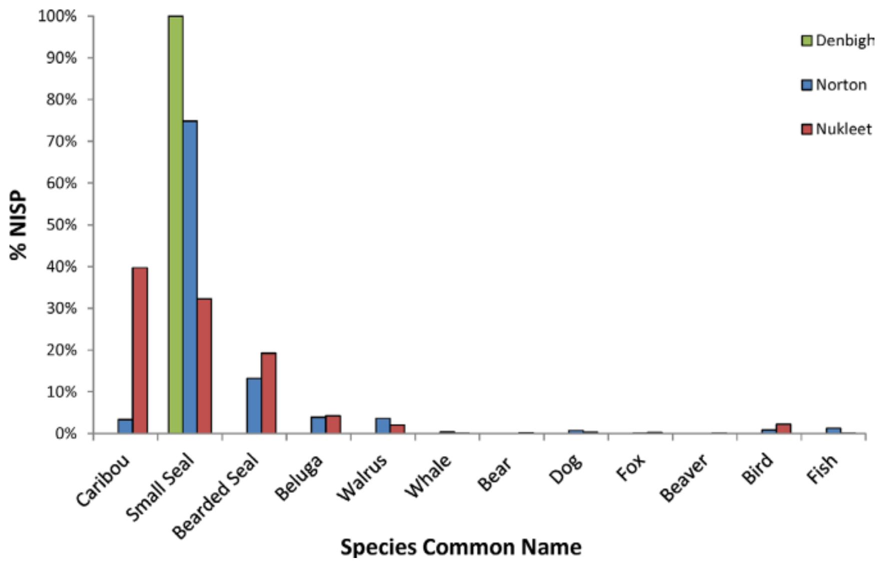

Figure 10. Summary of the relative frequencies of identified fauna represented in each component.

sampled—possibly to near exhaustion. Giddings also fully excavated the Nukleet houses that were present at the site. There are, however, portions of the site that appear to contain abundant deposits of excellently preserved Norton materials. Future researchers working at Iyatayet would do well to focus on the Norton component.

Taking into consideration the total number of artifacts we recovered, the size of the stratigraphic units that contained each component, and our modeled occupation spans for each tradition, we argue Norton people used the site most intensively. Norton deposits are widespread across the whole of the landform comprising the site, suggesting group size, length of stay, and intensity of use was considerably greater than it was during the Denbigh or Nukleet periods. Norton people's occupations in the Norton Sound region were extensive and potentially organized into a hierarchical arrangement of sites, at least if size and function are reliable indicators. Just to the south of Cape Denbigh are two large Norton villages—Difchahak (Giddings 1964; Harritt 2010) and Ungalaqliq (Lutz 1972). Difchahak has over 150 large depressions (Harritt 2010), and Ungalaqliq has over 200, most of which were likely semisubterranean house features (Lutz 1972:39). Iyatayet may have served as a satellite community or seasonal outpost for Norton populations residing at these larger sites.

Dating new samples from the oldest component confirms that researchers should disregard the earliest dates produced by Giddings (1964) for Denbigh occupations at Iyatayet. Our findings suggest the earliest occupation of the site was around 2310±290 BC, not 3870±370 BC. Out of seven new AMS dates from three test units, we were unable to substantiate Giddings's earliest Denbigh dates. Thus, while current estimates for the ASTt migration into North America is around 3000 BC (Savelle and Dyke 2002), our analysis suggests the probability that occupations at Iyatayet predate this time is very low (Table 1). While we would like to increase the number of AMS dates from the Denbigh levels, the samples we analyzed demonstrate these occupations occurred during the mid-to-late Denbigh period 2550–1550 BC.

Our findings indicate a 1,000-year hiatus between Denbigh and Norton occupations from 1480±150 BC to 430±80 BC. Norton people inhabited the site over the subsequent 500 years, which has a modeled end of AD 100±110. After this time, use of the site ceased again for another 1,000 years, with perhaps a brief visit around AD 560±210. We currently do not know the reasons for these abandonments, but Tremayne and Brown (2017) have demonstrated a widespread population decline in western Alaska coincident with the disappearance of the Denbigh Flint complex. However, there is no similar signal for regional population decline coincident with the disappearance of the Norton from Iyatayet, suggesting regional cultural evolution and shifting land use strategies. Why Iyatayet fell out of use during the end of the Norton period remains a mystery. There are indications from Iyatayet, and other sites in Norton Sound (Bockstoce 1973; Lutz 1972), that the Norton population in this area also declined around AD 0–100, but then recovered by approximately AD 500–600. AMS dates from the Norton levels suggest they were only present at Iyatayet between 300 BC–AD 100. Giddings

(1964:244) rejected the single young Norton date of 1460±200 BP (560±210 AD), but we cannot entirely dismiss it because similar Norton-associated dates occur at Unalakleet and Cape Nome (Bockstoce 1973; Lutz 1972), and Norton populations in southwest Alaska persist much later than in the north (Dumond 2016). It does appear that the main Norton population was based in southwest Alaska by this time, and their use of Norton Sound was limited and infrequent.

The Nukleet people first appear at Iyatayet around AD 1130–1380. This reoccupation lasted until AD 1320–1570, at which point the site was abandoned again. The reason for this last abandonment again is not clear; however, if the site was a satellite of the larger Nukleet village at the southern end of the cape, possibly population contraction no longer necessitated its use. Area-wide, people were still present at the Shaktoolik Airport site (NOB-072) at the time of Nukleet's abandonment (Darwent et al. 2016), and thus it might have been a shift in resource use that factored into its decline in occupation. Another possibility is that our sample of radiocarbon dates is too small for the Nukleet component to reveal the full history of repeated use.

With each component clearly defined and dated, we can now return to our question of resource intensification and economic change through time. Do we see evidence of change in subsistence strategies over time at Iyatayet? The lines of evidence we use to answer this question include technological organization, patterns of mobility, and faunal remains.

Tremayne (2017) makes a theoretical case that increased reliance on marine resources constitutes economic intensification, which should result in increased sedentism (Bettinger 1991), a greater diversity of tool forms (Oswalt 1976; Shott 1986), less concern with optimizing the size of tools for transport (Kuhn 1996), and increased use of local raw material sources (Brantingham 2003; Surovell 2009). Lacking a robust sample of faunal remains from the Denbigh component to test this theory, Tremayne (2017) analyzed the stone-tool technological organization of the Denbigh and Norton components making comparisons between numbers of tool forms, size of the tools, and raw-material diversity. The results of that study indicate that the Norton component exhibits a greater diversity of tool forms and significantly larger tools than observed in the Denbigh assemblage (Tremayne 2017).

Patterns in lithic raw-material use added further support to Giddings (1964) conclusions that Norton people depended on lower-quality, locally procured basalt rather than on high-quality cryptocrystalline silicates from more distant sources (Tremayne 2017). This difference is apparent in both the stone tools and the debitage (Fig. 8). Less reliance on local raw material by the Denbigh suggests they also spent less time foraging near Iyatayet. The fact that the Norton assemblage has a high diversity of raw materials, but exhibits a greater reliance on the local material, favors an interpretation of reduced mobility but increased trade networks (Giddings 1964; Tremayne 2017). The high number of obsidian artifacts from Siberia suggests their trade networks spanned the Bering Strait. Couple this with the observation that the Norton occupations—which occurred over a shorter time period—produced so much more material than the Denbigh, clearly indicates intensified use of the site. This shift in technological organization and reduced mobility, in our view, supports the hypothesis that marine-resource intensification occurred between ASTt and Norton time periods.

The scant faunal remain from the Denbigh component at Iyatayet suggests they were proficient maritime hunters. Elsewhere, research has demonstrated that Denbigh sites occur in Alaskan coastal contexts many centuries before they appear inland (Tremayne and Winterhalder 2017). Recent work at sites in Greenland has even demonstrated that other early cultures belonging to the ASTt were exploiting not only seals but bowhead whales as early as 2000 BC (Seersholm et al. 2016), which further suggests ASTt maritime adaptations were more sophisticated than generally permitted. The fact that ASTt people are taking seals by 2000 BC at both Iyatayet and Cape Espenberg (Buonasera et al. 2015) is further evidence that their coastal adaptations were an important part of their economic system in Alaska. Giddings (1964:242) argued Iyatayet was "primarily a caribou-hunting campsite during the time when it was customarily occupied." However, the only identified faunal remains from the Denbigh component are small seal, which suggests marine mammals were their "primary" subsistence pursuit at Iyatayet. With that said, it appears that Norton people invested more in taking a greater percentage of resources from the sea and spent a relatively greater amount of their time doing so at Iyatayet. The distinction is not necessarily one of capability, but rather the intensity of marine-mammal and fishing exploitation. The cause of this marine-resource intensification is still undetermined, but a collapse in caribou populations may be partially to blame (Dumond 1987; Tremayne and Brown 2017; VanderHoek 2009). More research is required to test this hypothesis.

Analysis of faunal remains from the younger components, on the other hand, indicates Norton and Nukleet hunters targeted the same suite of prey at Iyatayet (Fig. 10). This finding suggests Norton maritime adaptations were possibly as advanced and complex as the Northern Maritime tradition. While there is substantial evidence for maritime-resource intensification between Denbigh and Norton in the form of increased sedentism and technological organization (Tremayne 2017), we cannot say the same between Norton and Thule, at least not at this location. In fact, our results align with Giddings (1964) who suggested Norton people at Iyatayet were more reliant on marine mammals than Nukleet people were. This concordance would appear to falsify the hypothesis made by some (e.g., Ackerman 1998; Bockstoce 1973; Dumond 1975) that maritime adaptations increased in complexity between Norton and Thule periods.

Of course, the question that hangs over this assessment is whether Norton people were large whale hunters. Most arctic archaeologists accept that the most reliably unambiguous evidence for first whale hunters is with the Northern Maritime tradition (Thule), and it was probably not systematically practiced until about 800–1000 years ago (Jensen 2012; McCartney 1980) or possibly within the preceding Birnirk period, as a large harpoon head from Point Barrow seems to suggest (Ford 1959:41). However, Larsen and Rainey (1948:163, Plate 79) similarly report on two large harpoon heads from the Near-Ipiutak (Norton) component at Point Hope, which Dumond (2000:2) argued are for whaling. At Iyatayet, we found clear indications that Norton and Nukleet people alike exploited walrus and beluga, and that they exploited large whale on occasion, as well. The question remains whether they were hunted or scavenged and if the evidence documented at Iyatayet is indicative of subsistence strategies of these cultures more generally defined. We require additional case studies, such as completed here, to test and refine these hypotheses.

Conclusion

We renewed work at Iyatayet to investigate the development of maritime adaptations in northwest Alaska. Applying modern excavation techniques, lab methods, and current theoretical approaches, we were able to reassess the timing of occupations at the site and collect a sample of artifacts and faunal remains with which to test hypotheses concerning the progressive development of maritime adaptations. Occupation intensity, stone tools, debitage, and raw-material use and transport all provide evidence for reduced mobility and maritime-resource intensification between Denbigh and Norton (Tremayne 2017). Denbigh people spent less time at the site and appear to have left behind curated tools and debitage from their mobile toolkits. In contrast, the Norton used local raw material and spent significantly more time at this location; however, Norton trade networks were extensive and demonstrably reached across the Bering Strait to Asia. Norton prey species were similar to those taken by Thule/Nukleet groups, whom many archaeologists consider part of the apex maritime economy in this region. These results suggest researchers should not use the Denbigh component at Iyatayet as a representative example of early ASTt in North America, and that the progressive evolutionary model of maritime adaptation is not fully applicable, particularly in explaining differences between Norton and Thule cultures.

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References Cited

Ackerman, Robert E.
1998 Early Maritime Traditions in the Bering, Chukchi, and East Siberian Seas. Arctic Anthropology 35(1):247–262.

Anderson, Douglas D.
1984 Prehistory of North Alaska. *In* Handbook of North American Indians, vol. 5: Arctic. David Damas, ed. Pp. 80–93. Washington, D.C.: Smithsonian Institution Press.

1988 Onion Portage: The Archaeology of a Stratified Site from the Kobuk River, Northwest Alaska. Anthropological Papers of the University of Alaska 22(1–2):1–163.

Andrefsky, William, Jr.
2005 Lithics: Macroscopic Approaches to Analysis. Cambridge: Cambridge University Press.

Bettinger, Robert L.
1991 Hunter-Gatherers: Archaeological and Evolutionary Theory. New York: Plenum Press.

Bockstoce, John
1973 A Prehistoric Population Change in the Bering Strait Region. Polar Record 16(105):793–803. https://doi.org/10.1017/S0032247400063889.

Brantingham, Jeffery P.
2003 A Neutral Model of Stone Raw Material Procurement. American Antiquity 68(3):487–509. https://doi.org/10.2307/3557105.

Bronk Ramsey, Christopher, and Sharen Lee
2013 Recent and Planned Developments of the Program OxCal. Radiocarbon 55(2–3):720–730. https://doi.org/10.1017/S0033822200057878.

Buonasera, Tammy, Andrew H. Tremayne, Christyann M. Darwent, Jelmer W. Eerkens, and Owen K. Mason
2015 Lipid Biomarkers and Compound Specific δ13C Analysis Indicate Early Development of a Dual-Economic System for the Arctic Small Tool Tradition in Northern Alaska. Journal of Archaeological Science 61:129–138. https://doi.org/10.1016/j.jas.2015.05.011.

Clark, Donald. W. and A. McFadyen Clark
1993 Batza Téna: Trail to Obsidian: Archaeology at an Alaskan Obsidian Source. Archaeological Survey of Canada, Mercury Series Paper 147. Hull: Canadian Museum of Civilization.

Cook, John P.
1995 Characterization and Distribution of Obsidian in Alaska. Arctic Anthropology 32(1):92–100.

Crane, H. R., and James B. Griffin
1964 University of Michigan Radiocarbon Dates IX. Radiocarbon 6:1–24. https://doi.org/10.1017/S0033822200010511.

Darwent, John, Christyann M. Darwent, Kelly A. Eldridge, and Jason I. Miszaniec
2016 Recent Archaeological Investigations near the Native Village of Shaktoolik, Norton Sound, Alaska. Arctic 69(Supplement 1):1–16.

Dumond, Don E.
1975 Coastal Adaptation and Cultural Change in Alaskan Eskimo Prehistory. *In* Prehistoric Maritime Adaptations of the Circumpolar Zone. William Fitzhugh, ed. Pp. 168–180. Paris: Mouton Publishers.

1982 Trends and Traditions in Alaskan Prehistory: The Place of Norton Culture. Arctic Anthropology 19(2):39–51.

1987 The Eskimos and Aleuts. Revised ed. London: Thames and Hudson.

2000 The Norton Tradition. Arctic Anthropology 37(2):1–22.

2016 Norton Hunters and Fisherfolk. *In* The Oxford Handbook of the Prehistoric Arctic. T. Max Friesen and Owen K. Mason, eds. Pp. 395–416. Oxford: Oxford University Press.

Farrell, Thomas F. G., Peter Jordan, Karine Taché, Alexandre Lucquin, Kevin Gibbs, Ana Jorge, Kate Britton, Oliver E. Craig, and Rick Knecht
2014 Specialized Processing of Aquatic Resources in Prehistoric Alaskan Pottery? A Lipid-Residue Analysis of Ceramic Sherds from the Thule-Period Site of Nunalleq, Alaska. Arctic Anthropology 51(1):86–100. https://doi.org/10.3368/aa.51.1.86.

Ford, James A.
1959 Eskimo Prehistory in the Vicinity of Point Barrow, Alaska. Anthropological Papers of the American Museum of Natural History 47(1):1–272.

Gerlach, S. Craig, and Owen K. Mason
1992 Radiocarbon Dates and Cultural Interaction in the Western Arctic. Arctic Anthropology 20(1):54–81.

Giddings, J. Louis
1951 The Denbigh Flint Complex. American Antiquity 16(3):193–203. https://doi.org/10.2307/276780.

1955 The Denbigh Flint Complex is Not Yet Dated. American Antiquity 20(4):375–376. https://doi.org/10.2307/277071.

1964 The Archaeology of Cape Denbigh. Providence: Brown University Press.

1967 Ancient Men of the Arctic. New York: A.A. Knopf.

Giddings, J. Louis, and Douglas D. Anderson
1986 Beach Ridge Archaeology of Cape Krusenstern: Eskimo and Pre-Eskimo Settlements around Kotzebue Sound, Alaska. Publications in Archeology 20. National Park Service, U.S. Department of the Interior, Washinton, D.C.

Grebennikov, A. V., Y. V. Kuzmin, M. D. Glascock, V. K. Popov, S. Y. Budnitskiy, M. A. Dikova, and E. A. Nozdrachev
2018 The Lake Krasnoe Obsidian Source in Chukotka (Northeastern Siberia): Geological and Geochemical Frameworks for Provenance Studies in Beringia. Archaeological and Anthropological Sciences 10:599–614. https://doi:10.1007/s12520-016-0379-z.

Griffin, James B. and Roscoe H. Wilmeth, Jr.
1964 Appendix I: The Ceramic Complexes at Iyatayet. *In* The Archaeology of Cape Denbigh. J. Louis

Giddings, ed. Pp. 271–303. Providence: Brown University Press.

Grønnow, Bjarne
1994 Qeqertassussuk—The Archaeology of a Frozen Saqqaq Site in Disko Bugt, West Greenland. *In* Threads of Arctic Prehistory: Papers in Honour of William E. Taylor, Jr. David Morrison and Jean Luc Pilon, eds. Pp. 197–238. Archaeological Survey of Canada, Mercury Series Paper. Hull: Canadian Museum of Civilization.

Harritt, Roger K.
1998 Paleo-Eskimo Beginnings in North America: A New Discovery at Kuzitrin Lake, Alaska. Etudes/Inuit/Studies 22(1):59–81.

2010 Recent Work at Difchahak, a Center of Norton Culture in Eastern Norton Sound, Alaska. Arctic Anthropology 47(2):80–89. https://doi.org/10.1353/arc.2010.0011.

Hopkins, David M., and J. Louis Giddings
1953 Geological Background of the Iyatayet Archaeological Site, Cape Denbigh, Alaska. Smithsonian Miscellaneous Collections 121(11):1–33.

Irving, William N.
1957 An Archaeological Survey of the Susitna Valley. Anthropological Papers of the University of Alaska 6:37–51.

Jensen, Anne M.
2012 The Material Culture of Iñupiat Whaling: An Ethnographic and Ethnohistorical Perspective. Arctic Anthropology 49(2):143–161. https://doi.org/10.1353/arc.2012.0020.

Kuhn, Steven L.
1994 A Formal Approach to the Design and Assembly of Mobile Toolkits. American Antiquity 59(3):426–442. https://doi.org/10.2307/282456.

Larsen, Helge, and Froelich Rainey
1948 Ipiutak and the Arctic Whale Hunting Culture. New York: Anthropological Papers of the American Museum of Natural History.

Lutz, Bruce J.
1972 A Methodology for Determining Regional Intracultural Variations with the Norton, an Alaskan Culture. Ph.D. dissertation, Department of Anthropology, University of Pennsylvania.

1982 Population Pressure and Climate as Dynamics within the Arctic Small Tool Tradition of Alaska. Arctic Anthropology 19(2):143–149.

Lyman, R. Lee
1994 Vertebrate Taphonomy. Cambridge: Cambridge University Press.

2008 Quantitative Paleozoology. Cambridge: Cambridge University Press.

Mason, Owen K., and S. Craig Gerlach
1995 Chukchi Hotspots, Paleo-Polynyas, and Caribou Crashes: Climatic and Ecological Dimensions of North Alaska Prehistory. Arctic Anthropology 32(1):101–130.

McCartney, Allen P.
1980 The Nature of Thule Eskimo Whale Use. Arctic 33(3):517–541. https://doi.org/10.14430/arctic2581.

Melgaard, Morten
2004 Ancient Harp Seal Hunters of Disko Bay: Subsistence and Settlement at the Saqqaq Culture Site Qeqertasussuk (2400–1400 BC), West Greenland. Meddelelser om Grønland, Man and Society, vol. 30. Copenhagen: Danish Polar Center.

Murray, Maribeth S., Aaron C. Robertson, and Rachel Ferrara
2003 Chronology, Culture, and Climate: A Radiometric Re-Evaluation of Late Prehistoric Occupations at Cape Denbigh, Alaska. Arctic Anthropology 40(1):87–105. https://doi.org/10.1353/arc.2011.0103.

Oswalt, Wendell H.
1976 An Anthropological Analysis of Food-Getting Technology. New York: John Wiley & Sons.

Pearce, Christof, Aron Varhelyi, Stefan Wastegård, Francesco Muschitiello, Natalia Barrientos, Matt O'Regan, Thomas M. Cronin, Laura Gemery, Igor Semiletov, Jan Backman, and Martin Jakobsson
2016 The 3.5 ka Aniakchak Tephra in the Arctic Ocean: A Constraint on the Holocene Radiocarbon Reservoir Age in the Chukchi Sea. Climate of the Past Discussion 112:1–24. https://doi.org/10.5194/cp-2016-112.

Phillips, S. Colby, and Robert J. Speakman
2009 Initial Source Evaluation of Archaeological Obsidian from the Kuril Islands of the Russian Far East Using Portable XRF. Journal of Archaeological Science 36(6):1256–1263. https://doi.org/10.1016/j.jas.2009.01.014.

Prentiss, Anna M., Mathew J. Walsh, Thomas A. Foor, and Kristen D. Barnett
2015 Cultural Macroevolution among High Latitude Hunter-Gatherers: A Phylogenetic Study of the Arctic Small Tool Tradition. Journal of Archaeological Science 59:64–79. https://doi.org/10.1016/j.jas.2015.04.009.

Rasic, Jeffery T.
2016 Archaeological Evidence for Transport, Trade and Exchange in the North American Arctic. *In* The Oxford Handbook of the Prehistoric Arctic. T. Max Friesen and Owen K. Mason, eds. Pp. 131–152. Oxford: Oxford University Press.

Reimer, Paula J., Edouard Bard, Alex Bayliss, J. Warren Beck, Paul G. Blackwell, Christopher Bronk Ramsey, Caitlin E. Buck, Hai Cheng, and R. Lawrence Edwards.
2013 IntCal 13 and Marine 13 Radiocarbon Age Calibration Curves 0–50,000 Years cal BP. Radiocarbon 55(4):1869–1887. https://doi.org/10.2458/azu_js_rc.55.16947.

Reuther, Joshua D., Natalia S. Slobodina, Jeffrey T. Rasic, John P. Cook, and Robert J. Speakman
2011 Gaining Momentum: Late-Pleistocene and Early-Holocene Archaeological Obsidian Source Studies in Interior and Northern Eastern Beringia. *In* From the Yenisei to the Yukon: Interpreting Lithic Assemblage Variability in Late Pleistocene/Early Holocene Beringia. Ted Goebel and Ian Buvit, eds. Pp. 270–286. College Station: Texas A & M University Press.

Savelle, James M., and Arthur S. Dyke
2002 Variability in Palaeoeskimo Occupation on South-Western Victoria Island, Arctic Canada: Causes and Consequences. World Archaeology 33(3):508–522. https://doi.org/10.1080/00438240120107503.

Seersholm, F. V., M. K. Pedersen, M. J. Søe, H. Shokry, S. S. T. Mak, A. Ruter, M. Raghavan, W. Fitzhugh, K. H. Kjær, E. Willerslev, M. Meldgaard, C. M. O. Kapel and A. J. Hansen
2016 DNA Evidence of Bowhead Whale Exploitation by Greenlandic Paleo-Inuit 4,000 Years Ago. Nature Communications 7:13389. https://doi.org/10.1038/ncomms13389.

Shott, Michael J.
1986 Technological Organization and Settlement Mobility: An Ethnographic Examination. Journal of Anthropological Research 42(1):15–51. https://doi.org/10.1086/jar.42.1.3630378.

Slaughter, Dale C.
2005 Radiocarbon Dating the Arctic Small Tool Tradition in Alaska. Alaska Journal of Anthropology 3(2):117–134.

Surovell, Todd A.
2009 Toward a Behavioral Ecology of Lithic Technology: Cases from Paleoindian Archaeology. Tucson: University of Arizona Press.

Tremayne, Andrew H.
2015a New Evidence for the Timing of Arctic Small Tool Tradition Coastal Settlement in Northwest Alaska. Alaska Journal of Anthropology 13(1):1–18.

2015b The Origin and Development of Maritime Foraging Systems in Northern Alaska. Ph.D. dissertation, Department of Anthropology, University of California, Davis.

2017 Marine Resource Intensification and the Reorganization of Lithic Technologies during the Middle-Late Holocene in Northwest Alaska. Journal of Island and Coastal Archaeology. 12:1–17. https://doi.org/10.1080/15564894.2017.1278730.

Tremayne, Andrew H., and William A. Brown
2017 Mid to Late Holocene Population Trends, Culture Change and Marine Resource Intensification in Western Alaska. Arctic 70(4):365–380. https://doi.org/10.14430/arctic4681.

Tremayne, Andrew H., and Jeffrey T. Rasic
2016 The Denbigh Flint Complex of Northern Alaska. *In* The Oxford Handbook of the Prehistoric Arctic. T. Max Friesen and Owen K. Mason, eds. Pp. 349–370. Oxford: Oxford University Press.

Tremayne, Andrew H., and Bruce Winterhalder
2017 Large Mammal Biomass Predicts the Changing Distribution of Hunter-Gatherer Settlements in Mid-Late Holocene Alaska. Journal of Anthropological Archaeology 45:81–97. https://doi.org/10.1016/j.jaa.2016.11.006.

VanderHoek, Richard
2009 The Role of Ecological Barriers in the Development of Cultural Boundaries during the Later Holocene of the Central Alaska Peninsula. Ph.D. Dissertation, Department of Anthropology, University of Illinois at Urbana-Champaign.

Williams, Alan N.
2012 The Use of Summed Radiocarbon Probability Distributions in Archaeology: A Review of Methods. Journal of Archaeological Science 39(3):578–589. https://doi.org/10.1016/j.jas.2011.07.014.

Workman, William B., and Allen P. McCartney
1998 Coast to Coast: Prehistoric Maritime Cultures in the North Pacific. Arctic Anthropology 35(1):361–370.