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Neo-Inuit strategies for ensuring food security during the Little Ice Age climate change episode, Foxe Basin, Arctic Canada

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ABSTRACT

This paper examines Neo-Inuit (ca. AD 1250 to present) responses to the decreased temperatures of the Little Ice Age (LIA) climate change episode (ca. AD 1300–1900) in the Foxe Basin region of central Nunavut, Arctic Canada. Cooler temperatures (and increased sea ice) would be expected to have reduced both bowhead whale (*Balaena mysticetus*) and Atlantic walrus (*Odobenus rosmarus rosmarus*) habitats, forcing Neo-Inuit to refocus their hunting activities on landfast-ice-dwelling small seals (e.g., *Pusa hispida*) during winter months. However, an analysis of faunal remains from Foxe Basin's largest-known Neo-Inuit (Thule, historic and modern Inuit) archaeological site, *Pingiqqalik* (NgHd-1), reveals a long-term subsistence economy based largely on multi-seasonal walrus hunting. Two interrelated factors may explain these results: (1) a system of recurring polynyas provided a degree of ecological stability for local walrus populations, and (2) the development of a distinctive walrus caching regime—a form of which continues among the region's contemporary Inuit—allowed residents to adeptly exploit an ecological niche, thereby ensuring food security. Together, these factors likely insulated northern Foxe Basin Neo-Inuit from the worst effects of the LIA.

1. Introduction

There is increasing evidence contemporary climatic warming is adversely affecting Canadian Inuit hunting regimes (Ford, 2009; Beaumier and Ford, 2010; Wesche and Chan, 2010). While the damaging effects of rising temperatures are manifest, it is likely that both warming *and* cooling trends have the capacity to worsen Indigenous food security in the Arctic by threatening animal-resource bases in regions with relatively low species richness. Indeed, in terms of hunting success and long-term food security, one of the most precarious times for Neo-Inuit (ca. AD 1250 to present) across Arctic Canada may have been the onset of the Little Ice Age (ca. AD 1300–1900) cooling episode, during which decreasing ambient temperatures and associated heavy sea ice would likely have restricted the availability of large, economically important marine mammals favoring open water, such as bowhead whales (*Balaena mysticetus*) and Atlantic walruses (*Odobenus rosmarus rosmarus*).

In this paper, I examine the degree to which the LIA impacted the acquisition and management of animal resources among Neo-Inuit at *Pingiqqalik* (NgHd-1), an unusually large multi-season village site in the northwest Foxe Basin region of central Nunavut, Arctic Canada occupied (at least periodically) by Neo-Inuit for at least 600 years. I present faunal data from three well-dated archaeological contexts at the site, and compare them to the taxonomic profiles of 36 Neo-Inuit sites or site groups across the North American Arctic (see Fig. 1). To complement the zooarchaeological data, I draw upon *Inuit Qaujimajatuqangit* (*IQ*) ('things long known to Inuit') from northern Foxe Basin in the form of previously recorded interviews with hunters and elders obtained through the Government of Nunavut Oral History Project archive in Igloolik, my own interactions with, and observations of, Inuit hunters in the region, as well as ethnohistoric accounts of non-Inuit explorers.

2. Neo-Inuit occupations around Northern Foxe Basin

Neo-Inuit may have first occupied the coastlines of northern Foxe Basin—an area of approximately 35,000 km^2 (Fig. 2)—as early as the 13th century AD. These 'Classic Thule' Inuit had spread relatively rapidly from northern and western Alaska, bringing with them a sophisticated hunting economy based on marine mammals and caribou and social organization based on the group hunting of

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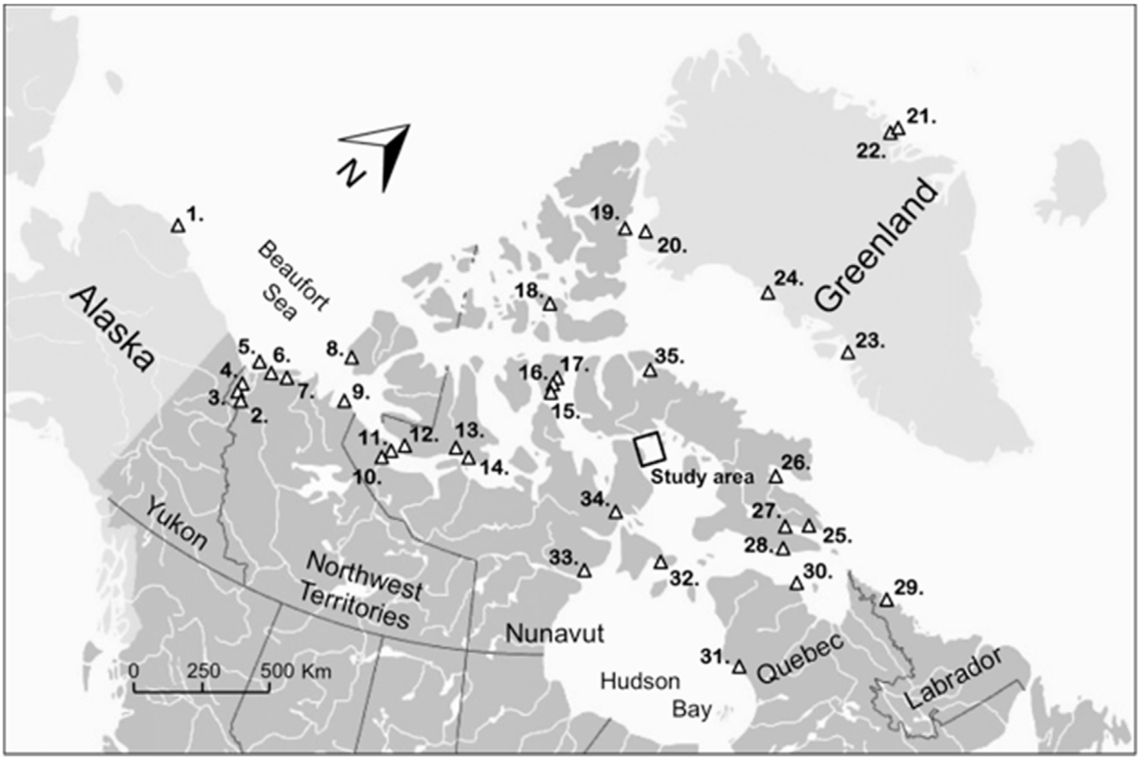

Fig. 1. Map of the North American Arctic, showing the Neo-Inuit archaeological sites mentioned in the text: 1) Walakpa; 2) Cache Pt. (NhTs-2); 3) Pond (NiTs-2); 4) *Kuupak*/*Gupuk* (NiTs-2); 5) Washout (NjVi-2); 6) *Gutchiak* (NhTn-1); 7) *Kugaluk* (NgTi-1); 8) OkRn-1; 9) *Tiktalik* (NkRi-3); 10) Clachan (NaPi-2); 11) Beaulah (NcPf-12), *Nuvuk* (NcPf-1); 12) Lady Franklin Pt. (NdPd-2); 13) Bell (NiNg-2); 14) Pembroke (NgNc-2); 15) Hazard Inlet group (PaJs-3, PaJs-4 and PaJs-13); 16) Cape Garry (PcJq-5); 17) Learmonth (PeJr-1); 18) Porden Pt. group (RbJr-1, RbJr-4 and RbJr-5); 19) Bache Peninsula group (SfFk-4, SfFk-4 and SgFm-4); 20) Cape Grinnell; 21) Walrus I.; 22) Clavering I. group (15 sites—see Gotfredsen, 2010); 23) *Sermermiut*; 24) *Nugarsuk*; 25) Outer Frobisher Bay group (KfDe-5, KfDf-2 and KeDe-7); 26) Cumberland Sound: B-1 (LlDj-1); 27) Peale Pt. (KkDo-1); 28) *Talaguak* (KeDq-2); 29) *Nachvak* Fiord group (IgCx-3 and IgCv-7); 30) JfEl-10; 31) *Qijurittuq* (IbGk-3); 32) Sadlermiut/Native Pt. (KkHh-1); 33) *Silumiut* (KkJg-1); 34) Naujan (MdHs-1) and 35) the Pond Inlet group (PeFr-1 and PeFs-1). The 'study area' inset includes Foxe Basin sites *Sanirajak* (NeHd-1) and *Pingiqqalik* (NgHd-1) and *Iglulik* Pt. (NiHe-2).

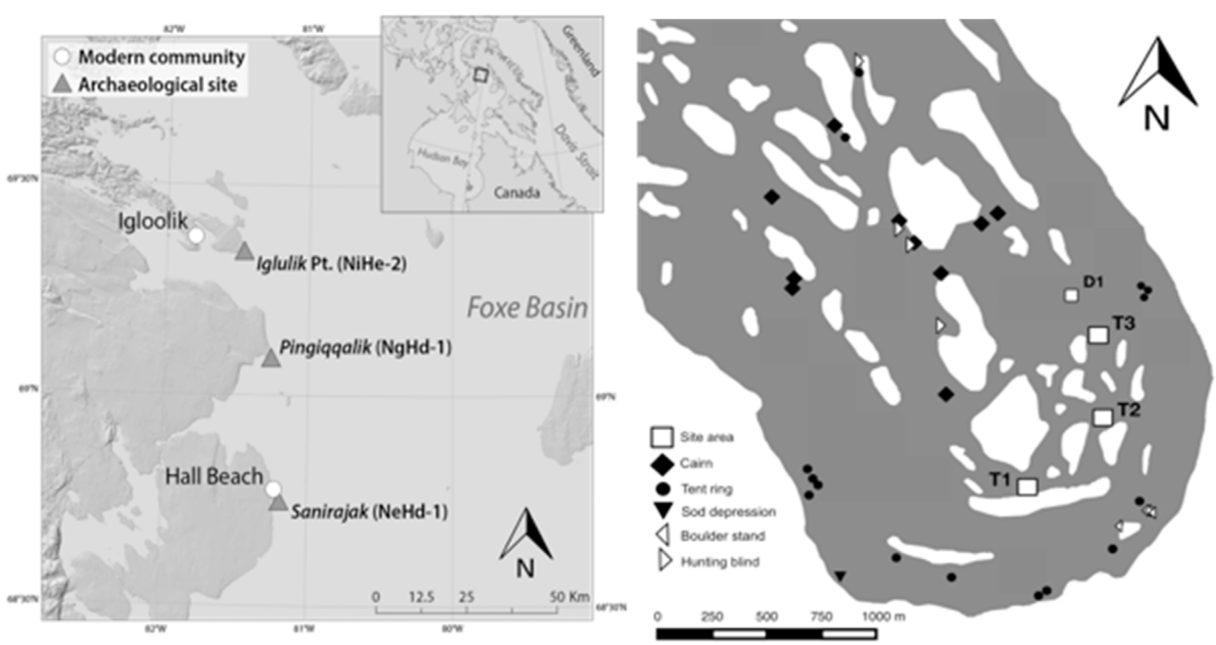

Fig. 2. Left: select Neo-Inuit sites in NW Foxe Basin (map by F. Steenhuisen); right: cultural features at *Pingiqqalik* (NgHd-1) (map by M. Hawley and S. P. A. Desjardins).

bowhead whales (McCartney, 1980; Maxwell, 1985; Whitridge, 1999). Over the next several hundred years, the hunting and settlement patterns around northern Foxe Basin were likely highly dynamic, undergoing both dramatic and subtle changes in response to altered ecological and social circumstances.

Compared with Inuit in other regions of Arctic Canada, the relative geographic isolation of Foxe Basin delayed the major changes to Inuit life brought about by colonialism. The first non-Inuit to enter the region arrived in 1822 (see Parry, 1824; Lyon, 1824), and subsequent contacts were sporadic over the following century. In the early 20th century, varied policies of the Canadian federal government, the Catholic and Anglican churches and the Hudson's Bay Company collectively shifted the local settlement pattern from seasonally mobile hunting to semi-sedentary trapping (Crowe, 1970; Damas, 1963; Rasing, 1994). Today, all Inuit in the region are known as Amitturmiut (Bennett and Rowley, 2004), and reside permanently in two modern communities: Igloolik and Hall Beach (Fig. 2). Residents of these hamlets are generally imbued with a strong sense of pride in the regular use of the Inuktitut language, a deep knowledge of local history, and the maintenance of culture-defining traditions, such as the hunting of walruses.

Walruses inhabit waters throughout northern Foxe Basin, comprising their own large and relatively discreet stock (Dunbar, 1954: 14; Loughrey, 1959; Born et al., 1995). According to local Inuit knowledge (Paulic et al., 2014), they are frequently found during summer months in a long swath of open water between 25 and 50 km east of the mainland that roughly corresponds to a recurring system of polynyas and sizeable shore leads (see Currie, 2014; Mallory and Fontaine, 2004; Stirling and Cleator, 1981). This relatively large area of year-round open water allows walruses access to ice floes and edges on which to haul out—even during cold-weather months.

2.1. A Neo-Inuit 'Core Area'?

Arctic Archaeologists know and refer regularly to the greater Foxe Basin region as the 'Core Area' of the Paleo-Inuit cultural tradition (ca. 2500 BC to AD 1300), which preceded Neo-Inuit in the Canadian Arctic. The informal organizing model for settlement around Foxe Basin maintains that the region (1) hosted large, repeated (perhaps continuous) Paleo-Inuit occupations, and (2) served as a base of periodic cultural rejuvenation or reinforcement for local groups, as well as those residing in 'marginal' areas outside the Core (McGhee, 1972; Maxwell, 1976, 1985).

The Core Area model has been critiqued on multiple fronts, most effectively by direct challenges to the region's status as a hub for Paleo-Inuit cultural continuity. Archaeological work in 'marginal' regions, such as northern Labrador, has shown lasting, healthy and locally well-adapted Paleo-Inuit occupations (see Tuck, 1976; Maxwell, 1985: 50–51). Additionally, the assumption that particular Paleo-Inuit sites within the Core were continually occupied has been challenged by Savelle and Dyke (2014), who have demonstrated convincingly the existence of population boom-and-bust cycles, with significant periods of abandonment recorded for even major settlements.

Despite the critiques of the Core Area model as it relates to the relative permanence and interregional cultural significance of occupations, its basic tenet—that a significant degree of ecological resilience or stability in the region can facilitate large, lasting (if not permanent) occupations—is broadly valid. Moreau Maxwell has described the Core Area as "a region in which no one food animal is uniquely numerous but in which the number of available species and individuals within each species is sufficiently great to assure a constantly favorable amount of food energy for the amount of work it takes to extract it from the environment" (Maxwell, 1985: 81). The degree to which these conditions were true for Neo-Inuit populations in the region has not been examined in detail.

It has been demonstrated that during the LIA, ambient temperatures across the North Atlantic dropped significantly (Bond et al., 2001; Kobashi et al., 2010; Miller et al., 2012). In much of the Canadian Arctic and Greenland (hereafter referred to as "the Eastern Arctic"), these lowered temperatures should have affected resource scheduling and prey choice by Neo-Inuit. Exploitation of marine mammals favoring open water would be expected to have declined in favor of ice-dwelling species, such as ringed seals (*Pusa hispida*). However, if distinct environmental features of northern Foxe Basin, such as the polynya system, offered more ecologically security to one or more high-utility species than in other parts of the Eastern Arctic, zooarchaeological data from local Neo-Inuit sites should reflect (1) a relative abundance of these indicator species, and (2) measurable consistency in the taxonomic proportions of prey during and after the onset of the LIA.

Due to its large number of well-preserved archaeological features, its numerous references in ethnohistoric accounts, as well as firsthand knowledge of the site by area elders, *Pingiqqalik* is an ideal locale in which to examine this issue further.

2.2. Pingiqqalik (NgHd-1)

Situated approximately 37 km southeast of Igloolik, *Pingiqqalik* encompasses the entirety of a relatively short and wide peninsula of the same name (sometimes referred to in English as "Pinger Point") (Fig. 2). The site features prominently in Amitturmiut mythology as one of the settings of the popular oral legend of Atanaarjuat and his brother Aamarjuaq—a story adapted into the award-winning 2001 film *Atanarjuat: the Fast Runner* directed by Igloolik local Zacharias Kunuk. Many locals are also familiar with the long history of occupation at the site—evidenced by the abundance of Late Dorset Paleo-Inuit (or *Tuniit*) and Neo-Inuit archaeological features scattered across the peninsula. Ethnohistoric and administrative accounts attest to the site's being at least sporadically occupied into the early 1930s (Crowe, 1970; RCMP, 1937), though a more precise date of abandonment is unclear. Igloolik elder H. Paniaq (b. 1933) informed me that he had no memory of Inuit settlement at the site in his lifetime (pers. comm. 2011). Similarly, elder E. Ipkarnak told me that in recent times (precise dates are unclear) the site was used only for caching walrus meat—a practice abandoned as polar bear activity increased in the early 20th century (pers. comm. 2014).

Pingiqqalik has been visited by archaeologists T. Mathiassen (1927), G. Rowley, J. Meldgaard, Fr. G. Mary-Rousselière (1954) and J. M. Savelle, with the most thorough—if still cursory—survey being carried out by Mary-Rousselière. No professional excavations had taken place prior to the present research. In July 2011, I accompanied H. Paniaq to *Pingiqqalik* in an effort to gain additional perspective on the site and walrus hunting in the region in recent-historic times. One Thule Inuit house feature (T1F20) and several areas likely representing front middens of cold-season houses were selected for archaeological testing to be carried out the following year. Over the summer of 2012, a small field crew from McGill University and the University of Toronto, members of the Kadlutsiak and Mikki families of Igloolik, and I maintained a research camp nearby to *Pingiqqalik*. The field crew carried out an extensive survey of the entire peninsula and an intensive program of excavation.

The goal of excavations was to gain as much information as possible about animal-resource use over time; thus, a focus was placed on the front middens—in many cases, clearly visible on the surface. A total of 29 test units (most measuring $1 \times 1\text{m}^2$) were excavated in these middens across the site. Additionally, 22 $1 \times 1\text{m}^2$ test units were excavated within the house feature T1F20. When possible, test units were excavated according to natural stratigraphic levels to sterile beach sand/gravel; all soils were screened through 1/8" mesh. The majority of excavated test units did not exceed 60 cm in depth. In 2014, the author returned to *Pingiqqalik* with Igloolik hunter S. Mikki to record the elevations of various features on the peninsula.

Surveys of the site in 2011 and 2012 revealed a total of 119 Neo-Inuit sod house features and 55 rectangular, semisubterranean Dorset Paleo-Inuit cold-season houses (Table 1 and Fig. 2), most of which are located immediately north of a series of well-elevated raised beach ridges at the southern end of the peninsula. The sod house features at *Pingiqqalik* are clustered into a series of four somewhat discrete “site areas,” designated by cultural affiliation of the majority of houses in the group (“T” for Thule; “D” for Dorset Paleo-Inuit): T1, T2, T3 and D1. (Though Dorset Paleo-Inuit features are abundant across the site, D1 is the sole group at which Neo-Inuit features are largely absent.) Each Neo-Inuit house at site has been classified as either ‘robust’—indicating deeply dug houses (single-, bi- or tri-lobed) with abundant structural whale bone and stone—or ‘light’—indicating smaller, shallower single-lobed structures commonly referred to as *qarmat* by Arctic archaeologists). Due to their size and insulation when complete, both robust and light structures would likely have been occupied during cooler seasons.

When compared to Neo-Inuit sites elsewhere in the Eastern Arctic, *Pingiqqalik* has one of the highest concentrations of cold season (sod) house features ever recorded (see Scheitlin et al., 1979; Park, 1998). Even if each site area at *Pingiqqalik* were to be considered as a discrete site, the largest (T2: 55 sod houses) would rival even the principal Classic Thule Inuit bowhead whaling villages of Somerset Island, Central Nunavut (see Savelle, 1987; Whitridge, 1999).

Large numbers of additional features were documented during the 2012 survey at *Pingiqqalik*, including tent rings, hunting blinds, stone-slab burial cairns and boulder caches (*pirujat*)—likely for storing caribou meat. Notably, along the raised gravel beach ridges to the south of the site areas were a large number (n = 587) of shallow gravel depressions typically measuring between one and 3 m in total diameter (Figs. 3 and 4A). Such features, which are also found along the raised beaches nearby to the *Iglulik* Pt. site, are toroidal, with vegetation in their centers and occasionally, lichen-covered stones in both their centers and along their outer edges (Fig. 4B). The depressions strongly resemble emptied caches used by Amitturmiut to store walrus meat for winter consumption (Fig. 4C), and thus, may be the remains of archaeological gravel caches. While it is possible the depressions represent patterned-ground features, such as sorted or unsorted circles, geologist A. S. Dyke of the Geological Survey of Canada (GSC), who has extensive experience surveying the beach ridges of Foxe Basin, believes representative features from *Pingiqqalik* he has observed in photographs to be cultural in origin (pers. comm. 2013). The caching activities that may have resulted in these features would likely have taken place during the spring or summer (see Section 4.1); this would help to explain the 17 recorded tent rings concentrated on the site's lower beach ridges.

Table 1
Feature distribution and elevations of the four site areas at *Pingiqqalik*.

	D1	T3	T2	T1	Pen.	Totals
Robust Neo-Inuit sod houses		18	26	19		63
Light Neo-Inuit sod houses		1	29	26		56
Dorset Paleo-Inuit houses	20	3	19	13		55
Tent rings					17	17
Boulder caches			8		68	76
Burial cairns					10	10
Gravel depressions	1	2	18	6	587	614
Indet. Pit features			14	1		15
Totals	21	24	114	65	682	906

Site area	T1	T2	T3	D1
Elevation ASL (m)	12–14	10–11	10–12	11

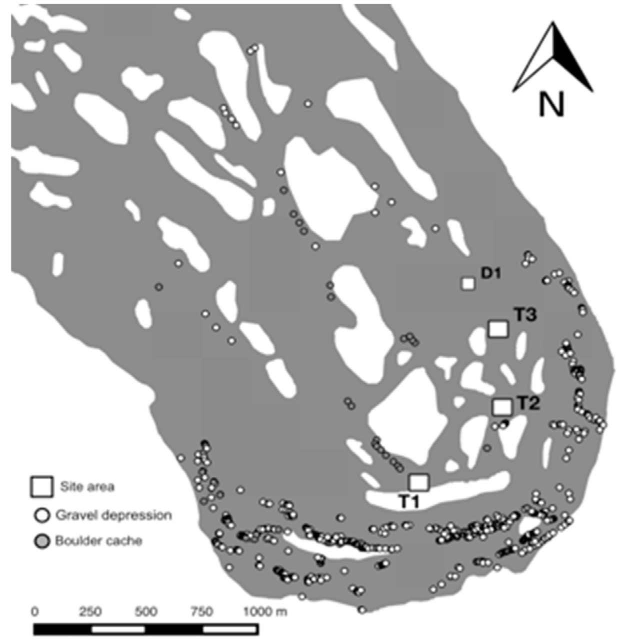

Fig. 3. Gravel depressions (n = 587) recorded on the lower beach ridges at *Pingiqqalik* in July 2012; locations of boulder caches (*pirujat*) are also shown (map by M. Hawley and S. P. A. Desjardins).

2.2.1. Radiocarbon dates

The results of radiocarbon testing of faunal samples from *Pingiqqalik* are presented in Table 2. In total, 13 samples were processed: 12 caribou bones and one portion of antler debitage. A single specimen was recovered from Neo-Inuit house feature T1F20; all other samples were found in middens. For Neo-Inuit, the calibrated dates show a gradual geographic shift in occupation from site areas T3 and T2 in the 14th century AD to T1 over the following two centuries. These results reinforce assertions about the relative ages of the site areas made by Amitturmiut informants prior to starting archaeological work at the site. In 2012, Igloolik hunter S. Mikki indicated to me site area T1 was the most recent house group, and that T3 was the oldest (pers. comm.).

The earliest dates from *Pingiqqalik* were from site areas D1 and T2, and fall within the late 11th century. A Dorset Paleo-Inuit date from the former sample is reasonable; however, the sample from T2 was recovered from the front midden of a relatively light Neo-Inuit sod house, making a pre-13th century date for this feature unlikely. It is possible material from Neo- and Paleo-Inuit contexts became mixed, as a large concentration of Paleo-Inuit features can be found roughly 100 m east of the light T2 sod house. (It is not uncommon for Thule Inuit to have reoccupied Dorset Paleo-Inuit locales in the Eastern Arctic.)

2.2.1.1. Reliability of the dates. In recent years, the validity of radiocarbon dates from Eastern Arctic contexts has been questioned, with concerns raised over (1) the provenance of raw materials used, and (2) contamination of samples by sea-mammal carbon (e.g., Morrison, 1989; Park, 1994; McGhee, 2000; Nelson and McGhee, 2002). The potential for bone specimens at Arctic sites to have been compromised by sea-mammal fats and oils is real; Neo-Inuit sites are noted for their excellent preservation. Caribou bones—the most preferred material for testing—may have spent dozens or hundreds of years undergoing annual freezing and thawing in soils along with the bones, frozen oils and (possibly) soft tissues of several species of marine mammal.

Fig. 4. (A): a representative gravel depression at *Pingiqqalik*; (B): a gravel depression with stones near the *Iglulik* Pt. site (NiNe-2), July 2011 and (C): modern full (left) and emptied (right) *igunaq* caches, Hall Beach, NU, July 2009.

Table 2
Radiocarbon ages (AMS) and calibrated calendar dates (2 sigma) from *Pingiqqalik*. Samples were processed at the W. M. Keck Carbon Cycle Accelerator Mass Spectrometry (KCCAMS) Laboratory at the University of California, Irvine. Dates were calibrated with OxCal 4.3 (Bronk Ramsey, 2009) using the IntCal 13 calibration curve (Reimer et al., 2013).

UCIAMS No.	Context (site area)	Material	d^{13}C (‰)	±	Fraction Modern	±	D^{14}C (‰)	±	^{14}C age (BP)	±	Cal. date (AD)	±
129057	D1TUA, L.2, 10cmbs	Caribou bone	−18.5	0.1	0.8896	0.0015	−110.4	1.5	940	15	1093	62
129051	T2TUH, L3, 28cmbs	Caribou bone	−18.8	0.1	0.8905	0.0015	−109.5	1.5	930	15	1097	58
129046	T3TUA/X, L.1	Antler debitage	−19.7	0.1	0.9197	0.0016	−80.3	1.6	670	15	1333	53
129045	T3TUA/X, L.2	Caribou bone	−18.4	0.1	0.9208	0.0013	−79.2	1.3	665	15	1334	53
129047	T3TUC, L.3	Caribou bone	−18.6	0.1	0.9254	0.0022	−74.6	2.2	625	20	1344	52
129052	T2TUI, L3, 56.5cmbs	Caribou bone	−19.0	0.1	0.9271	0.0015	−72.9	1.5	610	15	1349	51
129048	T2TUB, L.4, 42cmbs	Caribou bone	−18.3	0.1	0.9320	0.0015	−68.0	1.5	565	15	1367	49
129055	T1F20 (House), H22, L3B, 53cmbs	Caribou bone	−18.4	0.1	0.9331	0.0015	−66.9	1.5	555	15	1371	50
129049	T2TUC, L.1/2, 28cmbs	Caribou bone	−18.1	0.1	0.9336	0.0015	−66.4	1.5	550	15	1374	50
129050	T2TUF, L2	Caribou bone	−18.7	0.1	0.9517	0.0017	−48.3	1.7	400	15	1527	84
129056	T1TU4, L.2, 36cmbs	Caribou bone	−19.0	0.1	0.9520	0.0016	−48.0	1.6	395	15	1530	85
129054	T1TU5, L.3, 95.5cmbs	Caribou bone	−18.5	0.1	0.9532	0.0016	−46.8	1.6	385	15	1532	84
129053	T1TU11, L.3B	Caribou bone	−19.1	0.1	0.9589	0.0017	−41.1	1.7	335	15	1561	75

In an effort to ascertain if contamination by sea-mammal lipids had impacted the *Pingiqqalik* samples, J. Southon, Researcher and Co-Founder of the KCCAMS Laboratory at the University of California, Irvine, processed four subsamples of the 13 samples shown in Table 2 with only the standard ultrafiltration and decalcification pre-treatments. In addition to this treatment, the full sample of 13 bones received a sonication pretreatment in a chloroform-and-methanol, pure methanol and Milli-Q water solution. A comparison of (1) the four original samples receiving additional treatment, and (2) the four subsamples receiving only the standard pre-treatment is presented in Table 3. Both sets provide largely similar radiocarbon ages; this indicates strongly sea-mammal lipid contamination did not affect the dated samples at *Pingiqqalik*.

2.2.2. Climate and subsistence over time at Pingiqqalik

Fig. 5 shows calibrated radiocarbon dates from *Pingiqqalik* plotted against reconstructed surface temperature data from the Greenland Ice Sheet Project (GISP2) ice core dataset (see Kobashi et al., 2010). Though reconstructions of past environments via local sources (e.g., through fossil chironomids, diatoms and pollen) are always preferable (see D'Andrea et al., 2011), the GISP2 sample provides a good longitudinal baseline for examining broad temperature trends in the North Atlantic over the past several thousand years.

Temperatures during the occupation of site area T3 were slightly warmer than subsequent occupations. Additionally, faunal exploitation at T3 during this time shows a relatively low reliance on walruses, with a more diversified focus on large and small seals, as well as foxes. As the LIA intensified during the mid-14th century, the T2 occupation—located approximately 500 m south of T3—began relying increasingly upon walruses as a focal resource. However, the most compelling evidence for a causal relationship between temperature and intensification can be found at site area T1, where both house and midden samples show an overwhelming

Table 3
Radiocarbon ages (AMS) and calibrated calendar dates (2 sigma) of select samples from *Pingiqqalik*. Top set of four: samples receiving additional pretreatments; bottom set of four: samples from the same contexts not receiving the additional treatments. Dates were calibrated with OxCal 4.3 (Bronk Ramsey, 2009) using the IntCal 13 calibration curve (Reimer et al., 2013).

UCIAMS No.	Context (site area)	Material	d^{13}C (‰)	±	Fraction Modern	±	D^{14}C (‰)	±	^{14}C age (BP)	±	Cal. date (AD)	±
129057	D1TUA, L.2, 10cmbs	Caribou bone	−18.5	0.1	0.8896	0.0015	−110.4	1.5	940	15	1093	62
129045	T3TUA/X, L.2	Caribou bone	−18.4	0.1	0.9208	0.0013	−79.2	1.3	665	15	1334	53
129049	T2TUC, L.1/2, 28cmbs	Caribou bone	−18.1	0.1	0.9336	0.0015	−66.4	1.5	550	15	1374	50
129053	T1TU11, L.3B	Caribou bone	−19.1	0.1	0.9589	0.0017	−41.1	1.7	335	15	1561	75
129064	D1TUA, L.2, 10cmbs	Caribou bone	−18.5	0.1	0.8923	0.0019	−107.7	1.9	915	20	1101	65
129061	T3TUA/X, L.2	Caribou bone	−18.6	0.1	0.9246	0.0016	−75.4	1.6	630	15	1343	50
129062	T2TUC, L.1/2, 28cmbs	Caribou bone	−18.1	0.1	0.9362	0.0015	−63.8	1.5	530	15	1416	18
129063	T1TU11, L.3B	Caribou bone	−19.0	0.1	0.9587	0.0017	−41.3	1.7	340	15	1556	79

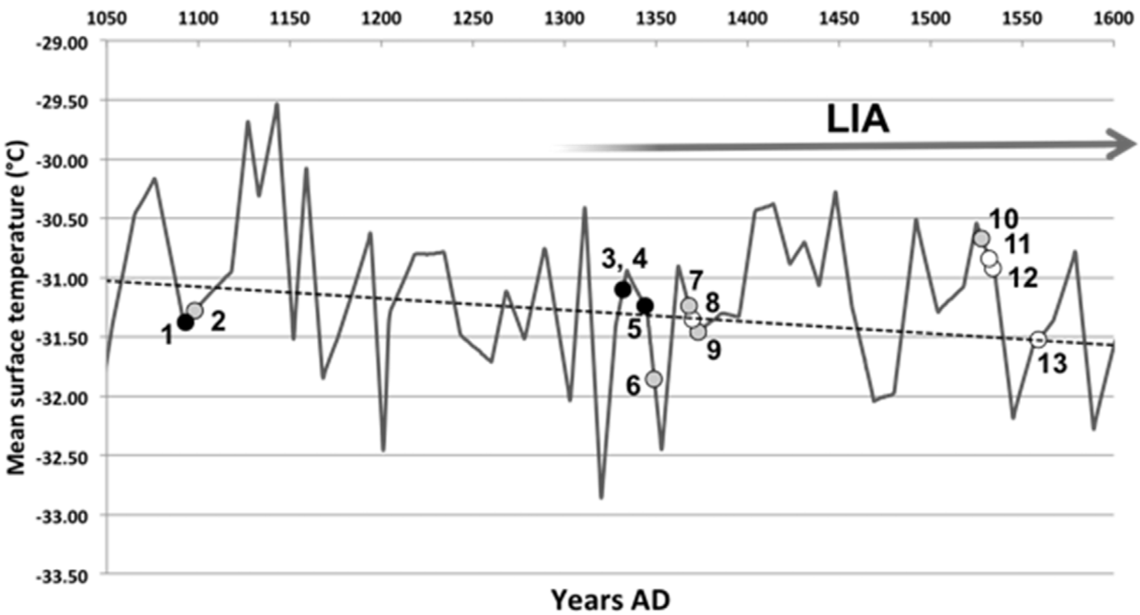

Fig. 5. Dated archaeological contexts at *Pingiqqalik* plotted against a climatic reconstruction of surface temperatures in central Greenland derived from the GISP2 ice core dataset (Kobashi et al., 2010). Black circles represent contexts from site areas D1 and T3; gray circles, T2; and white circles, T1. Data points: (1) D1TUA (Paleo-Inuit), (2) T2TUH (likely Paleo-Inuit), (3 and (4) T3TUA/X, (5) T3TUC, (6) T2TUI, (7) T2TUB, (8) T1F20 (house), (9) T2TUC, (10) T2TUF, (11) T1TU4, (12) T1TU5 and (13) T1TU11. Occupation ranges for each Neo-Inuit site area are as follows: T1, AD 1371–1561; T2, AD 1349–1527 (excluding the date from T2TUH) and T3: AD 1371–1561.

focus on walruses, as temperatures begin to trend notably lower (Fig. 5, Points 11, 12 and 13).

3. *Pingiqqalik* archaeofauna

3.1. Taxonomic frequencies

Across the *Pingiqqalik* peninsula, great amounts of animal bone—particularly those of walruses—are visible on the surface (Fig. 6). Thus, prior to excavation it was surmised walruses would prove to have been an important resource to site residents. Most Neo-Inuit test units yielded large amounts of exceptionally well-preserved animal bone, in addition to ivory debitage and baleen. The taxonomic breakdown (by NISP and %NISP) of the complete sample is provided in Table 4. As all excavated material was associated with cold-weather features, the faunal data presented here is likely reflective of autumn and winter hunting on the moving ice (see Section 4.2 for a discussion of resource scheduling at the site).

Fig. 6. Inundated area at the west end of T1, with a robust Neo-Inuit sod house feature (T1F9) in the distance. Facing northeast. (Note the abundance of submerged faunal remains in the foreground.)

Marine mammals dominate the aggregate sample at *Pingiqqalik*. Of particular interest is the high proportion of walrus remains in the middens of site areas T1 (37.5% of mammal NISP) and T2 (30.1% of mammal NISP). Only at T3—the earliest Neo-Inuit site area—do walruses (at 12% of mammal NISP versus 28.9% for small seals and 22.9% for bearded seals) fail to outrank every other species. (The size of the faunal sample from Dorset Paleo-Inuit contexts sampled at *Pingiqqalik* was very small (n = 142), and is unlikely to be broadly reflective of subsistence during the occupation.)

Interestingly, there are no significant differences between house and midden samples at site area T1 in terms of taxonomic distribution by NISP. In examining household and midden contexts of Thule Inuit from the Mackenzie Delta region of the Northwest Territories, Friesen and Betts (2006) found greater frequencies of mammal remains in the middens, and higher numbers of non-mammal fauna within house units, in addition to a significant amount of taxonomic variability within house features, as well as between houses and middens. Considering the likely differences in the activities resulting in the deposition of the two samples, the causes of the similarity between house and midden samples at *Pingiqqalik* are unclear.

3.1.1. Comparison with Neo-Inuit faunal assemblages elsewhere in the N. American Arctic

Taxonomic data from archaeofaunal analyses of 36 Neo-Inuit sites or closely situated groups of sites—from the early Classic Thule to historic Inuit periods—are presented in Table 5. While prima facie useful, any such inter-assemblage comparison is necessarily laden with caveats. Though all sites presented here are of the same broad cultural tradition (Neo-Inuit), and most represent cold-weather occupations, the data were collected and analyzed my multiple different researchers utilizing varied methods and techniques. Importantly, the fauna derive from a mix of household and midden contexts.

Both the *Pingiqqalik* assemblage and that of nearby Neo-Inuit site *Sanirajak* (NeHd-1) (the only two Foxe Basin Neo-Inuit sites for which faunal material has been analyzed in detail) reveal a

Table 4
Taxonomic frequencies (by NISP and %NISP) of the complete faunal sample (Paleo- and Neo-Inuit contexts) collected from *Pingiqqalik* (NgHd-1). Note that the category "small seal" could include either ringed or harp (*Pagophilus groenlandicus*) seals—both of which are ice-adapted species.

Taxon	D1 Middens (Paleo-Inuit)		T1F20(House)		TI Middens		T2 Middens		T3 Middens		Aggregate (Neo-Inuit contexts)	
	NISP	%NISP	NISP	%NISP	NISP	%NISP	NISP	%NISP	NISP	%NISP	NISP	%NISP
Polar bear			23	0.5	17	0.4	15	0.8			55	0.5
Small seal	2	9.10	676	16	875	20.1	531	27.7	72	28.9	2154	20
Bearded seal	8	36.4	473	11.2	573	13.1	233	12.1	57	22.9	1336	12.4
Walrus	10	45.5	1573	37.2	1633	37.5	577	30.1	30	12	3813	35.5
Large pinniped			169	4	296	6.8	25	1.3	9	3.6	499	4.6
Bowhead whale			54	1.3	31	0.7	23	1.2	1	0.4	109	1
Beluga whale			4	0.09							4	0.04
Whale - indet.			263	6.2	194	4.5	48	2.5	7	2.8	512	4.8
Caribou			181	4.3	251	5.8	174	9.1	3	1.2	609	5.7
Dog/wolf			97	2.3	140	3.2	110	5.7	13	5.2	360	3.3
Arctic fox	2	9.1	699	16.5	343	7.9	180	9.4	57	22.9	1279	11.9
Ground squirrel					1	0.02					1	0.009
Lemming			15	0.4	5	0.1	2	0.1			22	0.2
Mammal NISP	22	100	4227	100	4359	100	1918	100	249	100	10753	100
Mammal - unident.	20		6716		8584		2179		240		17719	
Total mammal	42		10943		12943		4097		489		28472	
Arctic char			1	7.1	4	16.7	2	22.2	1	50	8	16.3
Salvelinus sp.			13	92.9	20	83.3	7	77.8	1	50	41	83.7
Fish NISP			14	100	24	100	9	100	2	100	49	100
Fish - unident.			8		24		3		1		36	
Total fish			22		48		12		3		85	
Eider	14	93.3	73	67	37	67.3	80	67.2	15	35.7	205	63.1
Goose			21	19.3	8	14.5	33	27.7	26	61.9	88	27.1
Gull	1	6.7	8	7.3	7	12.7	3	2.5			18	5.5
Ptarmigan							1	0.8			1	0.3
Arctic tern			6	5.5	3	5.5	2	1.7	1	2.4	12	3.7
Snow bunting			1	0.9							1	0.3
Bird NISP	15	100	109	100	55	100	119	100	42	100	325	100
Bird - unident.	21		118		102		169		37		426	
Total bird	36		227		157		288		79		751	
Blunt gaper					16	94.1	1	33.3			17	77.3
Greenland cockle			2	100	1	5.9					3	13.6
Blue mussel							2	66.7			2	9.1
Bivalve NISP			2	100	17	100	3	100			22	100
Bivalve - unident.			2		16						18	
Total bivalve			4		33		3				40	
Unident. fragments	64		8388		12155		5098		552		26193	

walrus-focused subsistence pattern largely distinct from that elsewhere in the North American Arctic. At the vast majority of Neo-Inuit sites from Alaska to northeastern Greenland, small seals were the most frequently acquired prey species. Indeed, at those sites where small seals outrank all other species, they tend to do so by a wide margin, even in markedly dissimilar environments. For example, small seals comprise 75.2% of NISP at the Nachvak Fiord group in relatively temperate Labrador, and 65.6% at the 'marginal' high-Arctic Bache Peninsula sites. This reliance on small seals is broadly consistent with winter landfast (breathing hole) or floe-edge hunting strategies. The focus on seals is not seen everywhere, however; in the western Canadian Arctic, caribou and fish predominate at sites near productive river systems (e.g., Bell and Pembroke) and channel caribou crossings (e.g., Lady Franklin Pt.).

The Foxe Basin subsistence focus is mirrored to a degree at Walrus Island, where Grønnow et al. (2011) have demonstrated that walruses were exploited and cached in high numbers during the LIA, and where increased sea-ice cover was likely mitigated by the presence of a large polynya nearby. The parallels to *Pingiqqalik* are compelling; however, there are significant differences between the two sites. First, all habitation features at Walrus Island (stone shelters and tent rings) are indicative of warm-season occupations, though cold-season occupations were located elsewhere, such as the nearby Clavering Island group of sites (see Gotfredsen, 2010). Second, the subsistence pattern at Walrus Island did not survive into recent times; in the 19th century, temperatures in north-eastern Greenland fell to levels that forced Neo-Inuit populations to abandon the region altogether (Grønnow et al., 2011), while Amitturmiut populations utilized *Pingiqqalik* to stage walrus hunts and cache meat well into the 20th century.

Despite their abundance of walrus remains, the *Pingiqqalik* and *Sanirajak* samples are more even taxonomically—and less dominated by a single species—than any other analyzed Neo-Inuit samples. This breadth of diet would seem to be reflective of the use of generalized hunting technology and possibly, a resource-poor environment in which intensification of a single species is impractical or impossible. Given what is known of (1) the diverse and highly specialized Neo- Inuit toolkit, and (2) the longevity and

Table 5

Frequencies (by NISP) and diversity index values of select taxa recovered from 36 Neo-Inuit contexts across the North American Arctic. The value and %NISP of the highest-ranking taxon in each assemblage is highlighted. Unless otherwise noted, only bird and fish specimens identified to taxonomic order or below were included in the table. Remains of bowhead whales were not included in these tallies. Sites marked **(W)** were occupied primarily during warm-weather periods; all other sites are characterized primarily by the presence of cold-season dwellings. Sites, faunal sources and references include **Walakpa**, house and midden fauna (Stanford, 1976); **Cache Pt.** (NhTs-2), house (Betts and Friesen, 2004; Friesen and Betts, 2006; Friesen, 2009); **Pond** (NiTs-2), house (Betts and Friesen, 2004); ***Kuupak/Gupuk*** (NiTs-1), house and midden (Balkwill and Rick, 1994; Friesen and Arnold, 1995; Betts and Friesen, 2004); **Washout** (NjVi-2), house (Friesen and Huntston, 1994); ***Gutchiak*** (NhTn-1), fishing/faunal processing area (Morrison, 2000); ***Kugaluk*** (NgTi-1), house, cache and midden (Morrison, 1988); **OkRn-1**, house (Arnold, 2010 in Kotar, 2016; Kotar, 2016); ***Tiktalik*** (NkRi-3), house (Moody and Hodgetts, 2013); **Clachan** (NaPi-2), house and midden fauna (Morrison, 1983); **Beaulah** (NcPf-12), house; ***Nuvuk*** (NcPf-1), house (Morrison, 1983); **Lady Franklin Pt.** (NdPd-2), house (Taylor, 1972); **Bell** (NiNg-2), house and midden (Norman and Friesen, 2010; Howse and Friesen, 2016); **Pembroke** (NgNc-2), house and midden fauna (Norman and Friesen, 2010; Friesen and Norman, 2016); **Hazard Inlet** group, house and tent ring (Whitridge, 1992); **Cape Garry** (PcJq-5), house (Rick, 1980); **Learmonth** (PeJr-1), house and midden fauna (Taylor and McGhee, 1979; Rick, 1980); **Porden Pt.** group, house and stone features (Park, 1989); **Bache Peninsula** group, house (McCullough, 1989); **Cape Grinnell**, house (House 20 only) (Darwent and Foin, 2010); **Walrus I.**, tent ring, stone shelter and cache (Gotfredsen, 2010; Grønnow et al., 2011); **Clavering I.** group, house and midden (Gotfredsen, 2010); ***Sermermiut***, house and midden (Møberg, 1983); ***Nugarsuk***, house and midden (Møhl, 1979); **Outer Frobisher Bay** group, house (Henshaw, 1995); **Cumberland Sound, B-1** (LlDj-1) house and midden (Schledermann, 1975); **Peale Pt.** (KkDo-1), house and midden (Stenton, 1987); ***Talaguak*** (KeDq-2), House (Sabo, 1981); **Natchvak Fiord** group, house and midden (Swinarton, 2008); **JfEl-10**, house (Lofthouse, 2003); ***Qijurittuq*** (IbGk-3), house and midden (Desrosiers et al., 2010); **Sadlermiut/Native Pt.** (KkHh-1), house (Collins, 1956, 1981); ***Silumiut*** (KkJg-1), house and midden (Staab, 1979); **Naujan** (MdHs-1), house and midden (Mathiassen, 1927); **Pond Inlet** group, house and midden (Mathiassen, 1927); ***Sanirajak*** (NeHd-1), midden fauna (Desjardins, 2013); and ***Pingiqqalik*** (NgHd-1), house and midden fauna.

Figure 1 ref. no.	Site or site group	Bear sp. (polar/grizzly/black)	Beluga/narwhal	Small seal (ringed/harp/harbor) (%)	Bearded seal	Walrus (%)	Musk-ox	Caribou (%)	Moose	Dall sheep	Wolverine	Lynx	Beaver	Muskrat	Mink/Marten	Canis sp. (dog/wolf)	Fox sp. (Arctic/red)	Hare sp. (Arctic/snowshoe)	Bird spp.(multiple)	Fish spp. (multiple) (%)	**NISP**	Heterogeneity (Shannon)	Evenness (Shannon)	Dominance (Simpson reciprocal)	Taxonomic richness
1	Walakpa	34		9477 (57.3)	201	99	3	6076								296	172		660		**17018**	1.03	0.31	0.56	9
2	Cache Pt. (NhTs-2)		2332	182	1			41	4	26	13		4	3	49	95	87	25	211	3464 (53)	**6537**	1.17	0.22	0.59	15
3	Pond (NiTs-2)		3213	606	1			100	26		2		7	106	26	32	69	193	480	5648 (53.7)	**10509**	1.25	0.25	0.61	14
4	*Kuukpak/Gupuk* (NiTs-1)	13	11670	873	9			1137	251		32		97	5159	146	150	312	497	2330	22367 (49.7)	**45043**	1.44	0.28	0.67	15
5	Washout (NjVi-2)	13		617 (68.4)	14			6		2	1					17	76		16	140	**902**	1.08	0.3	0.5	10
6	*Gutchiak* (NhTn-1) (**W**)	2	195	13				4104			25		4	382	20	609	728		7189	17855 (57.4)	**31126**	1.19	0.27	0.6	12
7	*Kugaluk* (NgTi-1)	1	52					24065 (75.8)	23		41	4	2	53	12	9	31		791	6667	**31751**	0.68	0.15	0.38	13
8	OkRn-1	30		3870 (53.6)	8		1	688								23	2005	190	277	127	**7219**	1.26	0.35	0.62	10
9	*Tiktalik* (NkRi-3)	28		5621 (95)	9		1	31			1					25	75		125	2	**5918**	0.28	0.13	0.1	10
10	Clachan (NaPi-2)	5		37141 (89.8)	3			1027	2		5					251	2136		250[§]	521[§]	**41341**	0.46	0.16	0.19	10
11	Beaulah (NcPf-12)			3822 (87.3)	15			335								20	70	3	28[§]	87[§]	**4380**	0.54	0.21	0.23	8
11	*Nuvuk* (NcPf-1)			1978 (83.4)				153								15	158		41[§]	26[§]	**2371**	0.66	0.32	0.3	6
12	Lady Franklin Pt. (NdPd-2)	4		1020	6	2		4822 (81.8)								13	21[†]		7[§]	1[§]	**5896**	0.53	0.19	0.3	9
13	Bell (NiNg-2)			45	6		25	3644								25	209	12	348	4209 (49.4)	**8523**	1.01	0.3	0.57	9
14	Pembroke (NgNc-2)			57				1187								5	63[†]		135	2008 (58.1)	**3455**	0.96	0.44	0.54	6
15	Hazard Inlet group[1]	24	6	8793 (82.7)	59	1	2	98								129	1091	32	372	21	**10628**	0.68	0.17	0.3	12
16	Cape Garry (PcJq-5)	21		~2100 (76.4)	19	1	9	42								55	~410	1	90	1	**2749**	0.84	0.21	0.39	11
17	Learmonth (PeJr-1)	146	13	~3239 (63.3)	225	127	28	332								174	~563	45	222[§]		**5114**	1.38	0.36	0.58	11
18	Porden Pt. group[2]	132		8654 (80.4)	64	45	10	119								195	1250	13	255	27	**10764**	0.77	0.2	0.34	11
19	Bache Pen. group[3]	357		10197 (65.6)	379	1097	148	7								1015	2073	86	190		**15549**	1.22	0.34	0.54	10
20	Cape Grinnell			1184 (87)	23	40	2	19								3	34	6	50		**1361**	0.61	0.21	0.24	9
21	Walrus I. (**W**)	16	25	371	49	541 (52.1)	3	6								2	1		25		**1039**	1.16	0.32	0.6	10
22	Clavering I. group[4]	184	445*	5152 (70.6)	295	158	52	752								70	26	102	63	1	**7300**	1.16	0.27	0.48	12
23	*Sermermiut*		8	6629 (92.7)				16								115			367	14	**7149**	0.32	0.23	0.14	6
24	*Nugarsuk*	5		25631 (95.9)	261	24		318								155			341		**26735**	0.23	0.18	0.08	7
25	Outer Frobisher Bay sites[5]	17		4844 (76.4)	149	194		505								420	47	81	85		**6342**	0.95	0.29	0.4	9
26	Cumberland Sound, B-1 (LlDj-1)	3	55	18566 (98.9)	310	7		289								298	5	3	37[§]		**19573**	0.28	0.13	0.1	10
27	Peale Pt. (KkDo-1)	19	79	14243 (79.9)	251	104		2350								665	104	4			**17819**	1.04	0.23	0.34	9
28	*Talaguak* (KeDq-2)	13	4	2752 (51.3)	215[‡]			2236								85	60	3			**5368**	0.98	0.33	0.56	8
29	Nachvak Fiord group[6]	17	28	4103 (75.2)	231	11		550								318	39	13	51	92	**5453**	0.96	0.24	0.42	11
30	JfEl-10	31	16	638 (59.1)	49	76		264								5			1		**1080**	1.18	0.41	0.58	8
31	*Qijurittuq* (IbGk-3)	2		556 (46.4)	116	55		447								19	3				**1198**	1.18	0.47	0.63	7
32	Sadlermiut/Native Pt. (KkHh-1)	38		1840 (65.3)	204	149		332								180	75				**2818**	1.21	0.48	0.55	7
33	*Silumiut* (KkJg-1)			11208 (60.9)	1204	706	114	4480								204	243	5	134	108	**18406**	1.16	0.32	0.56	10
34	Naujan (MdHs-1)	1	7	335 (37.6)	8	47	2	320			1					37	123	1	6[§]	4	**892**	1.47	0.33	0.71	13
35	Pond Inlet group[7]		12	166 (63.1)	1	2		48								14	6		14[§]		**263**	1.2	0.41	0.56	8
Inset	*Sanirajak* (NeHd-1)	2		141	199	540 (48.1)		99								51	55		36		**1123**	1.54	0.58	0.71	8
Inset	*Pingiqqalik* (NgHd-1)	55		2154	1336	3813 (38.2)		609								360	1279		325	49	**9980**	1.69	0.6	0.77	9

[1] The Hazard Inlet group includes Ditchburn Pt. N, S. (PaJs-3), PaJs-4 and PaJs-13.
[2] The Porden Pt. group includes the Porden Pt. Brook Village site (RbJr-1), the Porden Pt. Pond Village site (RbJr-4) and RbJr-5.
[3] The Bache Peninsula group includes sites Skraeling I. (SfFk-4), Sverdrup (SfFk-5) and Eskimobyen (SgFm-4).
[4] The Clavering I. group includes 15 sites in close proximity to one another (see Gotfredsen 2010: 182).
[5] The Outer Frobisher Bay group includes sites *Kamaijuk* (KfDe-5), *Kuyait* (KfDf-2) and *Kussejeerarkjuan* (KeDe-7).
[6] The *Nachvak* Fiord group includes sites *Nachvak* Village (IgCx-3) and *Kongu* (IgCv-7).
[7] The Pond Inlet group includes sites *Mittimatalik* (PeFr-1) and Qilalukan (PeFs-1).
[†] Arctic foxes and hares were not differentiated within these assemblages.
[‡] Large seals and walruses were not differentiated within this assemblage.
* Narwhal tusk fragments (n=1020) were excluded from the species tally for the Clavering I. group (see Gotfredsen 2010: 182).
[§] Specimens are included with a taxonomic rank higher than family.

large size of the *Pingiqqalik* occupation itself, it is likely the greater taxonomic evenness in northern Foxe Basin is reflective of *greater* ecological stability and abundance, whereby a wide range of animal resources are available to area residents in high numbers (sensu Maxwell, 1985: 81).

3.2. Element frequencies

As walruses were the most exploited animals during most of the recorded occupation at *Pingiqqalik*, element frequencies the species were calculated to shed light on transport strategies of site residents (Table 6 and Fig. 7). There is a significant degree of consistency across the site in terms of which walrus elements were being returned to *Pingiqqalik*. Cranial elements predominate, which is unsurprising considering the value of ivory as a raw material for artifact manufacture. Intriguing is the abundance of dense limb elements—particularly front limb bones. The relative dearth of vertebrae in the aggregate sample indicates these elements were discarded during field butchery, as is done among Amitturmiut hunters today.

4. Discussion

4.1. Recent-historic and contemporary Amitturmiut walrus hunting and caching

Important information on contact-period Amitturmiut hunting practices and food security can be gleaned from the firsthand accounts of British Royal Navy-Captains Parry and Lyon (both 1824), each of whom took pains to emphasize his wonder at the abundance of walrus meat available to Foxe Basin residents. While visiting the summer encampment at *Iglulik* Pt., Parry was in awe of the "great lumps of raw [walrus] flesh and blubber, which at this season [residents] enjoyed in most disgusting abundance" (1824: 272). He documents similar abundances during the winter (Parry, 1824: 413).

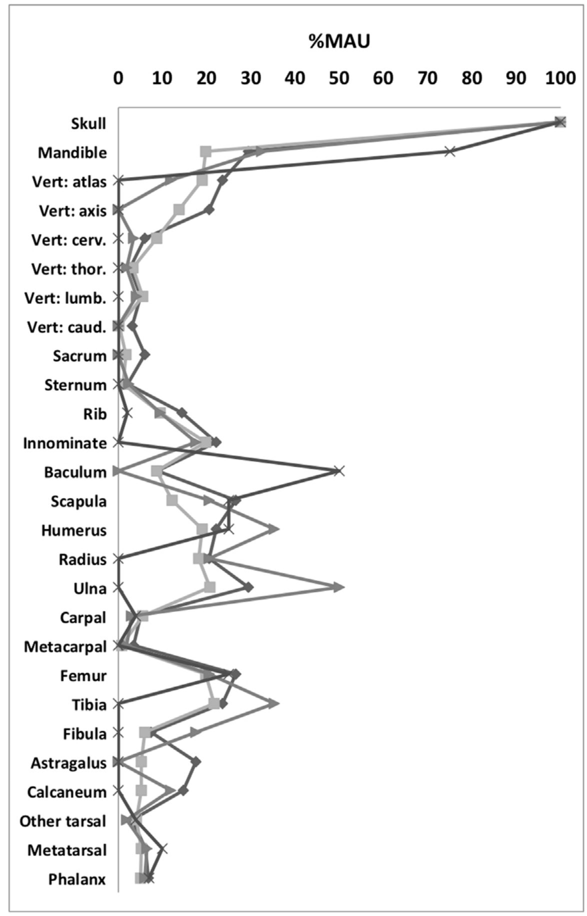

Fig. 7. A graph of these data, for which (◆) signifies walrus elements from T1F20 (house); (■), T1 middens; (▲), T2 middens and (✕) T3 middens.

Table 6
Element frequency values for walruses across the Neo-Inuit site areas at *Pingiqqalik*.

Skeletal Part	T1F20 (House)			T1 Middens			T2 Middens			T3 Middens		
	MNE	MAU	%MAU	MNE	MAU	%MAU	MNE	MAU	%MAU	MNE	MAU	%MAU
Skull	34	34	100	58	58	100	17	17	100	2	2	100
Mandible	20	10	29.4	23	11.5	19.8	11	5.5	32.4	3	1.5	75
Vert: atlas	8	8	23.5	11	11	19	2	2	11.8			
Vert: axis	7	7	20.6	8	8	13.8						
Vert: cerv.	10	2	5.9	25	5	8.6	3	0.6	3.5			
Vert: thor.	12	0.9	2.6	26	1.9	3.3	4	0.3	1.8			
Vert: lumb.	10	1.7	5	19	3.2	5.5	4	0.7	4.1			
Vert: caud.	9	1.1	3.2	1	0.1	0.2						
Sacrum	2	2	5.9	1	1	1.7						
Sternum	6	0.7	2.1	5	0.6	1	4	0.4	2.4			
Rib	137	4.9	14.4	154	5.5	9.5	45	1.6	9.4	1	0.04	2
Innominate	15	7.5	22.1	23	11.5	19.8	6	3	17.6			
Baculum	3	3	8.8	5	5	8.6				1	1	50
Scapula	18	9	26.5	14	7	12.1	7	3.5	20.6	1	0.5	25
Humerus	15	7.5	22.1	22	11	19	12	6	35.3	1	0.5	25
Radius	14	7	20.6	21	10.5	18.1	7	3.5	20.6			
Ulna	20	10	29.4	24	12	20.7	17	8.5	50			
Carpal	20	1.7	5	38	3.2	5.5	6	0.5	2.9	1	0.08	4
Metacarpal	12	1.2	3.5	4	0.4	0.7	3	0.3	1.8			
Femur	18	9	26.5	23	11.5	19.8	7	3.5	20.6	1	0.5	25
Tibia	16	8	23.5	25	12.5	21.6	12	6	35.3			
Fibula	5	2.5	7.4	7	3.5	6	6	3	17.6			
Astragalus	12	6	17.6	6	3	5.2						
Calcaneum	10	5	14.7	6	3	5.2	4	2	11.8			
Other tarsal	13	1.1	3.2	29	2.4	4.1	3	0.3	1.8	1	0.08	4
Metatarsal	21	2.1	6.2	30	3	5.2	11	1.1	6.5	2	0.2	10
Phalanx	65	2.3	6.8	82	2.9	5	28	1	5.9	4	0.14	7

The majority of the walruses acquired by contemporary Amitturmiut are hunted during the summer to produce *igunaq*—walrus meat and select organs cached for several months on select gravel beaches across the region. These open-water hunts can involve between two and ten able-bodied hunters. Walruses hauled out on the moving ice are shot with rifles and harpooned to prevent their being lost. Butchery, which occurs on the ice at or near the kill locale, can last several hours, and follows a carefully prescribed series of steps designed to produce *ungirlaat* (s., *ungirlaaq*): bundles of meat and organs woven tightly within wide strips of walrus skin (Fig. 8). Importantly, few bones aside from flipper elements are bound within them. A single bull walrus can produce up to six sizeable *ungirlaat*.

Immediately upon returning to shore, *ungirlaat* are buried at permafrost depth in beach-gravel caches, known as *qingniit* (s., *qingniq*). Only sand-free, medium-sized gravel can produce proper *igunaq* (Kappianaq, 1997; Qamaniq, 1999, 2000). Completed caches—roughly conical or mound-shaped, and measuring between 1.5 and 2 m in diameter—are often marked with a wooden stake (a kind of *inuksuk*), rendering them easier to locate on the snow-covered beaches during the darkest days of winter. The fairly strict provisions for butchery and caching were likely formulated over time to ensure the *ungirlaat* remained free of harmful contaminants; imprecisely cached sea-mammal resources can result in a number of foodborne illnesses, including botulism and trichinellosis (see Jung and Skinner, 2017 for a review of the recent literature on foodborne illness among Canada's Indigenous peoples).

Notably, traditional rules stipulated that gravel previously used to cache walrus meat never be reused for fear of contaminating new batches with rancid fat and oil (Qamaniq, 1999, 2000). If this practice extended into prehistory, each of the possible gravel depressions, or caches, described in Section 2.2 may represent discrete archaeological events.

Though an acquired taste savored as a seasonal delicacy by Inuit today, it is possible *igunaq* was once a vital sustaining resource for precontact Neo-Inuit during harsh winter months. *Igunaq* production and marine mammal caching at 19th-century Inuit camps in Foxe Basin are well documented (e.g., by C. F. Hall in Nourse, 1879: 307, who describes relying during a time of privation upon “logs of old walrus” cached at *Pingiqqalik*). According to local knowledge, such caches were scattered across the southern beach ridges of the *Pingiqqalik* Peninsula—on average, less than 500 m from the major site areas described in this paper. Igloolik elder G. Kappianaq (1992) remarks that gravel caches “covered a large area along the raised beaches, indeed, the whole camp site was covered at Pingirqalik (sic). […] There were a lot of cache (sic) indeed.” Most recently, in February 1936, a Royal Canadian Mounted Police (RCMP) patrol visiting *Pingiqqalik* via dog team documented “fourteen families of natives, all well supplied with meat,” and further noted that the residents “had made large kills of caribou, walrus and seal during the previous Fall and Winter, and after making caches of the meat for their future use, they had been able to spare some for their less fortunate brethren at Igloolik [presumably, *Iglulik* Pt.]” (RCMP, 1937: 84).

4.2. Seasonality and resource scheduling at Pingiqqalik

The butchery and transport strategies resulting from cold-season walrus hunts at *Pingiqqalik* represented in Table 6 and Fig. 7 were clearly distinct from those employed during warm-season hunts. With the former, a variety of walrus elements were

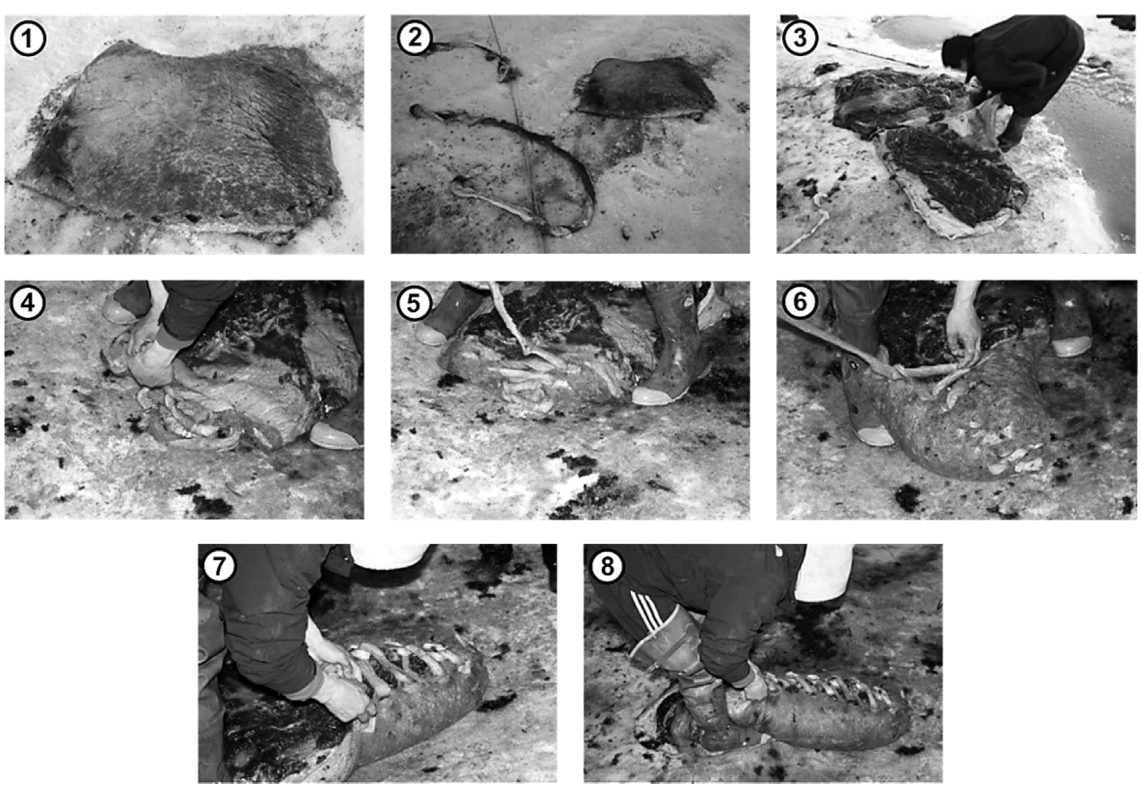

Fig. 8. Typical manufacture of an *ungirlaaq* at the site of butchery, west-central Foxe Basin, NU, July 2012: 1) a series of small incisions are made along the opposite long ends of a rectangular portion of skin; 2) a long skin strip, or thong, is cut to serve as a binding lace; 3) large amounts of meat and select organs are placed atop the skin slab; 4) the skin thong is cross-woven through the incisions on either side of the slab; 5–8) the lacing continues to the last set of incisions is reached, the thong is tied off and the *unirlaaq* is sealed (Desjardins, 2016).

returned to the village site for eventual deposition in sod house front middens. Because caching walrus meat does not typically result in bones (besides flipper elements) being returned to village or cache sites, a lingering problem is determining the degree to which such a caching regime contributed to precontact Neo-Inuit diets. A similar issue exists in determining the contribution of bowhead whales to precontact diets, though a recent investigation into aDNA sequencing of materials from multi-component middens (from ca. 2000 BC) in western and northeastern Greenland by Seersholm et al. (2016) may serve as a model for future investigations into more complete dietary reconstructions in the Arctic.

Regardless of the difficulties in reconciling distinct datasets, it is likely walrus hunting was occurring year-round at *Pingiqqalik*, and conclusions can be drawn about the varied means of acquiring and processing walruses from one season to the next. I suggest warm-season hunting unfolded largely as it does today, with Neo-Inuit hunters travelling east from the mainland by boat to meet the moving ice, where walruses were hauled out. The animals were likely butchered on the moving ice, and the boneless *ungirlaat* were returned to beaches with suitable caching gravel, such as around *Pingiqqalik* or *Iglulik* Pt. (precisely linking occupations to specific caches or even closely clustered groups of caches does not appear possible at this time). These stores of *igunaq*, which would have supplemented cold-season diets, significantly reduced anxiety over winter food security. Amitturmiut elder G. Kappianaq (1997) notes that hunters unsuccessful in “securing a walrus during [winter] would not get too anxious as [summer *igunaq*] cache[s] would be available as fall back during the dark season.”

Cold-season hunting at and around *Pingiqqalik* likely involved waiting for southerly winds to move loose, walrus-laden pack ice across the polynya system to the floe edge; hunters would travel traverse the ice either on foot by dog team to acquire walruses as quickly as possible, so not to be stranded if and when currents shifted to move the ice back out to sea (Piugaattuk, n.d.; Kappianaq, 1989, 1992; Ivalu, 1996). These hunts would have involved less extensive field butchery than did summer hunts, as participants would have been eager to return with their catch to the safety of the landfast ice (Kappianaq, 1997), and it is likely the bones resulting from these winter hunts that were recovered from the three site areas at *Pingiqqalik*.

5. Conclusions

This paper aimed to reconstruct strategies developed by Neo-Inuit of northern Foxe Basin, Nunavut, to cope with possible impacts on the local animal-resource base of the Little Ice Age climate change episode. The data collected during survey and excavations at *Pingiqqalik* show a roughly 600-year history of Neo-Inuit occupation, as well as an unusually large number of Neo-Inuit sod house features (n = 119). With temperatures falling during the LIA, a reasonable assumption would be that increases sea ice would limit both bowhead whale and walrus habitat, forcing Neo-Inuit to shift their subsistence focus to small seals, which favor relatively heavy ice. However, the *Pingiqqalik* archaeofaunal data show the opposite pattern, with small seal exploitation decreasing from early Thule Inuit (site area T3) to Classic and Postclassic Thule Inuit times (T2 and T1), during which high-utility walruses—thriving due to the presence of local polynyas) become the top-ranked prey species—though not overwhelmingly so. The most parsimonious explanation for this trend is both ecological and cultural: the development of an adept adaptation (the multiseasonal hunting and caching regime) to a singular local phenomenon (the recurring polynya system).

It is possible that the gradual increase in walrus exploitation over time at *Pingiqqalik* is reflective of a decline in bowhead whale hunting—the dietary contribution of which would not be reflected in the sample—at the close of the site's earliest Thule Inuit occupation (T3). The hunting and butchering of both bowheads and walruses are complex, time-consuming group activities. It is possible walruses were eschewed in the early days of *Pingiqqalik* in favor of large whales, which offered a greater return on invested time and energy. As the LIA intensified, bowhead whale migration routes in and out of northern Foxe Basin may have been restricted, while the polynyas offered the limited open water allowing walruses—a decent, if less substantial proxy to bowheads—to flourish under the new cooler environmental conditions.

It appears that the pattern of faunal exploitation shown in northern Foxe Basin is at least partly related to the distinctive local environment, and it is likely that other Neo-Inuit sites in the region will have similar archaeo-faunal profiles. In addition to its faunal assemblage, *Pingiqqalik* is also notable for the length of its occupation, as well as its large number and great diversity of archaeological features. Skillful adaptations to favorable environmental conditions may have allowed Foxe Basin residents a greater degree of long-term food security than was had by the vast majority of groups elsewhere in the Eastern Arctic. This, in turn, would have allowed groups the freedom to build larger, longer-lasting residential sites.

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