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PIONEERING THULE INUIT SUBSISTENCE: A FAUNAL ANALYSIS OF TIKTALIK (NkRi-3)

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PIONEERING THULE INUIT SUBSISTENCE: A FAUNAL ANALYSIS OF TIKTALIK (NkRi-3)

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Abstract

The Thule Inuit, ancestors of modern Inuit, were hunter-gatherers who colonized much of Arctic North America in the 13th century AD, but their migration remains poorly understood. Hunter-gatherer subsistence practices reflect their knowledge of local landscapes, knowledge colonizers would lack. This thesis attempts to assess the impact colonization had on Thule Inuit subsistence practices by examining the faunal assemblage from House 5 at Tiktalik (NkRi-3), a pioneering Thule Inuit site on Amundsen Gulf, NWT. Ringed seals dominate the faunal assemblage, suggesting that the site's occupants were subsisting almost entirely on this species. Detailed analyses of the Ringed seal bones showed that breathing-hole sealing might have been the main hunting activity conducted at the site, and that seals were brought back as entire carcasses. Comparisons between Tiktalik and nearby sites suggested that Thule colonizers practiced diverse subsistence strategies, and that shifts in subsistence in later periods might reflect increased landscape knowledge.

Keywords: Arctic, colonization, landscape learning, Ringed seal, Thule Inuit, zooarchaeology

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1. Introduction

To better understand the process of Thule Inuit migration this thesis documents the subsistence practices of a group of Thule Inuit pioneers in the Western Canadian Arctic. Thule culture arose in northwestern Alaska, where newly devised technologies, such as seal-skin floats and ocean-going canoes, enabled the Thule Inuit to be successful marine mammal hunters in a wide range of arctic environments. The earliest archaeological evidence left behind by the Thule Inuit from the Yukon to Greenland dates consistently to the 13th century AD. However, no explanation for the near simultaneous appearance of Thule culture over such a vast area is widely accepted by the research community. Amundsen Gulf, an extension of the Beaufort Sea in the Western Canadian Arctic, was one of the first regions occupied by expanding Thule Inuit populations as they moved eastwards from Alaska and will therefore be central to understanding the Thule Inuit migration, yet its archaeological record remains understudied (Morrison 1999, 2000). Tiktalik (Figure 1), an early Thule Inuit site on the coast of Amundsen Gulf, offers an excellent opportunity to examine the subsistence behaviours of one group of colonizing Thule Inuit.

This project will consider colonization as a process rather than an event (Anthony 1990), a perspective that sees the archaeological record as created by individual agents with differing and imperfect knowledge of their environment. Pioneering groups were likely unable to immediately replicate their previous life in new areas. Instead, colonization was accompanied by a phase of landscape learning. Researchers have suggested that subsistence practices might be one of the most sensitive indicators of this pioneering phase (e.g. Meltzer 2004, 2002; Beaton 1991; Kelly and Todd 1988; Webb

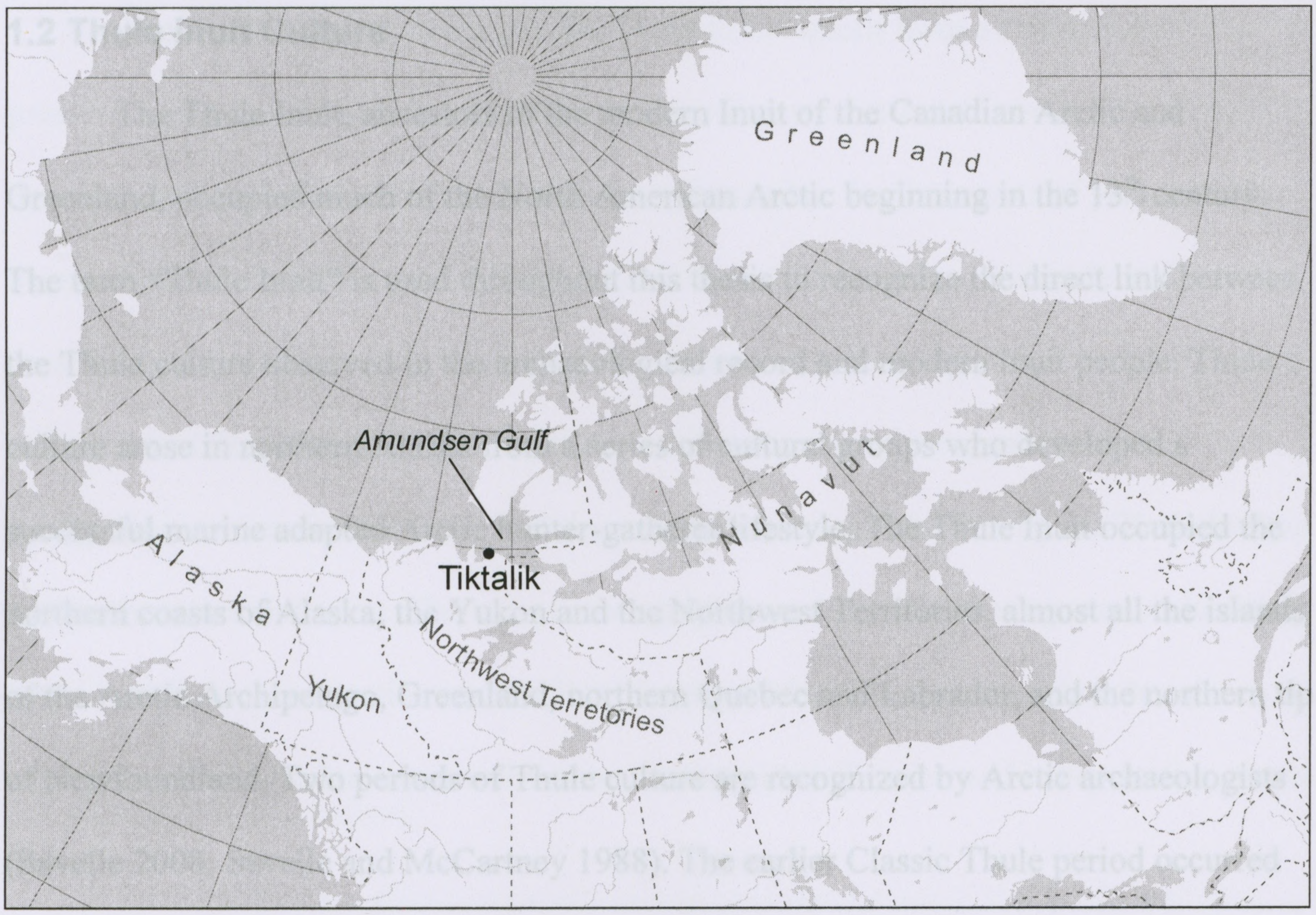

Figure 1: The location of Tiktalik in the North American Arctic

and Rindos 1997). As a colonizing population settles into a landscape their subsistence behaviours change as their knowledge of the environment increases. For hunter-gatherers like the Thule Inuit, landscape knowledge allows them to take advantage of unique and seasonal resources. Food remains found in archaeological sites provide the most direct means to determine subsistence behaviours in past groups. The Thule Inuit relied almost exclusively on foods derived from animals, and the preservation of faunal material is generally excellent on their archaeological sites. Therefore, the faunal remains from Thule Inuit sites present an excellent opportunity for examining the process of colonization.

1.2 Thule Inuit Culture

The Thule Inuit, ancestors of the modern Inuit of the Canadian Arctic and Greenland, occupied much of the North American Arctic beginning in the 13th century. The term "Thule Inuit" is used throughout this thesis to recognize the direct link between the Thule culture observed in the archaeological record and modern Inuit people. Thule culture arose in northern Alaska from a series of cultural groups who developed a successful marine adapted Arctic hunter-gatherer lifestyle. The Thule Inuit occupied the northern coasts of Alaska, the Yukon and the Northwest Territories, almost all the islands of the Arctic Archipelago, Greenland, northern Quebec and Labrador, and the northern tip of Newfoundland. Two periods of Thule culture are recognized by Arctic archaeologists (Savelle 2008; Savelle and McCartney 1988). The earlier Classic Thule period occurred roughly between 1200 and 1400 AD. Classic Thule groups had diverse subsistence strategies, but are best known for their large winter villages in the Central Arctic. These villages were supplied by the huge surpluses in food and materials obtained from hunting Bowhead whales. Around 1400 AD a shift in Thule culture is recognized, which marks the transition to the Modified Thule Period. This shift is linked to a cooling climate and led to the abandonment of the rich whaling areas of the Eastern Arctic (Savelle 2008; Whitridge 1999). In other regions the Modified Thule Inuit lived in smaller groups with more nomadic lifestyles, and hunting Ringed seals on the sea ice became the primary winter subsistence activity. Around 1850 AD the first Europeans arrived in the Arctic since the Norse abandoned their Greenlandic colony in the mid 14th century. These enterprising whalers and explorers had enormous impacts on the Inuit way of life.

The archaeologists who study the Thule Inuit benefit from a rich and well preserved material cultural record. Slow soil development in Arctic environments means that archaeological features remain visible on the surface for thousands of years, making them easy to find and study. Artifacts that end up buried are often extremely well preserved as they are quickly incorporated into the permafrost, and those made of organic material are often in equally good condition as those made of inorganic material. Archaeologists are also fortunate that the material culture left behind by the Thule Inuit is relatively easy to interpret. The use of ethnographic analogy with Inuit groups is justified by their historical connection and similar lifestyles. Most Thule culture tools have analogues in historic Inuit material culture, making identification and interpretation much easier.

The Thule Inuit possessed a complex and highly specialized technological tradition, with a separate tool for almost every task. Many of these tools, including seal-skin harpoon floats, large skin boats called umiaks, and dog sleds, had recently been developed by the ancestors of the Thule Inuit, and allowed them to be successful marine mammal hunters in a wide variety of habitats. Umiaks and dog sleds, along with kayaks, made it possible for the Thule Inuit to cover large distances quickly if they desired. The harpoon was the key hunting implement of the Thule Inuit because marine mammals made up the bulk of their diet.

During the cold season many Thule Inuit lived in semi-subterranean houses designed to be extremely efficient thermal insulators. The house foundations were excavated into permafrost, sometimes over one meter below ground surface. Floors were paved with flat stones or adzed logs, and walls were made from logs, stones and whale bone, depending on the local availability of resources. Skins, sods and snow were used to insulate the roof and walls. Each house was generally comprised of between one and three main living rooms, each occupied by a separate family (Dawson 2001). People entered the house through a long, sunken entrance tunnel. This entrance was dug lower than the main room and effectively trapped most of the cold air that entered the house. This feature, coupled with thick insulation and seal-oil burning lamps, made Thule semi-subterranean houses a comfortable place to spend the winter months. Later Thule Inuit groups built large villages of igloos, specialized snow houses, on the sea ice from which they hunted Ringed seals at their breathing holes throughout the winter (Dawson 2002).

1.3 Research Questions

Despite almost a century of study, the original migration of the Thule Inuit into the Canadian Arctic is not well understood. Most studies have focused on the causative forces for the migration. This study, on the other hand, attempts to examine how the process of colonizing new landscapes affected the Thule Inuit on the scale of individuals and family groups. It seeks to answer two linked questions: 1) What were the subsistence practices of an early colonizing group of Thule Inuit? and 2) How did subsistence practices change as the Thule Inuit settled in to their new landscape? To answer these questions, the faunal assemblage from a pioneering Thule Inuit site called Tiktalik will be analysed in detail. It will then be compared to other sites within the region in order to document how subsistence might have changed during the colonization process.

This thesis uses zooarchaeology, the study of animal remains from archaeological contexts, to examine the subsistence practices of pioneering Thule Inuit at Tiktalik. Chapter 2 provides background information on past zooarchaeological studies of the

Thule Inuit, the history of research on Thule colonization, and discusses how zooarchaeology can contribute to our understanding of the Thule migration. A description of Tiktalik is provided in Chapter 3. Chapter 4 describes the methodology used for quantifying the Tiktalik faunal assemblage, and describes it. Chapter 5 discuss specific aspects of the Ringed seal assemblage, in particular the age structure of the procured seals and the representation of skeletal parts, and what these tell us about the hunting behaviours of the site's occupants. In order to examine how colonization proceeded as a process, Chapter 6 compares the faunal remains from Tiktalik to those from other sites within Amundsen Gulf. Chapter 7 summarizes the results of this study and discusses them in the context of colonization.

2. Thule Zooarchaeology and the Thule Inuit Migration

Thule zooarchaeology is a relatively new field. During much of the history of Arctic archaeology, faunal material was often discarded in the field due to the high cost of transporting the often abundant material south for more detailed studies. Over the last thirty years, Thule zooarchaeology has progressed from simple analyses of subsistence (e.g. Staab 1979; Rick 1980) to complex studies of social dynamics (e.g. Whitridge 2002; Patton and Savelle 2006; Betts 2008). Our understanding of the colonization of the Eastern Arctic by Thule Inuit has also changed over the years, and is one avenue of research that will benefit from zooarchaeological studies. This chapter examines the development of Thule zooarchaeology, discusses our understanding of the Thule migration, and highlights the potential contribution of zooarchaeology to our re-interpretation of the migration.

2.1 Reconstructing Thule Inuit Subsistence

The Thule Inuit practiced a subsistence pattern focused on the procurement of marine mammals, and it is perhaps a testament to the flexibility of this strategy that the Thule Inuit were successful in the harsh environments across Arctic North America. The faunal assemblages preserved in Thule culture archaeological sites demonstrate the diversity and adaptability of their subsistence strategies and are an important resource for understanding their way of life. Archaeologists studying these remains have benefited from generally excellent organic preservation and a rich body of comparative data from historic and modern ethnographic studies of the Inuit. The general Thule Inuit subsistence strategy, as reconstructed from the archaeological record and ethnographic analogy to their Inuit ancestors, revolved around seasonal exploitation of terrestrial and marine resources (Betts and Friesen 2004; Savelle and McCartney 1988, 1999; Whitridge 2001, 2002). Mobility and settlement patterns were flexible and fluctuated with the availability of key resources. At some points, Thule Inuit groups were highly focused on seasonally available resources that provided huge surpluses and allowed them to remain in the same area throughout much of the year, such as during the peak whaling period in the Central Canadian Arctic (Savelle and McCartney 1988). At other points, Thule Inuit groups focused on a broader range of species and were more mobile, such as times of high caribou abundance on Baffin Island (Stenton 1991).

A wide variety of marine and terrestrial species were hunted by the Thule Inuit, both for food and as a source of raw material. It is easiest to see the Thule Inuit dependence on marine resources through Ringed seal remains, which often dominate winter residence faunal assemblages (Morrison 1983). The importance of Ringed seals is likely due to their ubiquity in most Arctic marine environments and their availability throughout the year. The Thule Inuit also hunted other seal species and walrus where available. Harvesting beluga and Bowhead whales provided huge surpluses of food resources for some Thule Inuit groups (Betts and Friesen 2004; Savelle and McCartney 1988), but these species have restricted ranges and require specialized technology and hunting strategies. Terrestrial mammals also played an important role in Thule Inuit diet. Caribou was the chief contributor to diet among land animals, although fox, muskox and smaller mammals were also hunted, depending on season and availability. Bird and fish remains are common in Thule Inuit middens and houses along with the specialized tools used to hunt them.

Animals were also specifically procured for the raw materials they provided. Caribou and fox remains are often present in high frequencies in Thule faunal assemblages, but often in inverse proportions (Savelle and McCartney 1988; Morrison 1983). These two species are important sources of the hides used to manufacture winter clothing. Savelle and McCartney (1988) have suggested that caribou are an important source of both food and hides while fox are typically hunted solely for their hides. This explains the inverse relationship between these two species since the Thule Inuit likely shifted to foxes as a source of furs in areas where caribou were rare or absent. The use of Bowhead whale bones as a source of raw material for tools and architectural elements is also notable (Savelle 1997). The conspicuous presence of whale bones on the landscape is one of the most obvious signs of Thule winter houses.

2.2 History of Zooarchaeological Studies of Thule Inuit

Although the Thule culture was first identified by Mathiassen (1927) over ninety years ago, Thule zooarchaeology has developed slowly. Initially, Arctic archaeology focused on culture history, but significant changes occurred starting in the 1970s as more sites were excavated, new researchers entered the field, and theories and methodologies from processual archaeology were adopted (Hood 1998). More recently, post-processual researchers have sought answers to new questions about social processes in the Thule zooarchaeological record.

Americans and Danes working within the cultural-historical paradigm conducted the first archaeology in Arctic North America (Hood 1998). The research questions of early Arctic archaeologists focused on the historical development of modern Inuit groups and their relationships with other Arctic and Sub-Arctic people (e.g. Mathiassen 1927;

Birket-Smith 1929; Collins 1951; McGhee 1972; Taylor 1963). These questions required the construction of normative archaeological cultures, largely based on stylistic differences in artifacts and houses. Often these researchers viewed Thule Inuit as practitioners of a "generalized" subsistence pattern focused on marine mammals, and most faunal studies were site-specific descriptive summaries of assemblages with little analysis (e.g. Collins 1950). Faunal data were considered secondary in answering questions of culture-history. It was also common for these researchers to assume that the environment had a dominant role in shaping the culture of Arctic adapted people (e.g. McGhee 1969).

By the 1960s, Arctic archaeologists were beginning to focus explicitly on Thule culture faunal assemblages, with publications beginning to appear in the 1970s (e.g. Staab 1979; Schledermann 1975; Stanford 1976; Taylor and McGhee 1979). Work by Staab (1979) demonstrates that the questions asked of the Arctic archaeological record were shifting. The typological description of artifacts was no longer an adequate level of analysis, and inferences were being made about more detailed aspects of the lives of Thule Inuit. Staab provides seasonality, age-at-death estimates, an analysis of butchering habits, as well as estimates of total meat and meat-days represented by the assemblage. Published studies of Thule zooarchaeological assemblages such as this were an important first step, and served as the basis for the later large-scale analyses of subsistence patterns. These studies also show the beginning of the influence of processualism, a theoretical paradigm that attempted to bring scientific rigor to archaeology.

During the 1970s and 1980s, Arctic archaeologists grappled with the role of whaling in Thule Inuit subsistence. Mathiassen (1927) was the first to recognize the dominant role of Bowhead whaling in Thule Inuit subsistence strategies, a characteristic that he used to define their culture. This generalization was questioned as processual archaeologists focused on faunal assemblages and recognized the diversity of Thule Inuit subsistence strategies. Subsistence is important in processual approaches because it is seen as having a central role in structuring culture. In a critique of whaling, Freeman (1979) argued that archaeologists had not demonstrated that the Thule Inuit were active whalers, as they could have salvaged skeletal elements from beached carcases for house construction and tool manufacture. A single adult Bowhead could provide up to 50,000kg of usable meat and blubber, and even yearlings weigh 5,000 to 12,000kg (Savelle and McCartney 1999). The difference one of these animals could make to the diet of a Thule Inuit group is significant. Therefore, archaeologists, particularly Savelle and McCartney (Savelle and McCartney 1988, 1999, 1991, 1994; McCartney and Savelle 1993, 1985; Savelle 2002a, b, 2000; Savelle, Dyke, and McCartney 2000; McCartney 1980), focused on developing methods for examining the role of Bowhead whale in Thule Inuit subsistence. Part of this research involved measuring a large sample of whale bones from archaeological contexts to determine the age of Bowheads present at different sites. They found that the vast majority of whale bones were from yearlings and two- and three-year-old subadults, demonstrating that Thule Inuit whalers were actively selecting these whales as this pattern would not be expected from scavenging beached whale carcasses (McCartney and Savelle 1993).

Another aspect of the processual emphasis in zooarchaeology was the development of predictive models. Following the publication of Binford's (1978) pioneering analysis of Nunamiut hunting strategies, the derivation and use of utility indices became common throughout zooarchaeology. The role of utility indices is to provide baseline data on the relative usefulness of skeletal elements. The frequencies of skeletal elements in archaeological samples can be compared to utility indices in order to examine economic and social processes. Meat Utility Indices (MUIs) are the most common form of utility index, and they rank skeletal elements based on the amount of meat, fat and grease they are associated with. Utility indices, like other techniques developed within the processual paradigm, were slow to be adopted by Arctic archaeologists, with the first studies published in the 1990s. MUIs applicable to Arctic faunal assemblages have been derived for caribou (Binford 1978), phocid seals (Lyman, Savelle, and Whitridge 1992), otarrid seals (Savelle, Friesen, and Lyman 1996), small cetaceans (Savelle and Friesen 1996), and Ringed seal (Diab 1998). An Architectural Utility Index was also developed for Bowhead whale skeletal elements (Savelle 1997).

All the previously cited works that developed utility indices and later publications that use them emphasize the need to look beyond just economic factors in interpreting the representation of skeletal parts. These studies show few significant correlations between MUI and the frequencies of skeletal elements, highlighting the many complex factors that create the archaeological record. Some part of human choice is based on economic factors, such as transportation cost and nutritional value, but choice is also affected by social and personal factors, like taste preference or status (Diab 1998). Non-human taphonomy caused by animals and natural destructive processes can also impact faunal material, preferentially removing less dense bones from an assemblage (Diab 1998).

Recent developments in understanding Arctic taphonomy and formation processes are helping Arctic archaeologists interpret skeletal element frequencies. The need to understand formation processes in Arctic contexts was first identified by McCartney (1979) following the influential early work of Schiffer (1972). The recognition and study of these processes is another influence of processual archaeology that was also slow to take hold in Arctic research. The study of these processes has mostly occurred within the last fifteen years (e.g. Park 1997; Habu and Savelle 1994; Stenton and Park 1994; Friesen and Betts 2006). Arctic archaeologists often note the excellent preservation of Thule culture faunal material. According to Stenton and Park, "as a result of low temperatures and reduced precipitation, skeletal remains and more perishable organic materials (e.g., skin, hair, baleen) are often found in exceptionally good condition. This perspective must be balanced, however, by the recognition of other factors that affect the interpretive potential of the assemblage regardless of their state of preservation" (1994: 410). Archaeologists have also recognized that the collapse of Thule Inuit semi-subterranean dwellings also helps insulate assemblages from weathering and decomposition by encasing them in permafrost (Whitridge 2001; Friesen and Betts 2006), but many post-depositional factors influence the formation of Arctic archaeofaunas (Habu and Savelle 1994; Stenton and Park 1994).

The impact of formation processes on site assemblages becomes clear during small scale analyses. Friesen and Betts (2006) analysed House 8 from the Cache Point site with the original intention of confirming the ethnographically observed functional spatial organization within Inuit semi-subterranean houses. However, they realized that post-depositional processes erased most of the spatial evidence of primary activities within the household, and had significant effects on the faunal assemblage outside the household. Additionally, they point out that no section of a house is representative of the house's faunal assemblage, and that in order to get a complete picture of a household's economy both household and midden faunal assemblages should be included in analyses, as they show complementary information.

As the theories, methods and questions of processualism were slowly adopted by Arctic archaeologists, another paradigm shift was occurring in mainstream archaeology. Post-processualism arose out of a rejection of, among other things, empiricism, normative constructs, and economic and environmental determinism, along with recognition of the importance of individual agents, social processes, and symbolism. Recent applications of post-processual theories to Thule Inuit archaeology have dealt with place-making (e.g. Patton and Savelle 2006) and social status (e.g. Whitridge 2002).

Whitridge has been instrumental in applying ideas of social process to Arctic zooarchaeology. His (2002) study of Qariaraqyuk is notable for using faunal data to examine not just subsistence, but possible social structures within a Thule Inuit settlement. Rather than simply comparing element frequencies and MUI values to determine the economic processes that constructed this site's faunal assemblage, he instead used whale bone frequencies to determine the social status of households. Using ethnographic analogy, he determined likely skeletal markers for high status butchering units of whales. He found that the distribution of whale bone elements among houses at Qariaraqyuk was not random or fully explained by economic utility. Instead, skeletal elements associated with higher status were located within only a few houses. He interpreted this as being a reflection of the differential access to high status whale parts because of social stratification within whaling crews. Whitridge (2001) also examined the distribution of fish remains and fish harvesting tools in sites across the arctic. He found that economic and taphonomic processes do not fully explain the abnormally large ratios of tools to faunal remains. He suggested that social processes are a possible explanation for this disparity, as fishing may have been a recreational activity or practiced to provide a food source valued for its taste.

The analytical techniques applied to Thule zooarchaeology for determining economic processes are now becoming useful as methods for determining social processes. Although originally devised to examine economic factors, utility indices provide a background against which archaeological variability can be examined. Patton and Savelle (2006) showed that the Architectural Utility Index strongly correlated to the frequencies of whale bone in Thule semi-subterranean houses on Somerset Island. Variability within entrance tunnels and main living spaces in these houses, however, was best explained by the symbolic nature of whale skeletal elements. Crania and maxillae were possibly selected for entrance tunnel construction to emphasize the symbolic link between entering a house and entering a whale. The distribution of these symbolically powerful elements was also used to infer the social status of households.

A great deal of information about the Thule Inuit has been uncovered over the last ninety years, however, many questions remain unanswered. Among these are the reasons for the original Thule Inuit migration into the Canadian Arctic. Zooarchaeology has a role to play in answering these questions by documenting subsistence patterns and practices across time and space, and determining the environmental, economic and social processes that structured these patterns.

2.3 History of Thule Inuit Colonization Studies

Today's Inuit are the descendants of the Thule Inuit recognized in the archaeological record. This link was made relatively early in the history of Arctic archaeology and has been consistently reaffirmed, but our understanding of the original Thule Inuit migration into the Eastern Arctic has undergone significant changes in recent decades. It is well established that Thule culture developed from a series of archaeological cultures on the northern shores of Alaska and Siberia, where the earliest Thule sites date to approximately 900 AD (Stanford 1976). Thule archaeological sites appear almost simultaneously throughout the rest of the Arctic, from the Mackenzie delta to the western shores of Greenland, suggesting a rapid migration. Until recently, the earliest Thule sites east of Alaska were dated to approximately 1000 AD, but reanalyses of the archaeological record have now established that the Thule migration occurred two hundred years later, in the 13th century (Friesen and Arnold 2008; McGhee 2000). An earlier cultural group, the Palaeoeskimo, resided in Arctic Canada and Greenland beginning around 2500 BC but these people largely disappear from the archaeological record just before the arrival of the Thule Inuit (Maxwell 1985).

The nature, timing and reason for the Thule Inuit migration into the Eastern Arctic were considered to be well understood throughout much of the history of Arctic archaeology. In part this is due to the high quality of the first Thule culture archaeological investigations conducted by Therkel Mathiassen in the 1920s (Mathiassen 1927, 1930). Mathiassen placed the Thule Inuit migration at around 1000 AD, based on comparisons with Scandinavian beach ridge chronologies and isostatic rebound rates. He identified Bowhead whaling as a defining characteristic of Thule culture, based on the abundance of whale bone in Thule culture sites as both an architectural element and a tool raw material, along with abundant evidence of marine mammal hunting. It is unsurprising that later researchers explored Bowhead whaling as a motivating factor in the Thule Inuit migration since this practice was regarded as central to Thule culture. The Thule Inuit migration was initially conceptualized, often implicitly, as a wave-of-advance, whereby groups gradually increased in size and passively expanded into adjacent unoccupied territory (McGhee 2000).

In the 1960s and 1970s, archaeologists took this idea one step further and elaborated on the link between environmental change and the Thule Inuit migration, bolstered by newly available palaeoclimatic data. This hypothesis fit with the dominant archaeological paradigm, Cultural Ecology, whose practitioners sought explanations for cultural change as adaptations to changing environments. Palaeoclimatic data showed that warmer temperatures prevailed in the Northern hemisphere during the Medieval Warm Period, beginning around 1000 AD. This coincided with the accepted timing of the Thule migration. It was thought that marine mammals, a staple in Thule Inuit diet, would be more widespread and numerous during warm climatic periods. Bowhead whales in particular were seen to be the most important species in this demographic expansion (McGhee 1969). Specifically, McGhee (1969) pointed out that a warmer climate would have freed the straits and sounds of the Central Arctic of much of the pack ice which currently cover them during the summer months. This would have allowed the Atlantic and Pacific Bowhead whale stocks to expand their ranges into the central Arctic, eventually uniting them. Thule Inuit whalers could then passively expand their range from Alaska through the Arctic Archipelago to Greenland.

Environmental change remained the dominant hypothesis to account for the Thule Inuit migration, but alternative explanations continued to be suggested. In addition to climatic warming and hunting opportunities at points further east, Taylor (1963) suggested that demographic pressure in their homeland and the possible advantages of newly developed dog sledding technology might have played a role in the Thule Inuit migration. Taylor also proposed the possibility of multiple Thule Inuit migrations to different regions in the Arctic for multiple reasons. He hypothesized that the earliest Thule Inuit migration was a demographic expansion into Amundsen Gulf and adjacent areas. Later migrations were eastward movements by groups who had been resident in the Western Arctic. The idea of an early expansion into the Western arctic followed by a large, fast eastern expansion is revisited in many later publications (e.g. McGhee 1984; Morrison 1999; Arnold and McCullough 1990). Evidence for this early migration eventually came in the form of the earliest Thule radiocarbon dates at sites in the Western Arctic (Yorga 1980; Arnold 1986)

McGhee (1984), who had initially proposed the idea, provided an early and especially strong critique of the Bowhead whaling hypothesis. His primary argument was that earlier researchers had oversimplified the palaeoclimactic data. He noted that climate change would not uniformly affect all areas in the Arctic, and that the Medieval Warm Period did not align precisely with the Thule Inuit migration. Furthermore, McGhee suggested that the Medieval Warm Period did not strongly alter pack ice conditions in the Central Arctic, which would have continued to be a barrier between the Atlantic and Pacific Bowhead populations. This was later confirmed by paleontological evidence that showed that these two populations did not have overlapping ranges in the Holocene

(Dyke, Hooper, and Savelle 1996). We can add to McGhee's critiques the fact that a warming climate, often referred to as "ameliorating," is not universally a good thing for marine mammals. Ringed seals, for example, depend upon thick sea ice to build their birthing lairs. A warming climate has been shown to have a negative effect on this species (Ferguson, Stirling, and McLoughlin 2005).

As an alternative to the whaling hypothesis, McGhee (1984) proposed that meteoric iron in the High Arctic might have been the prime force motivating the Thule Inuit migration. McGhee suggested that the pack ice buffer "must have been a formidable obstacle to population expansion caused by cultural or economic reasons" (1984: 4), and that the Thule Inuit must have crossed this expanse with a specific purpose in mind. McGhee speculated that the Thule Inuit would have gained knowledge of High Arctic iron sources from Palaeoeskimo Dorset populations. The only material the Dorset had easier access to than the Thule Inuit was iron, which came from a meteoric source in northern Greenland. The Thule Inuit were already familiar with the use of iron, as they had access to Asian sources in their Alaskan homeland. McGhee surmised that knowledge of these rich iron sources spurred entrepreneurial groups to obtain it and bring it home to trade. This would explain why the earliest recorded Thule culture sites in the Eastern Arctic were clustered on Ellesmere Island and in northern Greenland. The knowledge these first explorers shared about the rich environments of the Eastern Arctic encouraged others to venture into the area. However, as Morrison (1999: 140) pointed out, this hypothesis presupposes a degree of Dorset-Thule interaction which many researchers do not accept (c.f. Park 1993, 2000). McGhee has continued to argue that a desire for iron was the primary incentive for migrating Thule Inuit (Gulløv and McGhee

2006; McGhee 2009), but this notion has not garnered widespread support in the archaeological community.

More recently, Morrison (1999) revisited the Bowhead whaling hypothesis. He suggested that at least two Thule migration events occurred, which are reflected in the distribution of two early phases of Thule culture. The Natchuk phase is defined largely on the presence of stylistically early harpoon heads, specifically Natchuk and Sicco styles. Morrison noted that the distribution of these sites closely matches the location of summering Bowhead whales around Lancaster Sound, which may have been the resource sought by these colonizers. Ruin Island phase sites, on the other hand, are located in High Arctic Canada and Greenland. These sites have stylistically early artifact types and even some ceramic material of possible Alaskan origin (McCullough 1989: 188). Their distribution is close to two iron sources – meteoric iron of Cape York and trade iron from the Norse in western Greenland – suggesting that iron was the motivating factor in the settlement of this region. Morrison described a Thule Inuit migration that "was not a single, unified event, but a complex series of small-scale population movements" (1999: 151). He saw Bowhead whales as one of the motivating factors in the Thule Migration, but was quick to distance himself from any suggestion of environmental determinism, instead saying that the Thule migration might have been the result of individual actors who were seeking status by obtaining access to high status trade goods.

Much of the research outlined above was based on Mathiassen's original date for the Thule Inuit migration. Mathiassen had been sceptical of an 11th century Thule Inuit migration, but radiocarbon dates obtained from early Thule Inuit sites seemed to support his assertion. However, there are many problems associated with radiocarbon dating

Arctic archaeological sites (McGhee and Tuck 1976), and recent critical reanalyses have called the 11th century migration of the Thule Inuit into question (Friesen and Arnold 2008; McGhee 2000). The largest factor affecting Thule culture radiocarbon dates is the marine reservoir effect, which causes dates on marine material to appear older than terrestrial material of a similar age. Marine mammal bones, and terrestrial mammal bones from species whose diet includes marine species (e.g. polar bear and arctic fox), can give erroneously old radiocarbon dates. Marine mammal oil, which was extensively used by the Thule Inuit, can saturate other materials and cause them to appear older. Wood and wood charcoal can also provide erroneously old dates in Arctic contexts. No trees grow in the Arctic, and the only woody shrubs available might grow for centuries before being harvested. Similarly, driftwood can spend decades floating or washed up on beaches before being incorporated into archaeological assemblages. McGhee's (2000) study of the Thule radiocarbon data ignored all dates obtained from unsuitable material and discovered that there was little evidence for widespread Thule Inuit occupation of the Canadian Arctic prior to the 13th century AD. The only outliers were the Nelson River and Washout sites in the Western Arctic. Friesen and Arnold (2008) obtained new Accelerator Mass Spectrometry radiocarbon dates on terrestrial mammal bone from both of these sites, none of which predated the 13th century. There are currently no known Thule Inuit sites in the Canadian Arctic or Greenland that predate the 13th century (Friesen and Arnold 2008).

This new understanding of the timing of the Thule migration has significant implications for our understanding of its possible cause and nature. A 13th century migration does not correspond with the Medieval Warm Period, which further corroborates the idea that environmental change was not a prime motivating factor. However, it also decreases the likelihood that the Thule Inuit interacted with the Palaeoeskimo Dorset populations who had knowledge of High Arctic iron sources. Perhaps the most significant impact of the new migration date range concerns its speed and size. It becomes immediately obvious that the Thule migration was extremely rapid and the entire Eastern Arctic might have been colonized in as little as one or two generations (Friesen and Arnold 2008). Not only was it fast, but it also involved large-scale population movements, as almost every corner of the Arctic saw Thule occupation during the 13th through 15th centuries.

The migration of large groups, as in the Thule Inuit migration, is easy to conceptualize from a normative, cultural-historical perspective, which lends itself to explanations based on large-scale processes like climate change. But migrations of past human groups are as complicated as the migrations of modern populations, and are dependent on the motivations of individuals who are affected by forces pushing and pulling them to new areas (Anthony 1990). Therefore, although it might be easy to consider climate change as the reason for the Thule Inuit migration, this explanation neglects to clarify how the process worked at a human scale. Recently, Arctic archaeologists have distanced themselves from large-scale explanations for the Thule Inuit migration, and have stressed a combination of demographic, economic and social factors, all of which were acting on individuals (Friesen and Arnold 2008; Morrison 2009; Gulløv and McGhee 2006; McGhee 2009). However, as Meltzer (2004) has argued, the examination of migration is particularly difficult in archaeology where we are unable to bridge the material remains of individuals' choices with large-scale processes.

2.4 Landscape Learning and Thule Inuit Subsistence

This thesis conceptualizes the Thule Inuit colonization of Arctic Canada and Greenland as a process rather than an event. It deliberately ignores the reason for the migration, as the forces compelling migrating individuals were complicated and are difficult to examine through an imperfect archaeological record. Instead, it focuses on how moving into unfamiliar areas affected other aspects of Thule Inuit decision making. Archaeologists studying the colonization of other parts of the globe have suggested that subsistence behaviours may be one of the most sensitive aspects of the archaeological record left by pioneers (e.g. Meltzer 2004, 2002; Beaton 1991; Kelly and Todd 1988; Webb and Rindos 1997).

Hunter-gatherers must have intimate knowledge of landscapes in which they live in order to obtain the plant and animal food they need to survive. There are many ways of knowing and learning about a landscape (Meltzer 2003), but two that are significant for colonization are general and specific landscape knowledge. General landscape knowledge is not tied to specific places, but instead is knowledge about how things in a given landscape are generally expected to behave. General landscape knowledge can apply to both geographic features and the animals and plants that occupy them. For example, that rivers always eventually lead to the ocean, or that Ringed seals build breathing holes in sea-ice throughout the winter. Specific landscape knowledge, on the other hand, is knowledge tied to particular locales. For example, the point at which caribou always cross a river during their migration, or the place where your ancestors are buried. These areas are often named and become “places” (c.f. Ingold 1993) imbued with social meaning.

Both general and specific landscape knowledge is passed on from one generation to the next, building up a corpus of cultural knowledge.

Entering an unknown landscape is rife with risks, especially for hunter-gatherers like the Thule Inuit, because these groups lack specific geographic knowledge (Beaton 1991; Kelly and Todd 1988; Meltzer 2004). A lack of specific landscape knowledge puts colonizers at an increased risk of extinction if such knowledge is required in order to exploit the resources in the new area. This risk is further amplified by the very low population densities inherent in being the first group to occupy a new area. General landscape knowledge can be applied to new landscapes of similar geographies and environments, but this becomes more difficult the farther a colonizer is from their homeland. In order to lessen this risk it has been suggested that colonizers must focus on the most easily obtained and abundant food resources while they absorb knowledge about their new landscape (e.g. Meltzer 2004, 2002; Beaton 1991; Kelly and Todd 1988; Webb and Rindos 1997). Once this landscape knowledge is gained, colonizers can broaden and/or shift their procurement strategies to further reduce risk.

In the case of the Thule Inuit, some subsistence practices require knowledge of particular landscape features, including mass-killing caribou. Caribou form huge herds during their spring and fall migrations. These herds were an important source of food and skins for many Thule Inuit and Inuit groups, but the mass-kill hunting strategies necessary for obtaining a large number of animals using the least amount of effort require landscape knowledge. Some of this is general, for example knowing the behaviours of caribou, but much is specific, like knowing exactly where and when the caribou will migrate. Unlike the above example, Ringed seals require little specific landscape knowledge. Ringed seals are ubiquitous and common in most Arctic marine environments. They also do not migrate, and so provide a reliable source of food throughout the year. The only knowledge needed to hunt Ringed seals is about their behaviour, a form of general landscape knowledge that the Thule Inuit would have acquired long ago in their Alaska homeland. The expected faunal assemblage for the earliest Thule Inuit colonizers, therefore, is one focused primarily on Ringed seals. As knowledge of specific landscape features was gained, we would expect the Thule Inuit to broaden their subsistence to other species in order to reduce the risk of extinction.

This thesis investigates the subsistence practices at Tiktalik, an early Thule Inuit site in the Western Canadian Arctic, to see how the process of colonization affected these practices among Thule Inuit pioneers. Tiktalik is located on Amundsen Gulf, the gateway through which Thule Inuit pioneers entered the Eastern Arctic. This information is then compared to other published Thule Inuit faunal assemblages to examine the subsistence practices of both pioneering and settled groups of Thule Inuit.

3. The Tiktalik Site (NkRi-3)

Tiktalik (NkRi-3) is located on the southern coast of Amundsen Gulf in the Northwest Territories (Figure 2). Amundsen Gulf is the most easterly portion of the Bering Sea, and marks the western end of the Northwest Passage. Tiktalik is in the vicinity of Pearce Point, a rocky headland protruding into Amundsen Gulf north of the Melville Hills. At least 16 archaeological sites are located near Pearce Point, which offers access to numerous marine and terrestrial animal resources. Tiktalik is situated about two kilometres west of Pearce Point on a long, high, crescent-shaped beach. The site is

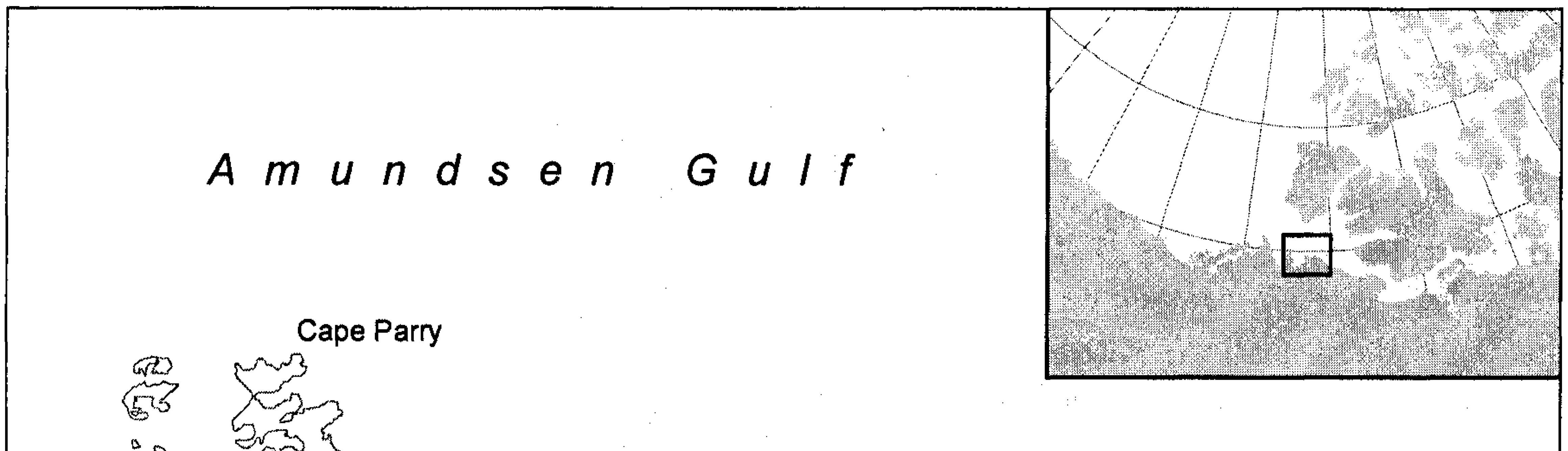

Figure 2: The location of Tiktalik on the southern coast of Amundsen Gulf

composed of the remains of at least five Thule semi-subterranean houses on a low mound a few metres from the shore. Eight shallow cache pits, which may or may not be associated with the house ruins, are located on the beach east of the houses, and a number of ill-defined tent rings are also nearby. The closest community is Paulatuk, approximately 72km to the southwest. Tiktalik was given its name in honour of Sachs Harbour elder Susie Tiktalik (Morrison 1998a).

The southern coast of Amundsen Gulf experiences long, cold winters, and short, cool summers. Two months of every winter are spent in total darkness while two months of every summer experience total daylight. The coastal landscape varies from level plain to rocky cliffs, but in the vicinity of Tiktalik it is composed mainly of rolling tundra. The area is over 100km north of the treeline and vegetation is made up of various arctic adapted wildflowers, grasses and shrubs. Terrestrial mammals in the area include caribou, muskox, polar and grizzly bears, wolverine, arctic fox and smaller fur bearers such as the Arctic ground squirrel. Offshore, Amundsen Gulf hosts year-round populations of Ringed and Bearded seals. During the short summer, the area is visited by many migratory bird species including gulls, swans, geese and sea ducks. Bowhead whales pass close to the coast during their fall migration and further offshore during the spring.

A field crew from the Canadian Museum of Civilization, led by Dr. David Morrison, excavated Tiktalik during the summer of 1998 (Morrison 1998a). While testing was conducted on both House 4 and House 5, excavation at Tiktalik focused on House 5, the largest of the five house ruins (Figure 3). Excavation was undertaken in 2m x 2m squares using 10cm arbitrary levels until sterile soil was reached, typically a depth of 75 - 85cm. Forty square metres of House 5 were excavated, 36 of which reached sterile soil.

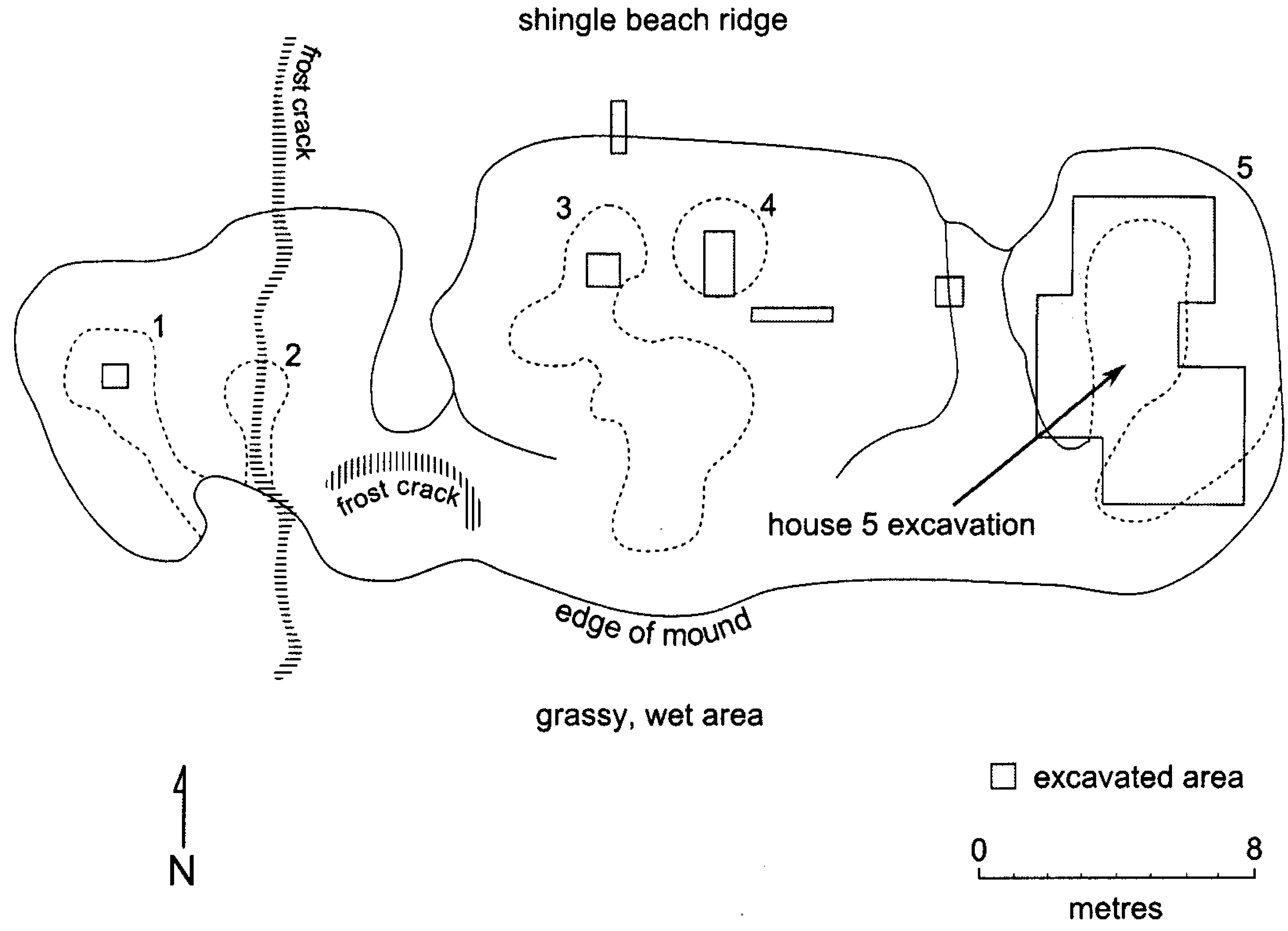

Figure 3: Tiktalik Site Map (Modified from Morrison 1998a)

Excavation of the four remaining squares was halted when excavators realized they were outside the house structure. The upper sod layer over the entire house was removed with shovels, while lower levels were dug with hand trowels. Not all soil was screened, as the gravelly soil did not fit through ¼" mesh, and some areas were heavily cemented by burnt sea mammal oil and had to be excavated using shovels.

The form of House 5 is typical of a Thule Inuit semi-subterranean house built in the Western Thule tradition (Figure 4). The main living space was a large rectangular room, approximately 3.2m by 3.2m. The walls of this room were made of a combination of log posts and adzed boards. During occupation, these walls would have been further insulated with layers of sod, hides and snow. The floor of the main living room, composed of adzed boards, rests about 70cm below the ground surface, and was placed

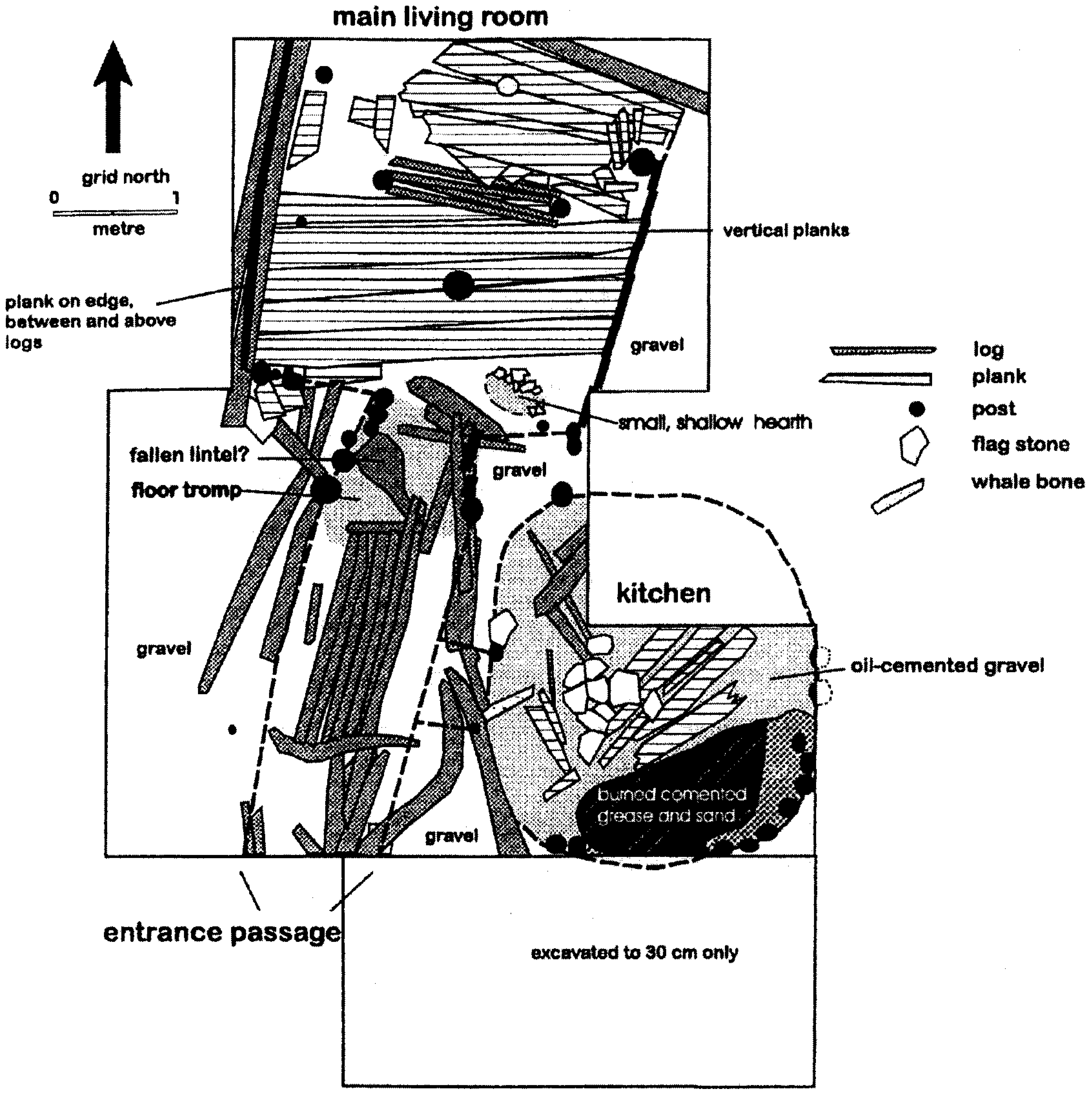

Figure 4: Plan map of Tiktalik House 5 (Modified from Morrison 1998a)

on top of layers of wood chips and gravel. The orientation of the floorboards changes at the rear of the room, which might indicate a sleeping platform, although it was not raised above the level of the floor as in other Thule Inuit houses. The main living room was entered through a sunken entrance passage, at least 4 metres long, that opened to the south. Again, the walls and ceiling of the entrance passage were built of logs and planks and likely further insulated with furs, sod and snow during use. A structure identified to the east of the entrance passage is likely the kitchen alcove typical of early Western Thule semi-subterranean houses. The kitchen alcove is demarcated by a circular mass of gravel that is burnt and impregnated with sea mammal oil. A series of posts around the edge of the kitchen suggest it was covered by a conical superstructure. The external kitchen alcove is an adaptation to allow wood burning fires, which would likely smoke-out the occupants of the house if it was located in the main living space.

Preservation within House 5 was generally excellent, and several hundred artifacts of both organic and inorganic material were recovered during excavation. Wood, bark, feathers, animal hair and hides were found intact within the house and some bones, especially those in the lower levels, retained fragments of soft tissue. Unfortunately, extensive Arctic Ground squirrel burrows had disturbed some of the house, especially in the northwestern corner.

The artifact assemblage reflects most of the suite of Thule Inuit tool types (Morrison 1998b). Several hundred artifacts were recovered, most of which were ground slate ulu fragments and ceramic shards. Some marine mammal hunting equipment was present, consisting of wound pins, endblades, a harpoon butt peg, a foreshaft, a socketpiece, and numerous harpoon heads. Artifacts associated with open water sealing, including seal skin float parts and throwing boards, are conspicuously absent. Other hunting items recovered, among them arrowheads, barbed prongs and leister prongs, indicate that terrestrial mammals, fish and birds were also hunted by Tiktalik's occupants. Tools typically associated with women's activities were also found, including ulus, awls, bodkins, a needle, a cutting board and a scapula scraper. Many decorative items were found including an ivory carving, pendants, a brow band and a shaman's necklace. The presence of a least one child among Tiktalik's occupants is suggested by a toy bow.

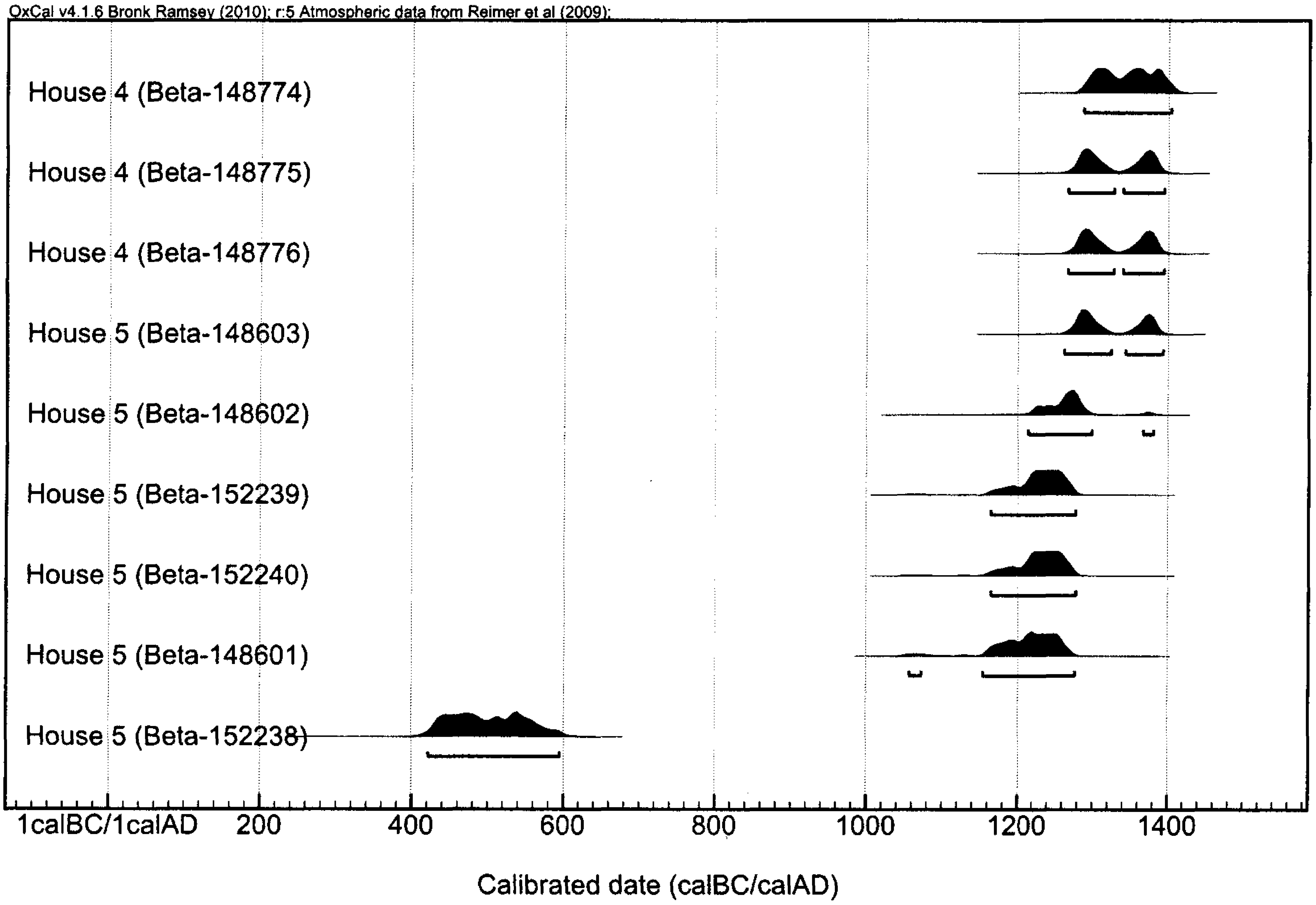

Figure 5: Calibrated radiocarbon dates from Tiktalik

Numerous pieces of bone, stone, baleen and whale bone debitage indicate that tool manufacture and maintenance were carried out at the site. Many copper items were found along with a possible sliver of iron. Notably absent are artifacts associated with dog sledding.

A number of lines of evidence demonstrate that Tiktalik was occupied early in the Thule Inuit colonization process. Some architectural features, including a single, rectangular living room and an external kitchen alcove, are typical of early Western Thule culture. Additionally, the harpoon head assemblage is dominated by Sicco style heads, considered to be one of the most chronologically sensitive early styles. Other harpoon head styles found include Thule type 2 and type 4. All lashing holes on these harpoon heads were gouged and not drilled, another characteristic of early Thule sites. In addition to the stylistically early artifact assemblage and architectural features, radiocarbon dates support Tiktalik's early occupation. Nine radiocarbon assays were run on material from the site, more than is typical for most Arctic archaeological contexts. These radiocarbon dates are presented in Figure 5. Three came from the test pit excavated into House 4 and are slightly later than House 5. This suggests that the houses may not have been occupied concurrently, but there is significant overlap between the dates. Five of the six assays run on material from House 5 are relatively consistent and point to an occupation in the 13th century. The one outlier is significantly older than the other five assays, and it was likely obtained from a misidentified sea mammal bone (Morlan 2010). These dates, combined with the stylistically early artifact types, confirm that House 5 at Tiktalik was occupied exceptionally early in the Thule Inuit period.

In addition to the recovered artifacts, House 5 also contained over 20,000 animal bones. These remains are representative of the animals hunted by Tiktalik's occupants and how they used them, and provide the primary data from which this analysis of the subsistence behaviours of pioneering Thule Inuit is built.

4. Tiktalik Subsistence

This chapter presents the baseline faunal data from Tiktalik, which are used to demonstrate which species were important for its occupants and the likely season in which the site was occupied. The faunal assemblage is heavily dominated by Ringed seal remains, suggesting that the site's occupants were subsisting almost entirely on this species. House 5's architecture indicates that it was a winter house, and the absence of many warm season indicator species in the faunal assemblage reinforces this interpretation.

4.1 Methodology

Over 20,000 faunal specimens were recovered from House 5, from which a representative sample was analysed for this study. Thule archaeofaunas have been noted to vary spatially within semi-subterranean houses (Friesen and Betts 2006; Morrison 1988). In particular, differences exist between the floor of the main living space, where cleaning often removes the largest bones, and kitchen areas, where modified bone frequencies are highest. Therefore, the sample used in this analysis was drawn from two units, one from the kitchen and one from the main living space, in order to get a more complete picture of the total faunal assemblage at the site. Unit S8W4 is located southeast of the main living area and is centred on the external kitchen area. Unit S4W6 is located in the centre of the main room. A random sample of 50% was selected from each level of each unit, totalling 7,747 faunal specimens. It is worth noting that, due to the previously noted damage to House 5 through rodent burrowing, there is likely some stratigraphic mixing among these levels. This does not affect the results of this analysis as it examines the sample as a whole and does not break it down by level.

Identification of the Tiktalik sample was conducted with the aid of the osteological comparative collection housed in the Zooarchaeology Laboratory of The University of Western Ontario. Additional identification was undertaken at the Howard Savage Faunal Archaeo-Osteology Laboratory at the University of Toronto, and the vertebrate palaeontology and ornithology osteological collections at the Royal Ontario Museum. Identification of each specimen was done to the most precise taxon possible and recorded in a Microsoft Access database. Elements were sided when possible, the state of epiphyseal fusion was noted, and cultural and natural bone modifications were recorded. The portion of each Ringed seal element was recorded using a zoning system described in Appendix 1. To avoid the possibility of counting a particular zone from one element more than once, a zone was recorded only when over 50% of it was present.

Two methods of quantification are typically used to assess the relative abundance of species in an archaeological faunal assemblage, Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNI), both of which have inherent biases. NISP is calculated by summing the total number of specimens identified within each taxonomic group. It can be thought of as the largest possible number of animals needed to create the assemblage, if each element came from a different animal. NISP is affected by both fragmentation (which does not affect all species or age categories equally) and the number of bones in an animal's body (which varies between species). However, its calculation is standardized and easy to accomplish, so it is the best unit to use when comparing assemblages identified by different analysts. MNIs, on the other hand, can be calculated in a number of different ways and are not as useful for comparison. They take into account the number of times an element or skeletal portion occurs in an animal's body. MNI is calculated by summing totals for every element or skeletal portion thereof identified to a specific taxon. The largest of these numbers represents the minimum number of individuals needed to create that assemblage. This number will depend on what skeletal portions the analyst decides to record. MNI values for the Tiktalik assemblage were derived using the largest number of elements, or proximal or distal portions thereof, for each species. The zoning system described in Appendix 1 was used to derive an MNI for Ringed seals.

4.2 Exploited Taxa

Of the 7,737 faunal specimens in the Tiktalik assemblage, 7,108 (91.87%) were identified to at least the class level (Table 1). Mammal is the most numerous class, with 6,941 identified elements (97.65% of identified specimens). Birds, while the second most numerous class, were clearly not as economically important, with only 157 identified elements (2.21%). Mollusc shells are the third most abundant class (NISP = 8, 0.11%). It is doubtful that they played an important role in the diet of Tiktalik's occupants, if any, and they are therefore not included in this analysis. Fish are represented by only two elements and make up just 0.03% of the identified Tiktalik faunal assemblage. Despite

Table 1: Class NISP values

Class	NISP	% of identified specimens
Mammal	6,941	97.65
Bird	157	2.21
Mollusc	8	0.11
Fish	2	0.03
Indeterminate	629	-
Total NISP	7,737	100.00

the low combined frequency for bird and fish remains, they make up over half of the species diversity in the total assemblage. The influence of taphonomic forces on both fish and bird remains is discussed below. The remaining 629 bones were too fragmentary or were not diagnostic enough to be identified to the class level.

A total of 6,346 elements were identified to order, family, genus or species (Table 2). The most striking feature of the Tiktalik faunal assemblage is the dominance of Ringed seal remains, which clearly were of primary economic importance to the site's occupants. Other exploited mammal species include fox, caribou, dog/wolf and bear. Bearded seal, wolverine, whale and muskox were also present in very small numbers. A relatively large number of rodent remains (including Arctic ground squirrel and lemming/vole) were also identified, but these are likely intrusive species for reasons discussed below. Ptarmigan is the most common bird taxon, followed by gulls and ducks. A few swan and goose specimens were also identified. Only two fish bones were identified, one from a member of the salmon family and the other from the cods. The habitat and behaviour of each identified taxonomic group, along with possible hunting strategies and the contribution of each to the Tiktalik economy are discussed below.

Table 2: NISP and MNI of taxa identified in the Tiktalik assemblage

(* species is considered intrusive and is therefore not included when determining totals and frequencies)

Taxon	NISP	NISP % of class	MNI	MNI % of class
Mammal				
Arctic ground squirrel *				
Spermophilus parryii	400		21	
Lemming/vole *				
family *Arvicolidae*	20		7	
Order *Rodentia* *	1			
Dog/wolf				
Canis sp.	25	0.43	2	4.17

Taxon	**NISP**	**NISP % of class**	**MNI**	**MNI % of class**
Fox				
Vulpes sp.	75	1.29	3	6.25
Family *Canidae*	3	0.05		
Bear				
Ursus sp.	28	0.48	2	4.17
Wolverine				
Gulo gulo	1	0.02	1	2.08
Ringed seal				
Phoca hispida	5621	96.91	36	75.00
Bearded seal				
Erignathus barbatus	9	0.16	1	2.08
Caribou				
Rangifer tarandus	31	0.53	2	4.17
Muskox				
Ovibos moschatus	1	0.02	1	2.08
Order *Artiodactyl*	5	0.09		
Order *Cetacea*	1	0.02		
Small Mammal	2			
Medium mammal	481			
Large mammal	17			
Indeterminate Mammal	220			
Total Mammal	6941		48	
Bird				
Swan				
Cygnus sp.	3	2.40	1	5.00
Snow goose				
Chen caerulescens	1	0.80	1	5.00
Long-tailed duck				
Clangula hyemalis	5	4.00	1	5.00
c f. *Clangula hyemalis*	1	0.80		
Eider				
Somateria sp.	3	2.40	1	5.00
cf. *Somateria*	1	0.80		
Duck sp.	2	1.60		
Rock/willow ptarmigan				
Lagopus sp.	79	63.20	10	50.00
Glaucous gull				
Larus hyperboreus	13	10.40	4	20.00
Herring gull				
cf. *Larus agentatus*	1	0.80	1	5.00
Mew gull				
cf. *Larus canus*	1	0.80	1	5.00
Larus sp.	15	12.00		
Indeterminate bird	32			
Total Bird	157		20	
Fish				
Family *Salmonidae*	1	50.00	1	50.00
Burbot				
cf. *Lota lota*	1	50.00	1	50.00
Total Fish	2		2	

Taxon	NISP	NISP % of class	MNI	MNI % of class
Mollusc				
Indeterminate	8			
Total Mollusc	8			
Indeterminate class	629			
Total	7737		70	

4.2.1 Mammal remains

Rodent (Rodentia)

Two species of rodent were identified in the Tiktalik assemblage, lemming/vole (family *Arvicolidae*) and Arctic ground squirrel (*Spermophilus paryii*). Arctic ground squirrel is the second most numerous species in the Tiktalik assemblage after Ringed seal based on both NISP (n = 400) and MNI (n = 21). Twenty lemming/vole elements were identified, most of which are mandibles. They probably represent animals that burrowed into the house after it was abandoned and are therefore excluded from this analysis. Arctic ground squirrel has been both included in (e.g. Betts 2008) and excluded from (e.g. Morrison 1983) analyses of Thule Inuit subsistence. There is documented evidence of Historic Inuit groups exploiting Arctic ground squirrels around Pearce Point (Farquharson 1976), but the remains in the Tiktalik assemblage are likely intrusive. Burrowing Arctic ground squirrels significantly damaged some of the architecture of House 5 (Morrison 1998a) and no evidence of modification, including cut marks or burning was observed on any ground squirrel elements. Ground squirrel is therefore also considered to be an intrusive species and is excluded from this analysis.

Dog/Wolf (Canis sp.)

As among the Historic Inuit, dogs played a central role in Thule Inuit culture (Park 1987). Historically, dogs were used to haul sledges and packs, to locate seal breathing holes, and to assist in hunting large terrestrial mammals such as bear and muskox. Dogs and wolves were also used as a source of meat and fur.

Twenty-five elements in the Tiktalik assemblage were identified as dog or wolf (0.43% of identified mammals; MNI = 2). It is notoriously difficult to distinguish between the closely related domesticated dog (*Canis familiaris*) and wolf (*C. lupus*) based on their skeletal remains. Crania provide the easiest means to distinguish between these species, but none are present in the Tiktalik assemblage. In general, the dog/wolf post-cranial elements from Tiktalik are smaller than the reference collections' wolf specimens, which weakly suggests that they represent the relatively smaller Inuit dog. Due to sexual dimorphism in both populations, female wolves may overlap in size with male Inuit dogs, so assigning post-cranial elements to either species is tenuous. One dog/wolf lumbar vertebra in the Tiktalik assemblage has a collapsed spinous process, and one exhibits osteophytosis. Arnold (1979) has suggested that these pathologies are indicative of the animal pulling or carrying a heavy load, a task only a domestic dog would do. The presence of these pathologies also suggests that at least some of the canid elements in the Tiktalik assemblage are from domesticated dogs, and that they were used to haul sledges or packs. It is worth noting, however, that no artifacts associated with dog sleds were found in the House 5 assemblage. Two lumbar vertebrae exhibit cutmarks, indicating that at least one dog/wolf was butchered.

Fox (Vulpes sp.)

Two species of fox have modern distributions in the vicinity of Tiktalik, the Red fox (*Vulpes vulpes*) and the Arctic fox (*V. lagopus*). Although sympatric in parts of the Arctic, these species have relatively different habitat and diet preferences (Peterson

1966). The larger and more aggressive Red fox has a relatively diverse and adaptable diet of small mammals, birds and carrion. It is typically found in more southerly environments, although its range has extended into the Arctic in modern times. The more diminutive Arctic fox is circumpolar in distribution, and prefers a more coastal environment, where they also subsist on small mammals and birds. Arctic foxes are particularly noted for feeding on abandoned Polar bear kills and actively hunting newly born seal pups on the sea ice. Fox trapping was undertaken by Historic Inuit groups in the vicinity of Pearce Point, concentrating largely on Arctic foxes, but with Red foxes being occasionally taken from more inland traplines (Usher 1976).

Both Arctic fox and Red fox have been identified in Thule archaeological sites in the Western Canadian Arctic (Betts 2008; Morrison 1997, 2000), but the Red fox is largely absent in sites from the Eastern Canadian Arctic (Monchot and Gendron 2010). Foxes played an important role in Thule Inuit subsistence. Not only did they serve as a minor source of meat, but they also provided a source of furs and skins if caribou were unavailable.

A total of 75 elements in the Tiktalik assemblage were identified as fox (MNI = 3). It is the second most abundant taxon (excluding Arctic ground squirrel), but makes up only 1.29% of identified mammals.

Bear (Ursus sp.)

Two species of bear inhabit the south coast of Amundsen Gulf, the marine adapted Polar bear (*Ursus maritimus*) and the terrestrially focused Barren ground Grizzly bear (*U. arctos*). Polar bears, the largest of the ursids, subsist mainly on seals killed on the sea ice. In fact, these bears spend most of their lives on or near the ice pack and rarely venture inland. Barren ground Grizzly bears, on the other hand, spend most of their lives inland subsisting on an omnivorous diet of large and small game, fish, berries and other plant material. Bear skeletal remains are common in marine-focused Thule assemblages throughout the North American Arctic (e.g. Morrison 1983; Stanford 1976; McCullough 1989; Rick 1980; Jacobs and Stenton 1985). Bears could be hunted with the aid of dogs using lances or caught in large boulder traps (Ekblaw 1928; Holtved 1967).

This analysis identified 28 bear elements (0.48% of identified mammals), with at least two individuals represented based on the presence of both immature and adult ribs. None of the specimens could be identified to species. Five of the bear specimens had cutmarks (17.86%), which is the highest frequency of modified bone for any species in the Tiktalik assemblage.

Wolverine (Gulo gulo)

The solitary wolverine occurs throughout the Arctic and sub-Arctic. Historic Inuit valued wolverine furs for their frost-resistance (Stefansson 1913). Wolverine skeletal elements have been identified at other Thule Inuit sites in the Western Canadian arctic (e.g. Morrison 1983), and are typically interpreted as being procured for their fur. Wolverine is represented by only one element, a 2nd metatarsal, in the Tiktalik faunal assemblage. It seems unlikely that this fur-bearer played a significant role in the diet of Tiktalik's occupants.

Ringed seal (Phoca hispida)

Phocid seal species (Ringed seal (*Phoca hispida*), Harbour seal (*Phoca vitulina*) and Harp seal (*Phoca groenlandica*)) are relatively difficult to distinguish based on bones alone, especially without the aid of extensive comparative collections including multiple individuals from each species (Hodgetts 1999). Only teeth and crania are easy to assign to species. Most of the small seal bones identified in the Tiktalik assemblage were therefore classified as "small seal." Ringed seal, however, is the only species of small seal currently found in eastern Amundsen Gulf. Additionally, all the teeth and cranial elements identified to species are Ringed seal. Therefore, all of the specimens identified as small seal are assumed to be Ringed seal.

The Ringed seal is ubiquitous in most Arctic marine environments, and played a significant role in the subsistence of most Arctic-adapted hunter-gatherer groups. Ringed seals are the smallest of the seals, with adults weighing around 68kg and reaching up to 1.5m in length (King 1983). They prefer shallow, coastal water, and during winter they remain under areas of land-fast ice, surfacing to breath at ice leads and breathing holes that they scratch through the ice. Expectant mothers build snow lairs above the fast ice, which they access through breathing holes. Pups are born between mid-March and mid-April. After the pupping season and with the coming of warmer weather and the open water season, Ringed seals spend most of their time basking on the sea ice, moulting and fasting.

The importance of seals for Historic Inuit cannot be understated. Seal meat and blubber were used to feed people and their dogs. Treated skins were made into clothing, ropes and tents, and whole skins were sewn shut and inflated to make harpoon floats. Seal oil was the fuel for soapstone and ceramic lamps. Even seal bones were used as gaming pieces or other tools. There are a number of Ringed seal hunting techniques which Inuit employed depending on the time of year and local ice conditions. During the winter months Ringed seals can be successfully hunted by patiently waiting at active breathing holes or ice leads and harpooning them when they surface. Both mothers and their young can be procured by opening up their lairs. During the open water season, seals can be killed by harpooning them from kayaks as they surface. A hunter can also stalk a seal by lying prone and crawling towards it while pushing a white screen in front of himself, eventually getting close enough to harpoon it. More recently underwater nets have been used by Inuit groups to catch seals.

Ringed seals were also a staple during the Thule period, and are often a main, if not the primary, prey-species in marine focused Thule Inuit sites (Morrison 1983). For example, they averaged 96% of NISP in multiple features at PaJs-12 (Whitridge 1992), a Thule site on Somerset Island in the Central Canadian Arctic. Thule Inuit hunters used similar techniques to those employed by the Historic Inuit. The advanced sea mammal hunting tool kit of the Thule Inuit, which included complex harpoons with toggling heads, seal-skin floats and kayaks, attests to the importance of seal hunting in Thule times.

A total of 5,621 faunal specimens were identified as Ringed seal. This is, by a large magnitude, the most abundant species in the assemblage, making up 94.84% of the total NISP identified to taxa smaller than class. Morrison (pers. comm.) noted a high frequency of foetal seal bone in the Tiktalik assemblage, but these were removed prior to this analysis. The true abundance of this species is therefore likely to be slightly higher than what was calculated. Although seal bones exhibiting cutmarks are more numerous than those of any other species (n = 70), they represent only 0.01% of the total number of seal bones. Because Ringed seal was clearly of primary economic importance for Tiktalik's occupants, exploitation of this species is further examined through skeletal part representation and the age-at-death in Chapter 5.

Bearded seal (Erignathus barbatus)

The Bearded seal (*Erignathus barbatus*) is the largest seal endemic to Amundsen Gulf and the second largest northern pinniped after the walrus. Bearded seals are generally solitary animals that inhabit shallow coastal waters throughout the circumpolar Arctic. In the winter they prefer heavy offshore ice, and from mid-March to April females give birth to their young on the pack ice. Adult Bearded seals weigh between 275 and 340 kg, and a single seal provides a significant source of food. Unlike the smaller seals, bearded seals are too big to transport whole, and are therefore butchered where they are killed and transported back to camp in smaller pieces. Historic Inuit particularly valued Bearded seal hides, which provided a tough, thick material suitable for boot soles, ropes, and the waterproof coverings of umiaks.

Nine elements in the Tiktalik assemblage were identified as Bearded seal (0.16% of mammals), with at least one individual represented. These include one humerus that has both proximal and distal epiphyses unfused, indicating that at least one immature Bearded seal was procured, but unfortunately no fusion data is available to age this individual.

Caribou (Rangifer tarandus)

Caribou are ubiquitous throughout the Arctic and played an important role in both recent and ancient human populations' subsistence. Caribou remains are present in most Thule culture assemblages as the second or third most abundant species, but the number of caribou remains tends to be inversely proportional to the number of fox (Morrison 1983; Savelle and McCartney 1988). It has been suggested that the consistently high numbers of caribou and/or fox remains reflect a need for high quality furs and hides in order to manufacture winter clothing. The most common method for hunting caribou was likely stalking with bow and arrow, but the extremely high frequencies of caribou at some sites (e.g. 98% of identified mammals at the Bison Skull site, Bathurst Peninsula, coastal NWT (Morrison 1997)) are suggestive of warm season mass-kill hunting strategies.

Caribou was the third most numerous mammal species with an NISP of 31 (0.53% of identified mammals; MNI = 2). The small number of caribou elements precludes an analysis of skeletal part representation. Spiral fractures on the caribou long bones are consistent with these elements being processed for their marrow.

Muskox (Ovibos moschatus)

Muskox herds of between eight and twenty-five animals are found throughout the Canadian tundra zone. Their defensive behaviour, whereby adults form a protective circle around their young, is effective against their natural predator, the wolf, but is easily exploited by human hunters. Dogs can be used to corral muskox into their defensive posture, and human hunters can then get close enough to dispatch animals with lances. Only one muskox element, an immature phalanx, was identified in the Tiktalik assemblage. The implications of a single muskox skeletal element are difficult to interpret, but it is clear that muskox was not a significant prey species for Tiktalik's occupants.

Whale (Cetacea)

Mathiassen (1927) was the first to suggest that whale hunting was a defining characteristic of Thule culture, but determining the significance of whales in Thule Inuit subsistence has been an ongoing problem for archaeologists, as outlined in Chapter 2. It has even been suggested that the expansion of Bowhead whale habitat during the

Medieval Warm Period was directly responsible for the original Thule Migration (McGhee 1969). It is now generally recognized that Thule Inuit subsistence was heavily focused on toothed and baleen whales where available. Specific whale hunting gear and symbolic representations of whales attest to this focus. Nevertheless, it is equally well established that the interpretation of whale remains at Thule archaeological sites is complex. Killed whales were generally hauled up on beaches or sea ice to be processed. Due to their large size, whale bones were typically not transported along with units of meat, skin and blubber, and are therefore unlikely to be introduced into a dwelling's archaeological assemblage. At the same time, whale skeletal elements were valued both as architectural elements and as a raw material for manufacturing tools. Bones could be obtained from harvested whales but could also be obtained from beached carcases and abandoned winter dwellings. Because of the various ways in which whale bone could enter the archaeological record, quantification of whale NISP and MNI is nearly meaningless as it will not realistically reflect the number of whales harvested or used by a dwelling's occupants.

Only one bone in the Tiktalik faunal assemblage was identified as cetacean: an ulna, likely from a Bowhead whale. This element is weathered and has tooth marks indicative of carnivore gnawing. During excavation, Morrison (1998) noted the presence of baleen throughout the House 5 as well as a rib fragment that he interpreted as architectural. There were also a number of whale bone tools and whale bone debitage. Despite the presence of whale bone, it is argued here that these more likely arrived at the site through scavenging. Ideal Bowhead hunting conditions occur in the early spring, when migrating animals enter narrow ice leads and melting ice pack as they attempt to move into their summer feeding grounds. These whales are effectively corralled and become easier prey for human hunters. Tiktalik is not situated particularly well to intercept Bowhead whales during this key period, as eastern Amundsen Gulf is mostly open water by the time the whales arrive, making procurement much more difficult. Therefore Tiktalik likely does not represent a whaling station, and the whale bone artifacts and elements probably represent material transported from elsewhere.

4.2.2 Avian remains

Avian remains make up just 2.21% of the identified specimens (NISP = 157), but represent almost half of the total species diversity (eight of eighteen identified species are bird). As with mammals, one species dominates. Seventy-nine of the bird specimens were identified as ptarmigan (63.20% of total identified bird), with at least ten individuals represented (50.00% of total bird MNI). Gull (n = 30), duck (n = 12), swan (n = 3) and goose (n = 1) make up the remainder of the identified bird specimens. The remaining 32 bird specimens were unable to be identified to a taxon smaller than class. The small number of bird elements combined with the high species diversity is perhaps indicative of an opportunistic hunting strategy. Bird bone is more susceptible to destruction by weathering and carnivore activities than mammal bone. It is also less likely to be collected from sediments that are not screened due to its relatively small size. As discussed with fish remains below, the low frequency of bird remains in the Tiktalik assemblage is likely not a result of differential destruction or sampling bias.

There were a number of bird-hunting techniques available to Thule Inuit hunters, including hunting with bow and arrow or birding darts, snaring, netting, and collecting by hand during the flightless moulting stage. There were also specialized tools for hunting birds, including multi-pronged birding darts thrown from throwing boards, stone bolas and gull hooks. Active bird hunting is a warm season subsistence strategy, and the implications of seasonally present bird species for interpreting Tiktalik's seasonal occupation are discussed in a separate section below.

Rock/willow ptarmigan (Lagopus sp.)

Two closely related species of ptarmigan, the rock ptarmigan (*Lagopus mutus*) and the willow ptarmigan (*Lagopus lagopus*), inhabit the North American Arctic. Unlike many other Arctic bird species, ptarmigan are year-round residents. No attempt was made to distinguish between the similar skeletal elements of rock and willow ptarmigan during identification, so the results are presented at the genus level. Both species share similar habitats and behaviours but differ in plumage. They are both ground-nesting, and are easily harvested through the passive use of snares, or actively hunted with birding darts, by hand, or with the aid of nets.

Ptarmigan are both common and numerous in Thule culture faunal assemblages in the Western Canadian Arctic. For example 24 of 33 Thule Inuit sites in the Mackenzie Delta examined by Betts (2008) contained ptarmigan remains. Over half (NISP = 79, 63.20%) of the bird specimens in the Tiktalik assemblage were identified as ptarmigan, but this species makes up only 1.11% of the total NISP.

Gull Family (Laridae)

At least three gull species have modern breeding ranges on the south coast of Amundsen Gulf (Godfrey 1966), but due to its proximity to the tree line the area is likely occasionally visited by more southerly species. Many of these gull species share similar sizes and morphology, making it difficult to distinguish between them based on skeletal elements. Thirty specimens in the Tiktalik assemblage were identified as gull, thirteen of which were identified as Glaucous gull (*Larus hyperboreus*). The Glaucous gull is the largest of the gulls, making it much easier to identify in the archaeological record than other species. Glaucous gulls, like ptarmigan, are year round inhabitants of the Arctic coasts and are therefore poor indicators of site seasonality. At least four Glaucous gulls are represented in the Tiktalik assemblage. Tentative species designations were assigned to Herring gull (*L. argentatus*) and Short-billed gull (*L. canus*) elements. Many of the remaining elements were Herring gull sized, but the large number of similarly sized species makes precise identification difficult.

Duck

A large number of duck species migrate to Arctic Canada to breed, at least two of which are represented among the 12 duck bones identified in the Tiktalik assemblage. Six elements were identified, one tentatively, as Long-tailed duck (*Clangula hyemalis*), or Oldsquaw. Long-tailed ducks are small sea ducks that migrate to Arctic coasts to breed. The other identified duck taxon, with an NISP of 3, is the genus *Somateria*, which includes both the Common eider (*S. mollissima*) and the King eider (*S. spectabilis*). Eiders are large sea ducks that also breed in coastal areas throughout the Arctic. The presence of two species of sea duck in the Tiktalik assemblage speaks to its coastal location, and the maritime focus of the site's occupants.

Goose (Anserinae) and Swan (Cygninae)

As with ducks, a large number of goose (subfamily Anserinae) and swan (subfamily Cygninae) species migrate north to the Arctic for the summer breeding season. At least one individual from each of these groups was procured by Tiktalik's occupants based on the identification of three swan and one goose elements. Two species of swan breed in the arctic: the Tundra swan (*Cygnus columbianus*) and the slightly more robust Trumpeter swan (*Cygnus buccinator*). Three leg bones belonging to a member of this genus were identified in the assemblage. Two of these elements are from an immature individual, while the other is tentatively identified as a Trumpeter swan. Only one specimen in the Tiktalik assemblage was identified as goose, a distal humerus fragment from a snow goose (*Chen caerulescens*). This specimen had numerous fine cutmarks around the shaft just proximal to the head. Interpretation of these marks is difficult, but they perhaps represent a skinning attempt with a dull cutting implement. This is the only bird bone in the Tiktalik assemblage that exhibits cutmarks.

4.2.3 Fish remains

Only two fish bones were identified in the Tiktalik assemblage, both of which are vertebrae. One is from a member of the salmon family (*Salmonidae*) and the other is a member of the order *Gadiformes* (Cod and allies). A large number of species from the salmon family inhabit the fresh and coastal waters of the Amundsen Gulf region, and this non-diagnostic vertebra could not be assigned to species. The Gadiformes vertebra is tentatively assigned to Burbot (*Lota lota*), a large fresh water fish whose Inuktitut name is *Tiktaalik.*

Fish were a dietary staple for many Inuit groups, but typically occur in only low frequencies in Thule faunal assemblages despite the common presence of fishing implements at Thule sites (Whitridge 2001). Whitridge's (2001) analysis of Thule Inuit fish use suggests that a dietary focus on fish was a relatively recent development. The complex taphonomic factors that affect fish remains in Thule archaeological contexts have been discussed in depth by Whitridge, and will not be explored in detail here. However, it is important to explain how some of these factors may have biased the Tiktalik assemblage. Some archaeologists have argued that sample collection strategies, especially inconsistent fine-screening, may bias collected assemblages against fish remains (Shaffer 1992; Gordon 1993; Zohar and Belmaker 2005). Although Tiktalik was only "casually" screened (Morrison 1998a), many fish-sized bones and smaller were collected, including bird, lemming/vole and arctic ground squirrel. It is therefore very unlikely that a lack of screening led to the dearth of fish bone in the Tiktalik assemblage. Secondly, preservation at Tiktalik was generally excellent, and was exceedingly good in the lower levels, such that fragments of soft tissues remain on some bones. Although fish bones are generally considered to be more susceptible to density- and size mediated attrition than those of mammals (Lyman 1994; Colley 1990; Wheeler and Jones 1989), this taphonomic bias likely played a minimal role in the lower levels at Tiktalik.

Whitridge (2001) also suggests that procurement, butchery and consumption practices had an impact on Thule fish bone assemblages. Specifically, fish processing activities, and therefore fish bones, may have been distributed differently both inside and outside dwellings. However, at Kugaluk (Morrison 1988), one of the few Thule sites where both internal and external activity areas were excavated, fish bones were most common on the floor of the living area. This area was included in the analysed sample of the Tiktalik assemblage. If similar behaviours were structuring the assemblage at both sites, fish bones could have been targeted by the spatial sampling strategy utilized for this analysis. It is therefore likely that the amount of fish bone identified in the Tiktalik assemblage is proportional to its dietary contribution. As only two fish bones are present, fish appear to have played an insignificant role in the total diet of Tiktalik's occupants, a situation similar to that seen by Whitridge (2001) at Thule Inuit sites throughout the Canadian Arctic.

4.3 Site Seasonality

A mobile way of life is common to all hunter-gatherer groups as it allows them to exploit a larger and more diverse resource base and reduces the risks of over-harvesting resources in a single area. Away from the equator, differences between warm and cold seasons increase and the availability of animal and plant resources becomes more seasonal (Rowley-Conwy 1999). Resource scheduling, or shifting the subsistence focus to different resources throughout the seasonal round, is facilitated by a mobile lifestyle and is one way hunter-gatherers combat the highly seasonal nature of resources in the Arctic. The result of resource scheduling is that certain dwellings and other features visible in the archaeological record are only used during certain seasons. Thule culture site seasonality is most often inferred from architecture. Heavily built semi-subterranean houses, such as House 5 at Tiktalik, are assumed to have been occupied during the winter, when their thermally-efficient characteristics would have been most useful. Warm season occupations are often attributed to more ephemeral tent-rings and less robustly built sod house features.

The faunal material preserved in Thule assemblages is the other dataset used to determine site seasonality. Unfortunately, it is not easy to interpret the seasonality of Thule faunal assemblages. Stored meat, facilitated by freezing temperatures during much of the year, was an extremely important component of Thule Inuit winter diet. The seasonal aggregation of some Arctic species, including caribou, fish, and bowhead whales, created huge surpluses of food resources at certain times of the year. The difficulties associated with winter hunting, including lack of daylight and extremely cold temperatures, also necessitated the storage of food resources to provide extra food during this period. Therefore, faunal material from Thule Inuit winter sites may demonstrate seasonal patterns more typical of warm season occupations, especially late summer or autumn, if stored meat contributed a large portion of the food.

Nevertheless, stored food likely never provided all of the food for the entire winter, and animals would have been taken throughout this season to supplement stored food. For example, Ringed seals could be hunted on the sea-ice throughout the winter, but there is good ethnographic evidence that dried seal meat was also an important resource during this season (Park 1999). Furthermore, animals hunted during the warm season were likely taken and stored in the vicinity of the winter house in order to facilitate easier access. Therefore, although they may not represent the season the site was occupied, they do represent hunting activities in the geographic area. Based on its architecture, House 5 at Tiktalik was likely occupied during the winter. The faunal refuse preserved at the site is likely a combination of animals procured and stored in the warm season and animals hunted during the winter.

As with humans, many arctic animal species use migration to adapt to the extreme seasonal fluctuations in temperature and resource availability. Most of the species identified in the Tiktalik assemblage, including all the mammal species, are year-long occupants of the Arctic, and their presence does not necessarily suggest occupation at a certain time of year. Birds, on the other hand, are particularly good seasonal indicators because most species are only present during the breeding season, roughly between spring and fall. Four species of migratory bird (swans, snow geese, Long-tailed ducks and eiders) were identified in the Tiktalik assemblage and can be used to assess site seasonality.

In the Beaufort Sea and Amundsen Gulf region, most migrating sea ducks arrive at their spring staging areas between the last week of May and the middle of June (Dickson and Gilchrist 2002). Open-water areas on Amundsen Gulf in the vicinity of Tiktalik are moderate density staging areas for both Long-tailed ducks and eiders. Starting in mid-June, these species disperse from spring staging areas to nesting sites throughout the Canadian Arctic. A returning moult migration, largely composed of males and failed breeders, reaches peak numbers in Amundsen Gulf from mid-July to late August. The fall migration of Long-tailed ducks occurs throughout this season, while eiders have a longer fall migration from June through November (Dickson and Gilchrist 2002: 50). Therefore, the Long-tailed ducks and eiders identified in the Tiktalik assemblage may have been harvested at any point between late-May and November. The low frequencies of these species suggest that they may represent individuals harvested during the fall migration. During both the spring and moult migrations these birds form large flocks. If birding was undertaken during these seasons, there would likely be many more individuals in the Tiktalik assemblage as it would have been easier to procure many animals simultaneously.

Swans and geese follow similar migration patterns (Bellrose 1980). Tundra swans arrive at their nesting grounds on the southern shores of the Beaufort Sea and Amundsen Gulf in early to mid-May. Most of these swans leave the breeding grounds for more southerly areas during September. Lesser snow geese arrive in the Arctic throughout May and early June, and leave in late September to early October. The only immature bird bone identified in the Tiktalik assemblage is swan. The bone of this cygnet was only slightly smaller than bones of adult swans, which suggests that it was harvested during the late summer/fall season when the individual was almost fully grown.

The relatively low abundance of migratory bird species in the Tiktalik assemblage compared to overwintering birds, such as ptarmigan and Glaucous gull, also provides a good indication of site seasonality. If most birding was done opportunistically, as suggested by the low overall abundance of birds in the assemblage, then it appears that the site was largely occupied during the winter when only over-wintering birds were available. However, the presence of migratory birds does suggest that some of the birds consumed at the site were harvested outside the winter season, likely in late summer or fall based on the size of the immature swan element. Alternatively, the migratory bird remains in the assemblage may represent stored food resources harvested in the summer that were transported to the site and consumed during the winter.

4.4 Summary

Subsistence at Tiktalik was almost entirely focused on Ringed seals. Other mammals were hunted, both marine and terrestrial, but are present in relatively low frequencies of both NISP and MNI. Bird remains make up just 2.21% of total identified NISP, but represent 28.57% of total MNI and almost half the total species diversity identified in the assemblage. These data suggest that birding was done opportunistically by Tiktalik`s hunters. A closer examination of the bird remains supports the assumption that House 5 at Tiktalik was occupied during the winter. Because Ringed seals were clearly a dietary mainstay for Tiktalik's occupants, hunting strategies and consumption patterns for this species are examined in more detail in the following chapter.

5. Ringed seal hunting and consumption

Ringed seals were the most important prey species for Tiktalik's occupants, and so understanding how they hunted and utilized these seals is central to understanding life at the site. Ethnographic analogy to historic and modern Inuit groups is usually used to infer Thule Inuit Ringed seal use. However, there is a great deal of diversity in how the Inuit procured, stored and consumed seals. Two methods are used to examine these behaviours at Tiktalik. First, the age structure of the population of seals is reconstructed. This is a good indicator of the method the Thule Inuit used to hunt the seals as well as the season that they undertook sealing. Next, the frequencies of individual ringed seal elements are examined in order to determine how the seals were stored and consumed, and the possible taphonomic processes that affected the site after it was abandoned.

5.1 Ringed seal age-at-death

Zooarchaeologists use age-at-death profiles of a range of harvested animals to provide information about both hunting strategies and season of site occupation (Lyman 1994). Recently, archaeologists have applied these techniques to seal remains (e.g. Danielson 1994; Storå 2000, 2002; Hodgetts 2005, 2010, 2001; Nagy 2005). Ringed seals were of dietary importance for almost every group to occupy Arctic North America, as they are ubiquitous and abundant in most arctic marine environments. Additionally, unlike many other species, they are non-migratory and are adapted to winter sea-ice, and can therefore be procured throughout the year. Because Ringed seals occupy slightly different habitats at different ages, age-at-death profiles can be used to infer hunting season and method.

5.1.1 Ringed seal behaviour

The age-at-death profiles of Ringed seals observed in zooarchaeological assemblages are the combined result of seal behaviour and the hunting strategies used to kill them. The most important factor dictating the age structure of harvested seals is the season in which they were hunted, as there are significant differences between summer and winter populations. As Ringed seals do not migrate they must keep breathing holes open in the sea-ice throughout winter. From autumn to spring, Ringed seal habitat is divided into two areas: inshore fast ice and offshore pack ice. Fast ice forms adjacent to the shore and remains attached to it throughout the winter, whereas pack ice is free floating, forms over deeper water, freezes later in the year, and is much less stable. Fast ice is the preferred habitat for Ringed seals in the winter because it offers access to the best feeding grounds and stable ice in which to build birthing lairs. Competition among seals for the limited inshore habitat results in higher numbers of large adult seals close to shore, while smaller and younger seals are forced into the marginal pack ice habitat (Smith 1987). This competition begins during the first few weeks in autumn before the sea-ice begins to form and lasts until the end of the breeding season in late spring. On the other hand, during the summer open water season, there is little competition between seals for the best territories so the living age structure is more uniformly distributed among all ages in all locations. During the summer months, seals spend much of their time basking and moulting on land or the remaining pack ice, where they are easy prey for skilled human hunters.

Ringed seals go through three life stages. During the first year of life, Ringed seal pups grow quickly but have relatively high mortality rates. After one year of life, Ringed

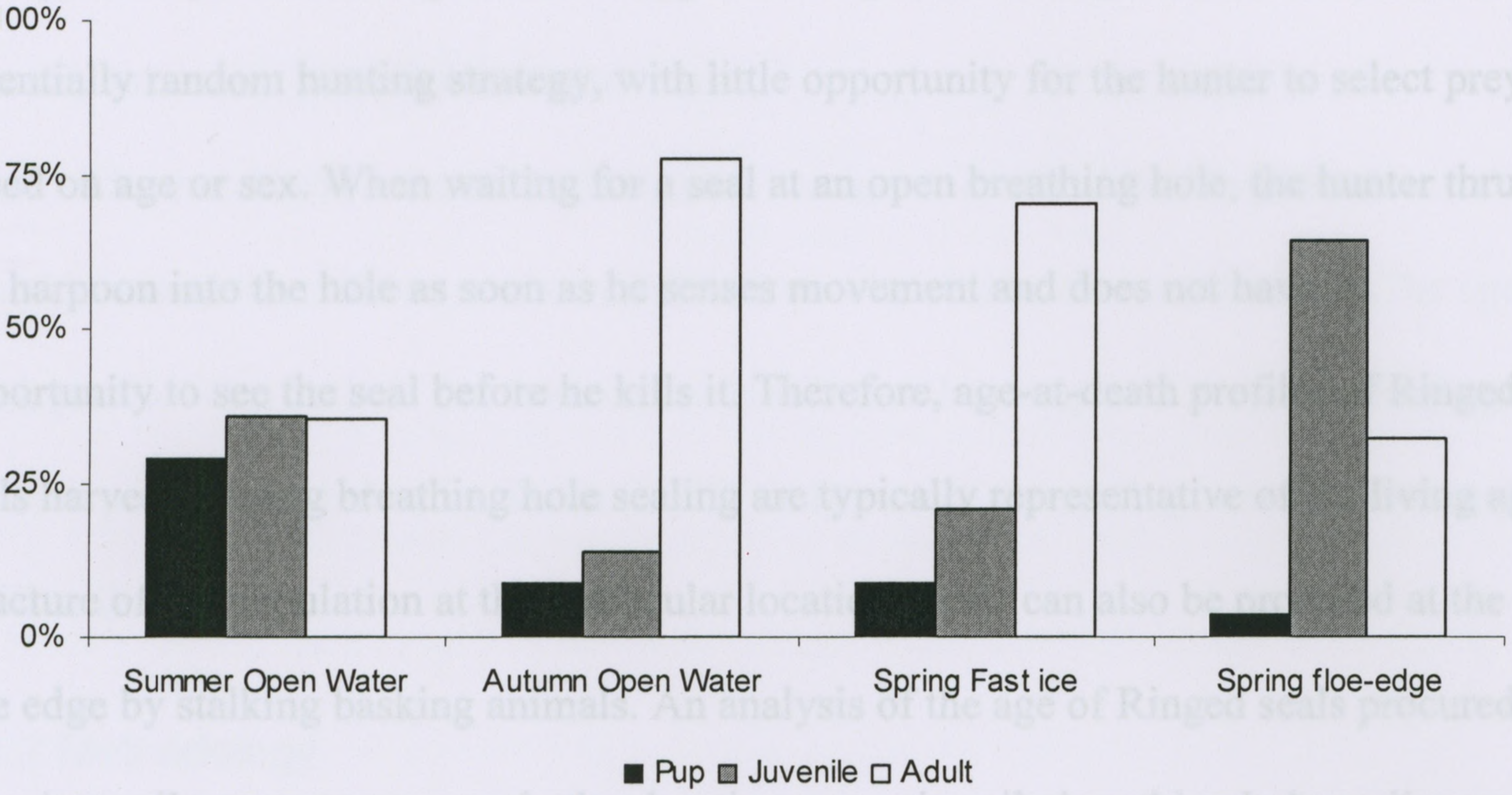

Figure 6: Four Ringed seal profiles at different seasons and locations (from Smith 1987)

seals reach the juvenile life stage. Juveniles are not yet sexually mature and continue to grow, but at a much slower rate. Female seals reach sexually maturity on average in the fifth year of life, while males reach it at age seven (Smith 1987). Figure 6 presents the living age structures of Ringed seals during different seasons and ice habitats from Amundsen Gulf in the vicinity of Holman, Victoria Island (Smith 1987). The summer open water, autumn open water and spring fast-ice samples all come from inshore habitats, and show that adults dominate this area during the cold season. The spring floe-edge sample represents a less desirable offshore habitat, and displays the correspondingly high frequency of juvenile seals.

Arctic archaeologists typically reference the Inuit ethnographic record when describing seal hunting techniques, an analogy that is justified by the direct historical link between the two groups and the similarities in their lifestyles. Ethnographic work by Birket-Smith (1936), Boas (1964), Nelson (1969) and Balikci (1970) were used to develop the following summary of Ringed seal hunting techniques. During the winter, Inuit primarily hunted Ringed seals using breathing-hole sealing. This technique is an essentially random hunting strategy, with little opportunity for the hunter to select prey based on age or sex. When waiting for a seal at an open breathing hole, the hunter thrusts the harpoon into the hole as soon as he senses movement and does not have an opportunity to see the seal before he kills it. Therefore, age-at-death profiles of Ringed seals harvested using breathing hole sealing are typically representative of the living age structure of the population at that particular location. Seals can also be procured at the floe edge by stalking basking animals. An analysis of the age of Ringed seals procured in the winter allows us to assess whether hunting was primarily breathing hole sealing on land fast ice (more adults) or floe edge sealing (more juveniles). On the other hand, there is little competition among seals during the open-water season and all age groups occur in similar frequencies. The Inuit hunted seals during this season using a number of techniques, including harpooning from kayaks and stalking. Pups and juveniles are as abundant as adult seals during the open water season, but are naive and easily fall prey to hunters. We would therefore expect open-water hunting techniques to yield an age-at-death profile with at least equal proportions of all three age groups, if not more pups and juveniles.

A hunting strategy focused on newborn seals also leaves a distinctive archaeological signature. Ringed seal pups are born between mid-March and mid-April in lairs built by their mothers in the sea-ice. They typically stay there for 1-2 months while they grow and moult. Pups in their dens can be easily harvested by human hunters, and are frequently used as bait for their mothers. The archaeological signature of this type of hunting strategy would be an assemblage with many pups and adult females, and few sexually immature juveniles and adult males.

Three methods are used to determine the age-at-death of the Ringed seals in the Tiktalik assemblage. These methods and their results will be discussed below. The age-at-death profile from each of the three methods will then be compared to the seasonal age-at-death profiles published by Smith (1987) to determine the sealing season and technique at Tiktalik.

5.1.2 Methodology

Three methods can be used to age seal bones in zooarchaeological assemblages: thin sectioning canine teeth, the application of skeletal fusion schedules, and metric data. Both epiphyseal fusion and metric data were used to determine the age structure of the Ringed seal bones preserved in the Tiktalik assemblage. Epiphyseal fusion data were recorded for Ringed seal scapulae, innominates, metapodials, and all long bones. Epiphyses were recorded as open (no connection between diaphysis and epiphysis), closed (epiphysis attached to diaphysis but with a line of fusion still visible) or fused (epiphysis fully fused to diaphysis and no line of fusion visible). For the purposes of this study, closed and fused elements were grouped together. Measurements were taken of mandibles, scapulae, baccula and all long bones following the guidelines in Ericson and Storå (1999). Only metric data from humeri and femora, which have been showed to be most sensitive to age (Storå 2002), were used to examine the age-at-death profile of Tiktalik's seals. The measurements recorded for these elements are presented in Table 3. Measurements were taken of both right and left elements using digital callipers with ±0.01mm of error.

Table 3: Measurements of Ringed seal skeletal elements

Skeletal Element	Measurement
Humerus	Smallest diagonal breadth of diaphysis Smallest height of diaphysis
Femur	Greatest length Smallest breadth of diaphysis Greatest depth of diaphysis

A schedule of Ringed seal skeletal fusion from a Baltic Sea population (Storå 2000) was used to determine the age structure of seals in the Tiktalik assemblage (Table 4). Storå assigned each epiphysis to a skeletal age. Although skeletal age corresponds to neither biological nor behavioural age, groups of skeletal ages correspond with age groups at different life stages. The age groups, skeletal ages, and epiphyses used in this study are presented in Table 4. The youngest age group, pups, represents seals of biological ages of less than one year. Age group 2, or juveniles, are seals of biological ages between 1 and 7 and represent seals that are sexually immature and not yet fully

Table 4: Age groups and skeletal ages based on Ringed seal epiphyseal fusion (after Storå 2000)

Age Group	Skeletal Age(s)	Epiphyses
1, Pups	1-3	Metacarpal 1 – distal epiphysis Metatarsal 1 – distal epiphysis Innominate – acetabulum Scapula – glenoid tubercle Humerus – head and greater tubercle of the proximal epiphysis
2, Juveniles	4-5	Cruris – tibial and fibular part of the proximal epiphysis Femur – proximal epiphysis Humerus – distal epiphysis Radius – proximal epiphysis Sacrum
3, Young Adults	6	Humerus – proximal epiphysis to diaphysis Femur – distal epiphysis Ulna – proximal epiphysis Cruris – proximal epiphysis
4, Old Adults	7-8	Metacarpal 1 – proximal epiphysis Metacarpals 2-5 – distal epiphysis Metatarsal 1 – proximal epiphysis Metatarsals 2-5 – distal epiphysis Ulna – distal epiphysis Radius – distal epiphysis Cruris – distal epiphyses

grown. Two age groups correspond to sexually mature adults at the same life stage. Age group 3 is young adults that have not yet reached adult size, while age group 4 is old adults that have completely fused skeletons.

Three methods were used to obtain age-at-death profiles of the Ringed seals in the Tiktalik assemblage. An analysis of all epiphyses was first used to determine the survivorship of each age group. Detailed analyses of femora and humeri, involving both fusion stages and metrics, were then used to derive a more precise estimate of the relative importance of different age categories.

5.1.3 Epiphyseal fusion of all elements

Table 5 displays the minimum number of open and fused epiphyses in the Tiktalik assemblage. The number of open epiphyses is the greater number of either open epiphyses or open diaphyses observed in the sample, while closed and fused elements were added together. Both left and right elements are included in the minimum number of epiphyses (MNE) values in Table 5.

The survivorship curve derived from these data (Figure 7) suggests a number of characteristics for the Tiktalik Ringed seal population. A survivorship curve plots the percentage of a population that has survived past a certain age. For example, 74% of epiphyses that fuse during age group 2 were fused, which shows that 74% of the seals in the sample were at least juveniles or older. Almost all the seal elements in the sample are older than one year (97%), while over 70% are young adult or older. However, it is difficult to make accurate estimates of the number of Ringed seals from each age group from these data alone because of the overlapping age classes.

Table 5: Minimum number of epiphyses for Ringed seal elements in the Tiktalik assemblage

Age group	Epiphysis	Open	Closed + Fused	Total	Frequency of fused elements
Pup	Metatarsal 1 – distal	1	38	39	0.97
	Innominate – acetabulum	1	45	46	0.98
	Scapula – glenoid	3	54	57	0.95
	Humerus – head to greater tubercle	1	32	33	0.97
	Total Pup	*6*	*169*	*175*	*0.97*
Juvenile	Cruris – tibular and fibular proximal epiphysis	3	28	31	0.90
	Femur – proximal	13	38	51	0.75
	Radius – proximal	17	33	50	0.66
	Humerus – distal	9	21	30	0.70
	Total Juvenile	*42*	*120*	*162*	*0.74*
Young Adult	Femur – distal	16	39	55	0.71
	Humerus – proximal	11	21	32	0.66
	Ulna – proximal	9	33	42	0.79
	Cruris – proximal	13	22	35	0.63
	Total Young Adult	*49*	*115*	*164*	*0.70*
Old Adult	Ulna – distal	22	15	37	0.41
	Metatarsal 1 – proximal	15	26	41	0.63
	Radius – distal	23	13	36	0.36
	Cruris – distal	24	15	39	0.38
	Total Old Adult	*84*	*69*	*153*	*0.45*

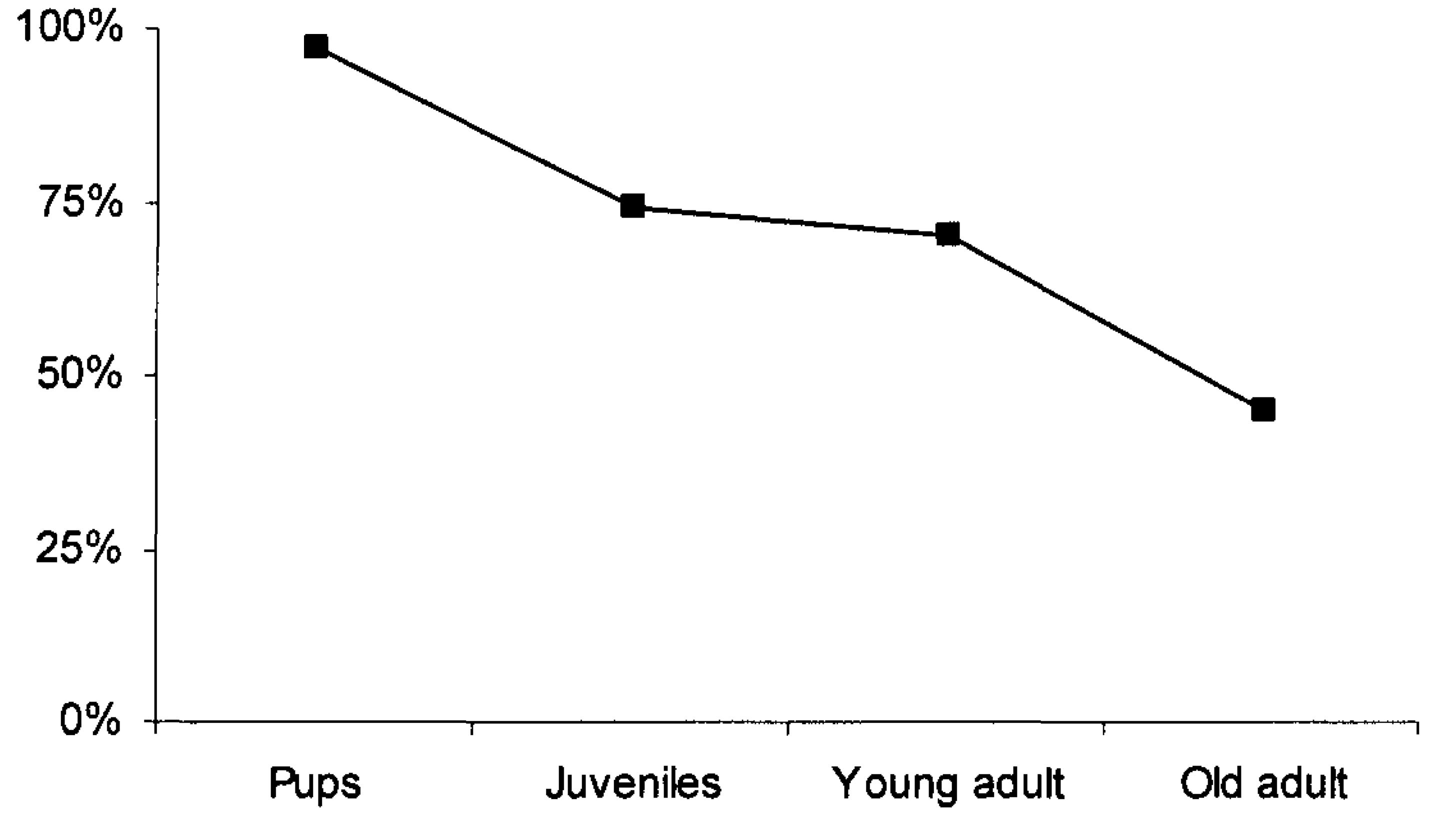

Figure 7: Survivorship of each age class in the Tiktalik sample

5.1.4 Femur

The fusion schedule of the femur makes it one of the best elements for determining the age structure of a skeletal seal population (Storå 2002). Unlike most other elements, femora can be divided into three groups that correspond to life stages. Unfused diaphyses only occur in pups and juveniles. The fusion of the proximal epiphysis occurs during the juvenile life stage, and fusion of the distal epiphysis marks the transition into the young adult life stage. Therefore, all femora can be assigned to one of three groups: pups and juveniles, juveniles, or adults. For the purposes of this study, foetal femurs were separated from pups and juveniles based on their extremely small size and porous surface texture.

Pup femora cannot be distinguished from juvenile because fusion of the proximal epiphysis occurs part way through the juvenile life stage. They can be separated, however, using comparative metric studies. Figure 8 displays measurements of smallest breadth of diaphysis versus greatest depth of diaphysis for all the Ringed seal femora in the Tiktalik assemblage, broken into the three age groups described above. The unknown age group consists of two femora mid-shaft fragments where epiphyseal fusion could not be established. A range of measurements from a modern population of Ringed seals is used as comparative data (Storå 2002). Almost all the femurs within the pup-juvenile group fall within the range of modern juveniles. Only one femur in the pup-juvenile group is within the size range of modern pups, and the two femora in the unknown age group also fall within this range.

The combined result of the femur epiphyseal and metric data provides a more complete picture of the Ringed seal demographic profile in the Tiktalik sample. The majority of the seals are adult (MNE = 31) and juveniles are the next most numerous group (MNE = approximately 14). Pups are represented by as few as three elements.

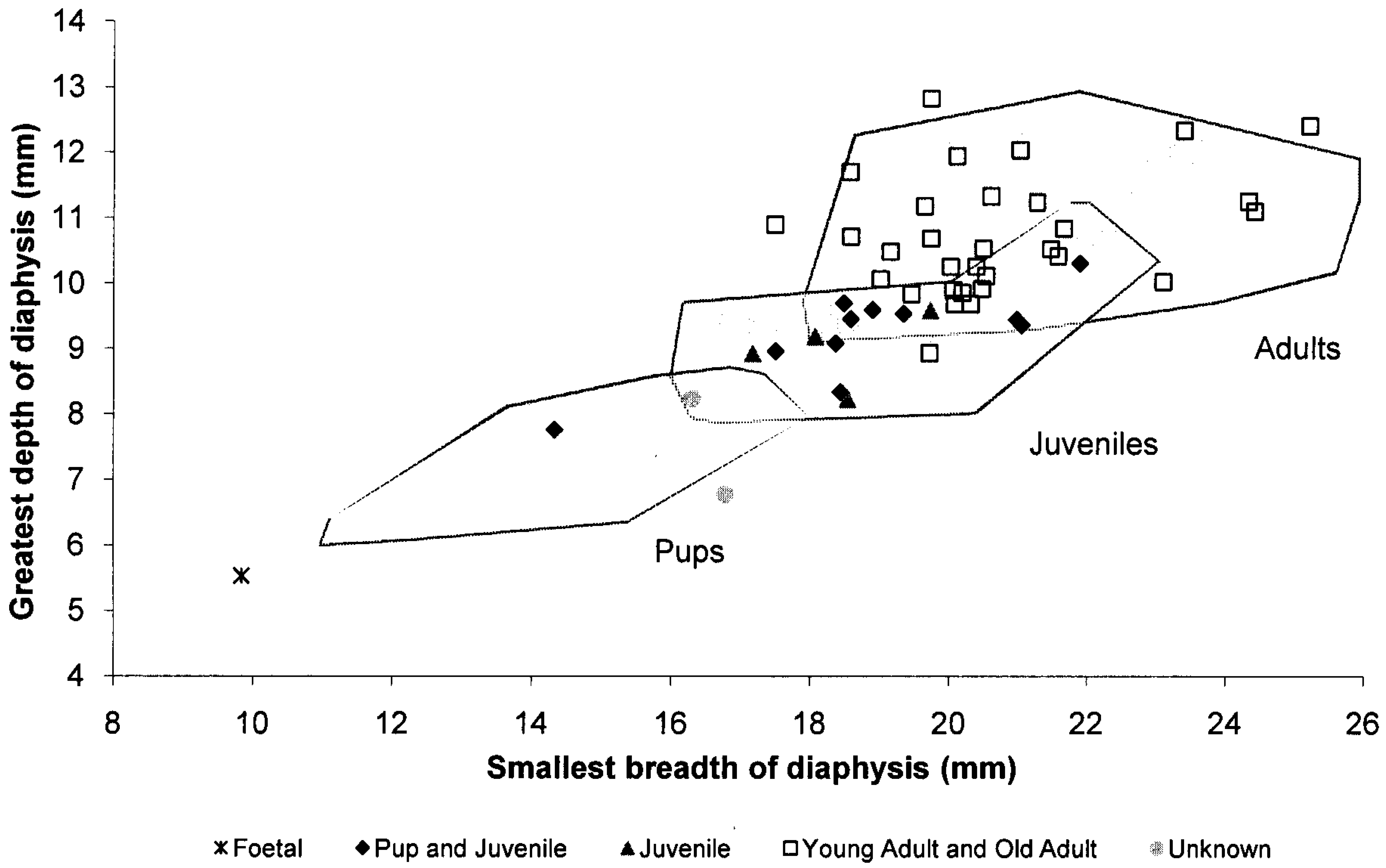

Figure 8: Smallest breadth of diaphysis versus greatest depth of diaphysis for Ringed seal femora in the Tiktalik sample (Envelopes represent the range of measurements for each age group from Storå 2002)

These results confirm what was demonstrated with the survivorship curve: that the Tiktalik sample is dominated by adult seals with only a few pups.

5.1.5 Humerus

As with femora, the seal humerus can be assigned to one of three groups based on epiphyseal fusion. Unfused diaphyses occur in both pups and juvenile seals. The fusion of the proximal epiphysis occurs midway through the juvenile life stage, while fusion of the distal epiphysis marks the transition into the adult life stage. Therefore, like femora, humeri can be assigned to one of three groups: pups and juveniles, juveniles, or adults. Foetal humeri were identified based on the same characteristics as femora. In one instance, a humerus was missing the distal epiphysis and therefore could not be assigned to a more specific group than juvenile-old adult.

Unfortunately, humeral measurements from a modern Ringed seal population have not been published, so it is difficult to determine which of the pup-juvenile age class humeri belong to each group. Hodgetts (2001), however, has published data on an archaeological sample of Ringed seal humeri from Arctic Norway. She has interpreted the Norwegian data as representing a spring and summer seasonal hunt with a large percentage of pups. These data are plotted alongside the Tiktalik assemblage data in Figure 9. Three of the humeri in the Tiktalik assemblage form a tight cluster within the range of pup data in the Norwegian assemblage, and are assumed to be the only pups

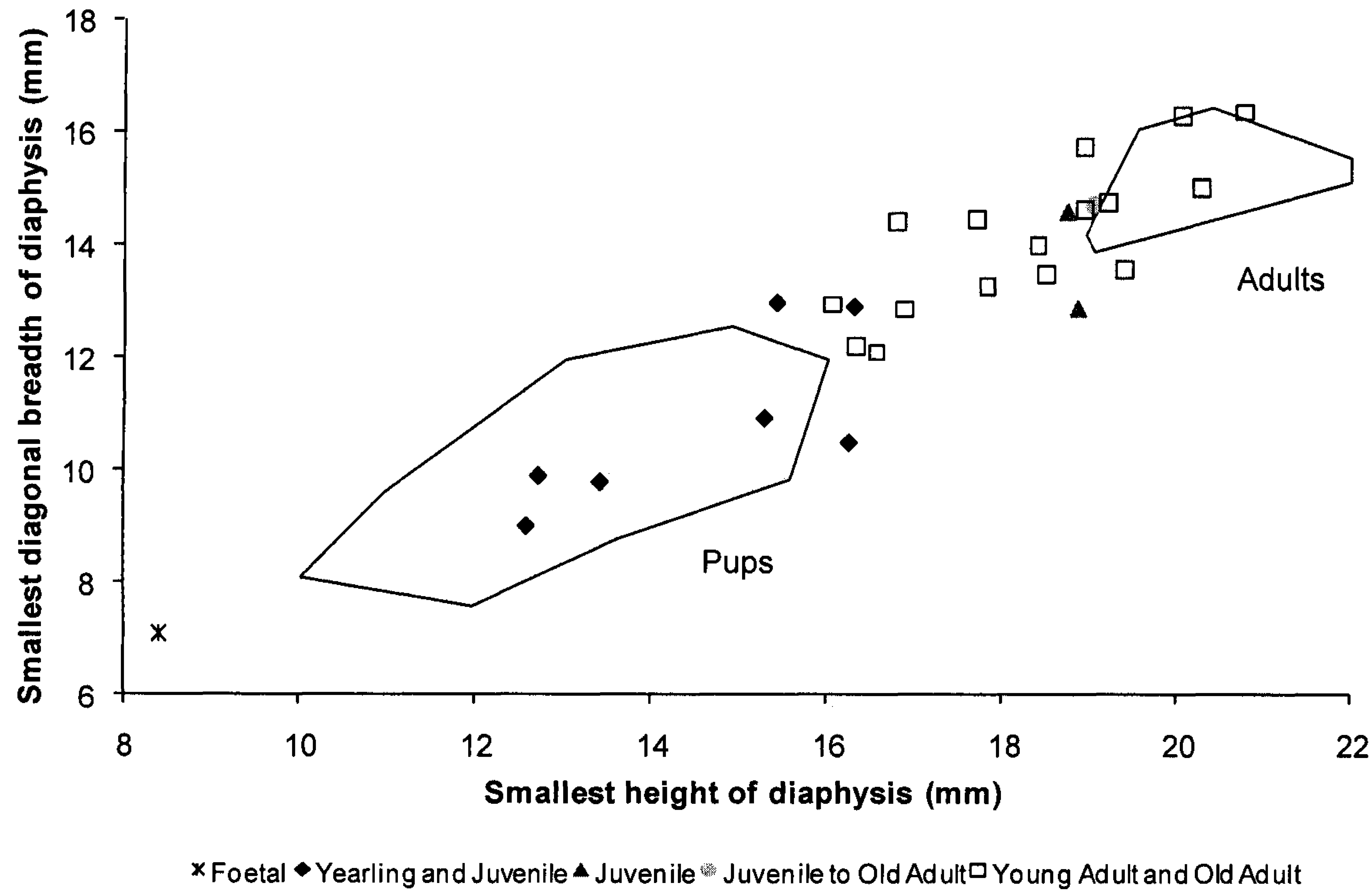

Figure 9: Smallest height of diaphysis versus diagonal breadth of diaphysis for Ringed seal humeri in the Tiktalik sample (Envelopes represent the range of measurements for each age group from Hodgetts 2001)

present in the Tiktalik assemblage, with the remainder of the pup-juvenile class specimens falling within the expected range of juveniles.

The Ringed seal humeri from the Tiktalik sample support the information obtained from the survivorship curve and femur data. Humeri in the Tiktalik sample are similarly dominated by adult elements (MNE = 16). As many as seven juvenile humeri may be present. Only three humeri appear to be from Ringed seals in their first year of life.

5.1.6 Discussion

The three methods used to determine the age-at-death profile of the Ringed seals at Tiktalik produced similar results (Figure 10); the sample is dominated by adult seals with very few pups. The survivorship curve suggests that at least 70% of the sample comes from adult seals, while 65% of the femora are adult and 62% of the humeri are adult. All three methods show that pups were represented by relatively few individuals. Only 3% of all epiphyses came from pups, while 6% of femora and 11% of humeri were

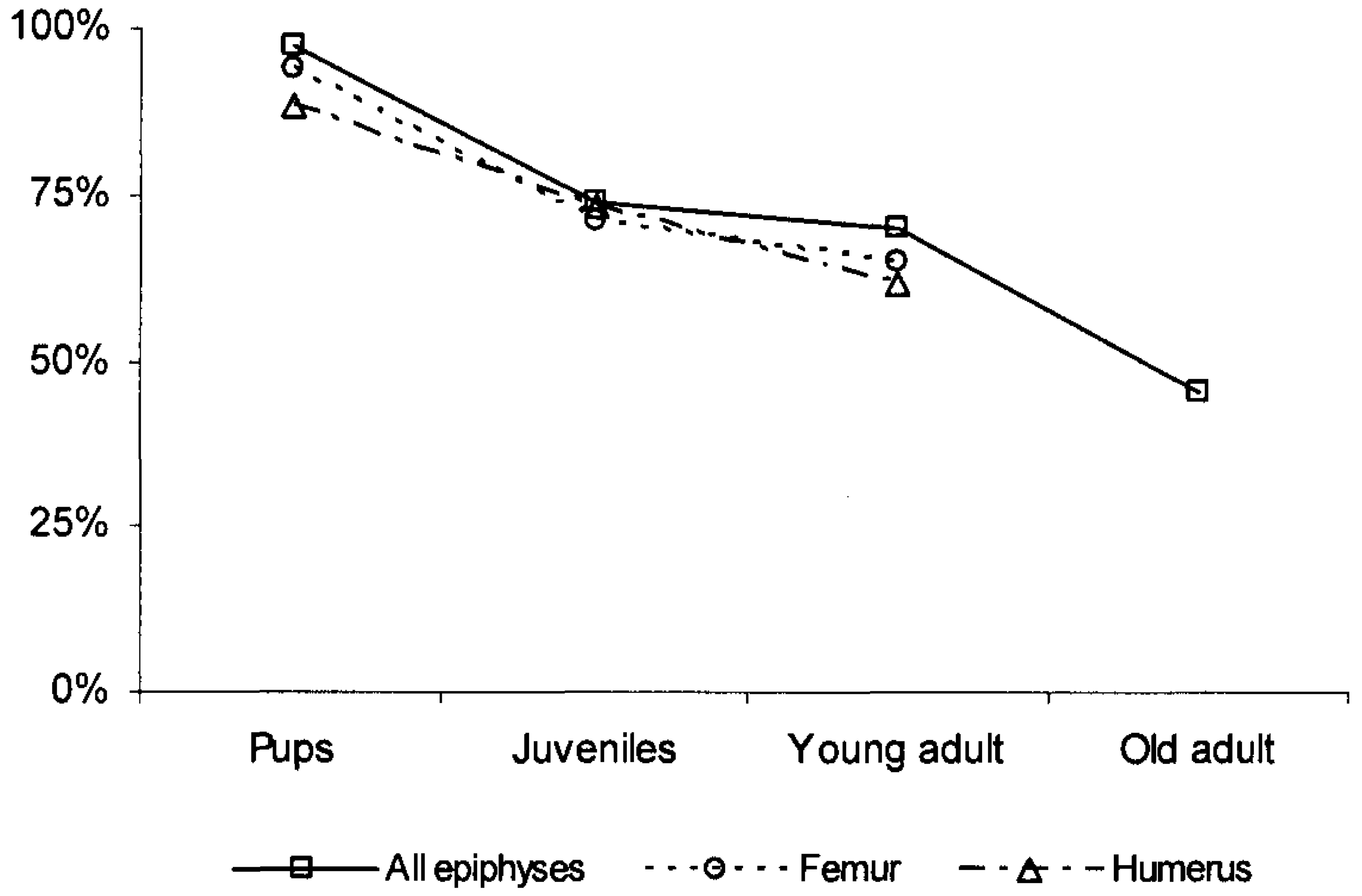

Figure 10: Comparison of the three methods used to determine the Age-at-death profile of Ringed seals in the Tiktalik sample.

likely pups. The proportion of juveniles in the sample falls between pups and adults, with 29% of femora and 27% of humeri representing juvenile seals. The epiphyseal data from all elements combined cannot be used to directly assess the contribution of either juvenile or young adult seals, since open and closed epiphyses in these age groups can overlap others. For example, open epiphyses in age group 2 might come from either pups or juvenile seals, while fused epiphyses might come from young adults or old adults. An estimate of the contribution of juveniles to the assemblage based on the combined epiphyseal data was obtained by subtracting the frequency of open epiphyses of age group 1 from the frequency of open epiphyses of age group 2. This results in an estimated value of 23%, which is similar to the frequency of juveniles based on femora and humeri.

An age-at-death profile dominated by adults is best explained by the age segregation of Ringed seals during the cold season and the use of breathing-hole hunting. Figure 11 presents the age structure of Ringed seal humeri and femora alongside the age

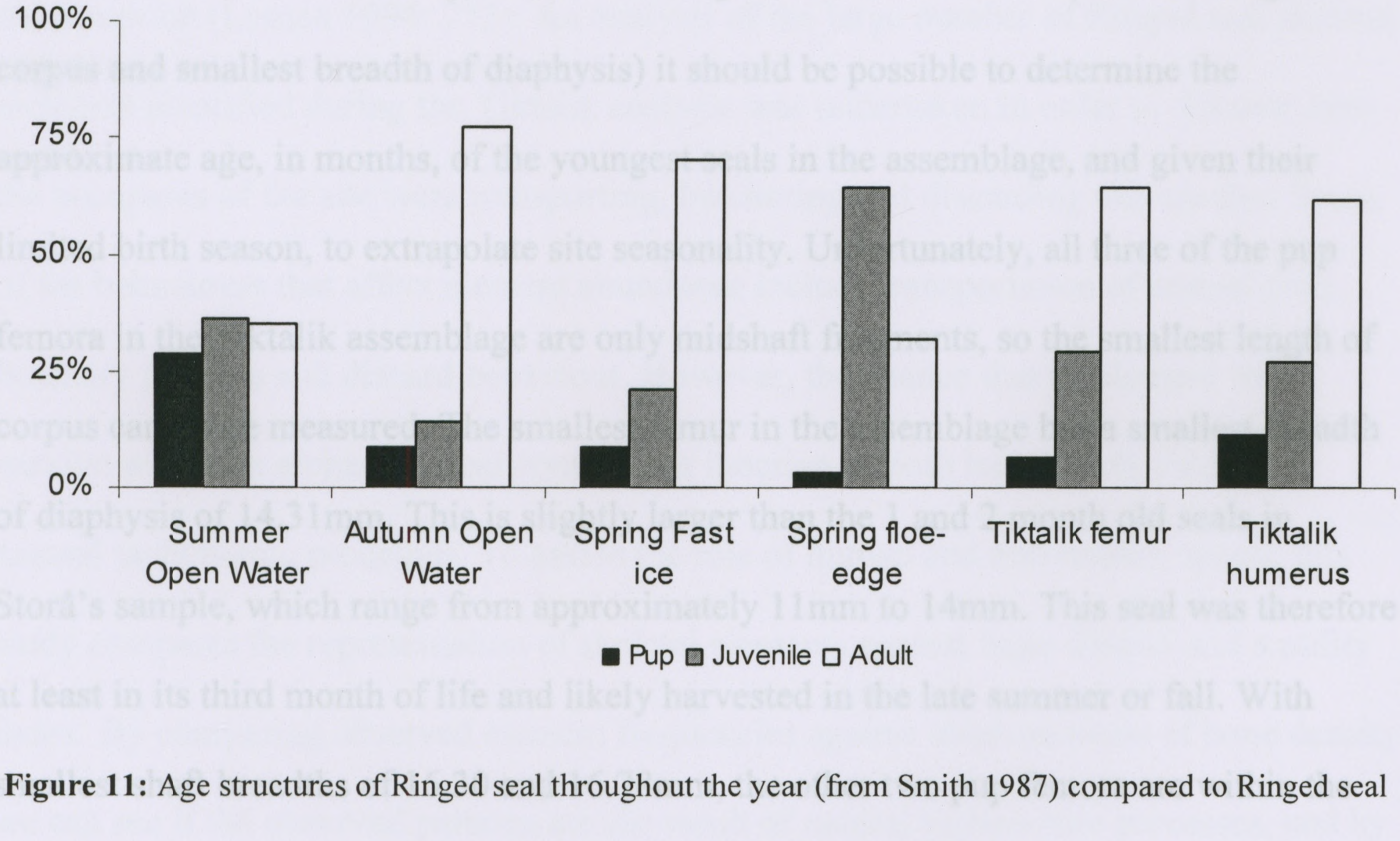

Figure 11: Age structures of Ringed seal throughout the year (from Smith 1987) compared to Ringed seal age structure in the Tiktalik sample

structures of modern populations discussed above. The Tiktalik age-at-death profile is most similar to both the open water autumn population and the spring fast-ice populations. These two populations bracket the winter season. The Tiktalik Ringed seal assemblage was therefore likely derived from a population of Ringed seals hunted between autumn and spring, either in open water during the autumn or on the fast ice in winter and/or early spring.

Other features of the Tiktalik assemblage suggest that sealing was primarily undertaken on the fast ice using breathing-hole sealing. The one foetal seal mandible identified had a canine and several post-canines which were not yet erupted. Canines first appear in foetal seals in December and erupt soon after birth (Stewart et al. 1996). This indicates that at least one pregnant female was procured late in the winter, likely between early January and early March. Newborn seals, on the other hand, are conspicuously absent from the Tiktalik sample. Storå (2002) has published data on Ringed seal femora measurements from the first year of life. Using these measurements (smallest length of corpus and smallest breadth of diaphysis) it should be possible to determine the approximate age, in months, of the youngest seals in the assemblage, and given their limited birth season, to extrapolate site seasonality. Unfortunately, all three of the pup femora in the Tiktalik assemblage are only midshaft fragments, so the smallest length of corpus cannot be measured. The smallest femur in the assemblage has a smallest breadth of diaphysis of 14.31mm. This is slightly larger than the 1 and 2 month old seals in Storå's sample, which range from approximately 11mm to 14mm. This seal was therefore at least in its third month of life and likely harvested in the late summer or fall. With smallest shaft breadths of 16.30 and 16.78mm, the other two pup femora are within the range of pups that died in the fall or winter in the modern sample. As noted earlier, many of the tools indicative of open-water hunting are absent from the Tiktalik artifact assemblage (Morrison 1998b). These include throwing boards and artifacts associated with seal skin floats. Their absence and the presence of sealing harpoons further supports breathing hole sealing as the main hunting strategy at the site. Nevertheless, these data do not rule out the possibility that some or all of the Ringed seals in the Tiktalik assemblage might have been procured in the late fall open water season and stored for winter consumption. The skeletal element abundance of Ringed seals was examined in detail in order to address the issue of stored meat, and in particular dried meat, in the Tiktalik assemblage.

5.2 Ringed seal skeletal element abundance

The relative frequencies of skeletal elements preserved in archaeological assemblages can reflect patterns of human behaviour related to animal transport and consumption (Lyman 1994: 223). An analysis of the large number of Ringed seal skeletal elements identified during the Tiktalik analysis was undertaken in order to discover how the occupants of the site were transporting, butchering and discarding this species. Some of the behaviours that affect element abundance include transportation of animal parts, butchery patterns and discard behaviour. However, the chance that an element will survive within an archaeological context is a function of both human behaviour and natural taphonomic processes. To assess the role of human and non-human agents, this study compares the representation of skeletal elements against bone density and a utility index. By comparing observed element frequencies against measurements of bone density we can see if the observed patterns are the result of natural taphonomic processes, and by comparing element frequencies against measurements of the usefulness of animal parts we can see if transport considerations influenced past human decision making. Interpretation can be complicated by the fact that Ringed seal bone density correlates with utility (Diab 1998), but the results presented here demonstrate that this correlation has little bearing on the interpretation of the Tiktalik assemblage.

Ethnographic observations of Inuit suggest that most Ringed seals are transported back to households in their entirety (Diab 1998). This is a product of their relatively small size and the ease with which they can be transported on a dogsled, dragged by a hunter across the ice or towed behind a kayak. In the winter, the storage of Ringed seals is facilitated by cold temperatures, as entire carcases can simply be left outside to freeze until needed. If entire seal carcases are brought back to residential sites, we would expect Thule Inuit faunal assemblages to be composed of skeletal elements in similar frequencies as they are found in the body, if no other processes are selectively removing certain elements. However, Park (1999) has suggested that a significant portion of Thule Inuit winter diet might have been provided by dried seal meat procured during the warm season. As he states, "seals caught in the spring or summer and destined for winter consumption would have required some form of processing prior to storage so as not to be totally unpalatable by the time they were to be eaten" (1999: 86). If the Thule Inuit were drying seal meat prior to consumption it would produce a significantly different faunal assemblage than that observed if they were consuming whole seals obtained during the winter. Park was unable to suggest what this faunal pattern might look like because no ethnographic descriptions of Inuit seal drying are available.

Clues to the way Thule Inuit might have processed seal meat for drying comes from descriptions of caribou drying by Inuit groups. Both Binford (1978) and Friesen (2001) noted that caribou bones with high marrow content can spoil the meat and so were removed prior to drying. Similarly, brain is difficult to dry and will spoil quickly. Meat that remained attached to bones was cut into thin strips and laid out to dry in the sun and wind. Seal bones have relatively little marrow and so this consideration likely has little effect on the selection of body portions for drying. However, two other factors affect whether or not a bone will be dried attached to the meat: the amount of meat attached to the bone and the ratio of bone weight to gross weight (Binford 1978). Elements with much more meat are more likely to be selected for drying than those with little meat. The ratio of bone weight to gross weight indicates the total surface area and the amount of meat available to be removed and dried off the bone. At the very least we can suggest that two seal anatomical units were unlikely to be dried: flippers and crania. Although flippers have a high bone weight to gross weight ratio, most of the non-bone mass is hide, fat, tendons and ligaments. Crania would also be an unlikely choice for drying because they contain the brain which would spoil quickly.

The age structure of Ringed seals in the Tiktalik assemblage suggests that hunting was primarily carried out during the winter. If this is the case we would expect to see relatively similar frequencies of all elements in the assemblage. On the other hand, if Tiktalik's occupants were primarily subsisting on dried seal meat, we could expect to see relatively few crania and flipper elements.

5.2.1 Quantification

As a first step in examining Ringed seal element frequencies in the Tiktalik assemblage abundance was calculated using three methods: Number of Identified Specimens (NISP), Minimum Number of Elements (MNE) and Minimum Animal Units (MAU). NISP is a count of the total number of fragments or complete specimens identified to a particular skeletal element. NISP overestimates abundance because elements can be counted more than once if they are fragmented. On the other hand, the MNE represents the smallest number of elements that could possibly occur in the assemblage. MNE was obtained by counting individual portions of each bone (zones). The zone with the highest occurrence is used as the MNE value for that element. Although fragmentation does not affect MNE in the same way it affects NISP, it is affected by the number of times each element occurs in the body. For example, if an MNE of six is calculated for ribs it might represent as few as one individual, while an MNE of six for crania must represent a minimum of six individuals because it only occurs once in each animal. In order to compensate for this difference, MAUs are derived for each skeletal element. The MAU is calculated by dividing the MNE by the number of times that element appears in the skeleton. Finally, a %MAU was calculated by dividing each element MAU by the largest MAU calculated (so the highest MAU becomes 100%). The %MAU normalizes MAU to facilitate inter-site comparisons, and is the calculation used to compare against the utility index and bone density. The abundance of Ringed seal elements in the Tiktalik assemblage are presented in Table 6.

Table 6: Ringed seal skeletal abundance

Animal Unit	Skeletal Element	NISP	MNE	MAU	% MAU
Head	Cranium (1)	117	14	14	38.89%
Head	Mandible (2)	56	47	23.5	65.28%
Vertebrae	Atlas (1)	34	33	33	91.67%
Vertebrae	Axis (1)	34	33	33	91.67%
Vertebrae	Cervical vertebra (7)	120	118	16.86	46.83%
Vertebrae	Thoracic vertebra (15)	368	354	23.6	65.56%
Vertebrae	Lumbar vertebra (5)	93	93	18.6	51.67%
Pelvic girdle	Caudal vertebra (13.5) *	110	110	8.15	22.63%
Pelvic girdle	Innominate (2)	74	47	23.5	65.28%
Pelvic girdle	Baculum (2)	14	10	10	27.78%
Pelvic girdle	Sacrum (2)	23	9	9	25.00%
Rib-cage	Rib (30)	894	411	13.7	38.06%
Rib-cage	Costal cartilage	430	-		
Rib-cage	Sternebra (9)	144	137	15.22	42.28%
Front limb	Scapula (2)	106	55	27.5	76.39%
Front limb	Humerus (2)	65	33	16.5	45.83%
Front limb	Radius (2)	81	50	25	69.44%
Front limb	Ulna (2)	67	51	25.5	70.83%
Front flipper	1st metacarpal (2)	50	50	25	69.44%
Front flipper	2nd metacarpal (2)	46	46	23	63.89%
Front flipper	3rd metacarpal (2)	43	43	21.5	59.72%
Front flipper	4th metacarpal (2)	47	49	24.5	68.06%
Front flipper	5th metacarpal (2)	26	26	13	36.11%
Front flipper	Scapholunar (2)	38	38	19	52.78%
Front flipper	Capitate (2)	18	18	9	25.00%
Front flipper	Hamate (2)	19	19	9.5	26.39%
Front flipper	Pisiform (2)	8	8	4	11.11%
Front flipper	Trapezium (2)	30	30	15	41.67%
Front flipper	Trapezoid (2)	12	12	6	16.67%
Front flipper	Triquetral (2)	10	10	5	13.89%
Front flipper	Front flipper distal phalanx (10)	116	116	11.6	32.22%
Rear limb	Femur (2)	81	55	27.5	76.39%
Rear limb	Patella (2)	29	29	14.5	40.28%
Rear limb	Cruris (2) **	27	-		
Rear limb	Tibia (2)	41	35	17.5	48.61%
Rear limb	Fibula (2)	59	37	18.5	51.39%
Rear flipper	1st metatarsal (2)	64	45	22.5	62.50%
Rear flipper	2nd metatarsal (2)	72	72	36	100.00%
Rear flipper	3rd metatarsal (2)	73	72	36	100.00%
Rear flipper	4th metatarsal (2)	56	56	28	77.78%
Rear flipper	5th metatarsal (2)	69	69	34.5	95.83%
Rear flipper	Calcaneus (2)	69	67	33.5	93.06%
Rear flipper	Astragalus (2)	54	53	26.5	73.61%
Rear flipper	Cuboid (2)	58	58	29	80.56%
Rear flipper	Navicular (2)	53	53	26.5	73.61%
Rear flipper	Internal Cuneiform (2)	46	46	23	63.89%
Rear flipper	Middle Cuneiform (2)	30	30	15	41.67%

Animal Unit	Skeletal Element	NISP	MNE	MAU	% MAU
Rear flipper	External Cuneiform (2)	40	40	20	55.56%
Rear flipper	Hind flipper distal phalanx (10)	138	138	13.8	38.33%
	Phalanx	951	-		
	Other	322	-		
	Total	5625			

The number in brackets is the number of times each element appears in the Ringed seal body. * caudal vertebra in the Ringed seal vary from 12-15 so the average number was used to calculate MNE and MAU; ** complete and fragmented cruris bones were used to calculate MNE and MAU values for the tibia and fibula

As carcasses are generally divided into larger units than single bones, %MAU values were also determined for ethnographically observed butchering units (Nelson 1969). These units are: the head, the vertebrae, the pelvic girdle, the rib-cage, the front limb, the front flipper, the rear limb and the rear flipper. Each butchering unit contains a number of individual skeletal elements. For example the head is represented by the cranium and mandibles. The %MAU value for each butchering unit was determined by the largest %MAU of any element in the unit. Figure 12 presents the relative abundance

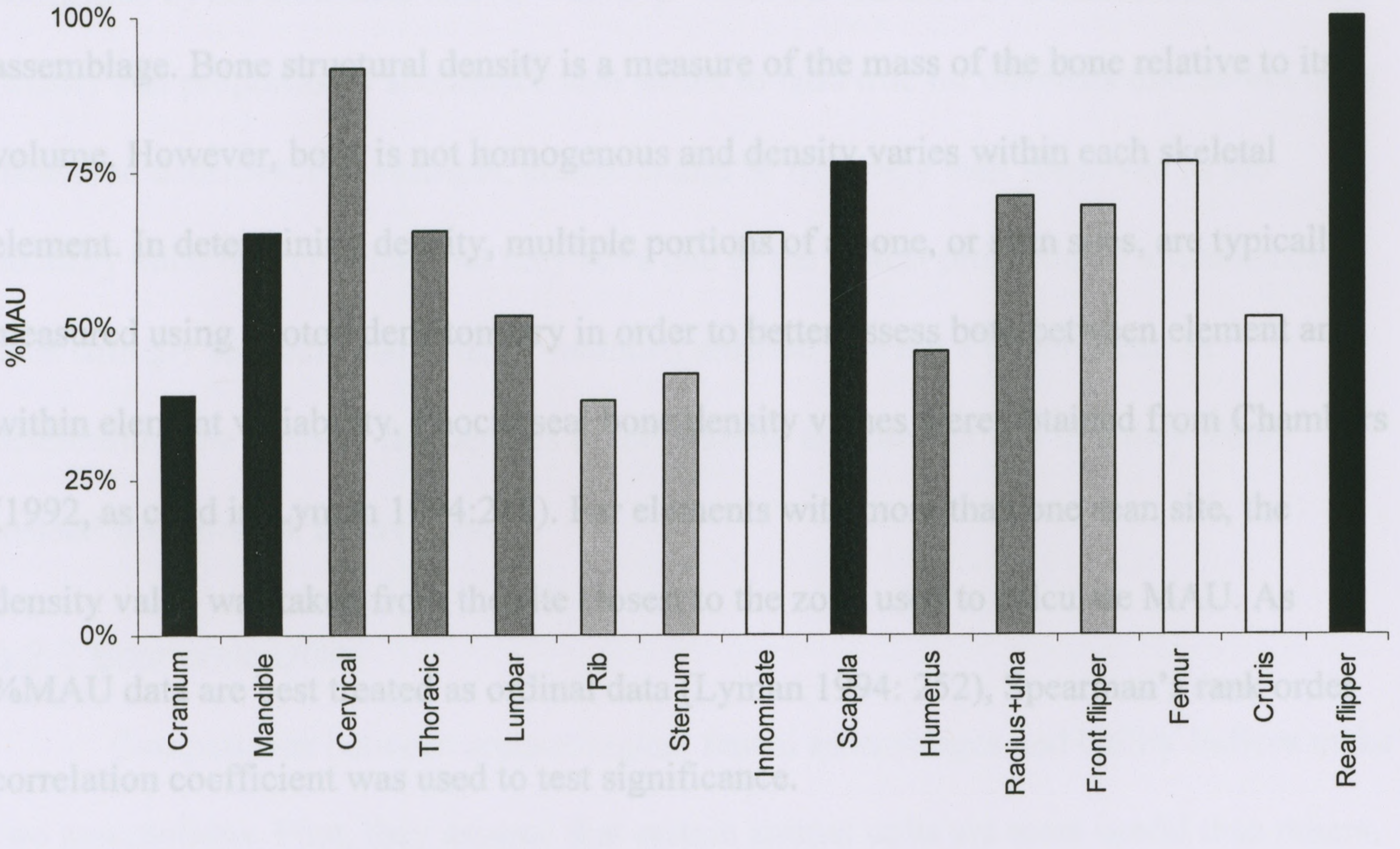

Figure 12: Relative abundances of Ringed seal skeletal units

of major Ringed seal skeletal elements, categorized by butchering units. All skeletal and butchering units are present, but frequencies vary. Some of the difference between elements are likely a reflection of the ease with which fragments of elements can be identified. For example, rib fragments are difficult to assign to species and this may explain their relatively low %MAU. The relative differences among skeletal elements are explored in more detail using comparisons with measurements of bone density and a Ringed seal Meat Utility Index.

5.2.2 Density Mediated Attrition

The ability for a skeletal element to survive various natural taphonomic forces is, in part, a function of its density (Lyman 1994: 235). Simply put, less dense elements are more likely to be destroyed than more dense elements. We would therefore expect a significant correlation between frequencies of skeletal elements and density if density-mediated attrition was a strong force in structuring the element frequencies in the assemblage. Bone structural density is a measure of the mass of the bone relative to its volume. However, bone is not homogenous and density varies within each skeletal element. In determining density, multiple portions of a bone, or scan sites, are typically measured using photon densitometry in order to better assess both between element and within element variability. Phocid seal bone density values were obtained from Chambers (1992, as cited in Lyman 1994:248). For elements with more than one scan site, the density value was taken from the site closest to the zone used to calculate MAU. As %MAU data are best treated as ordinal data (Lyman 1994: 252), Spearman's rank order correlation coefficient was used to test significance.

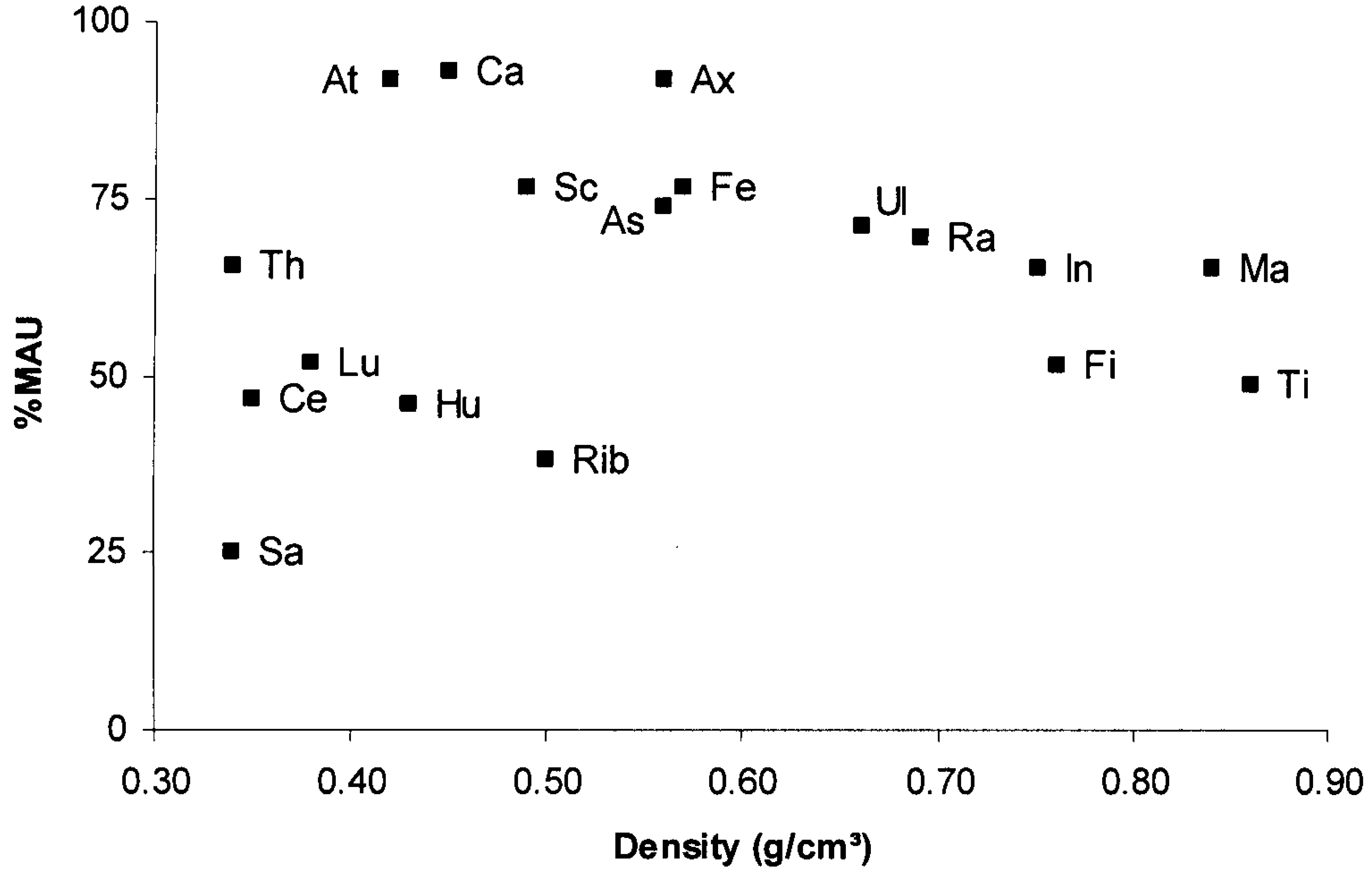

Figure 13: Ringed seal bone density versus %MAU

Figure 13 displays a plot of density values for each element against %MAU in the Tiktalik assemblage. No correlation is suggested by a visual examination, and this is confirmed by the statistical test ($r_s = 0.08$, $p = 0.713$). The lack of a relationship between density and proportional abundance also seems to hold true for elements that do not have measured densities. For example, crania should be relatively well preserved as the auditory bulla is very dense, but they have one of the lowest proportional abundances. This strongly suggests that density mediated attrition was not a major factor in determining the element frequencies in the Tiktalik assemblage and that they result instead from human behaviours.

5.2.3 Economic Utility

Comparisons between archaeological faunal assemblages and Utility Indices make two assumptions. First, they assume that certain animal units are more useful than others, and that economic usefulness of animal parts can be measured and ranked. Second, they assume that economic considerations affect how hunter-gatherers butcher and transport animal carcases. A utility index is created by quantifying how useful a given element is for a certain purpose. Typically, utility indices attempt to measure the food value in the flesh attached to skeletal units. These are created by weighing the meat, fat and grease associated with each skeletal element in an animal. Elements with a great deal of flesh associated with them are said to be of high food utility. A Meat Utility Index (MUI) has been developed both for both phocid seals (Lyman, Savelle, and Whitridge 1992) and Ringed seals (Diab 1998). This study will compare the proportional representation of elements in the Tiktalik assemblage with the specific Ringed seal MUI published by Diab (1998). As with density, the data are treated as ordinal and are tested for statistical significance with Spearman's rho.

Figure 14 displays a plot of %MUI versus %MAU for Ringed seal skeletal elements in the Tiktalik assemblage. There is no apparent correlation between the two variables, a result confirmed by the statistical test ($r_s = -0.269$, $p = 0.403$). Ribs, which have the highest MUI rank, are relatively rare in the Tiktalik assemblage, but as noted above this might be a result of the difficulty in identifying rib fragments. Often, when hunter-gatherers butcher an animal they do so at the kill site and only the highest utility elements are transported back to the residential site. As noted above, Inuit typically bring Ringed seals back to residential sites as entire carcasses. The lack of a correlation between %MUI and %MAU indicates that the observed skeletal element frequencies are not the result of differential transport costs, a trend also noted by Lyman and colleagues

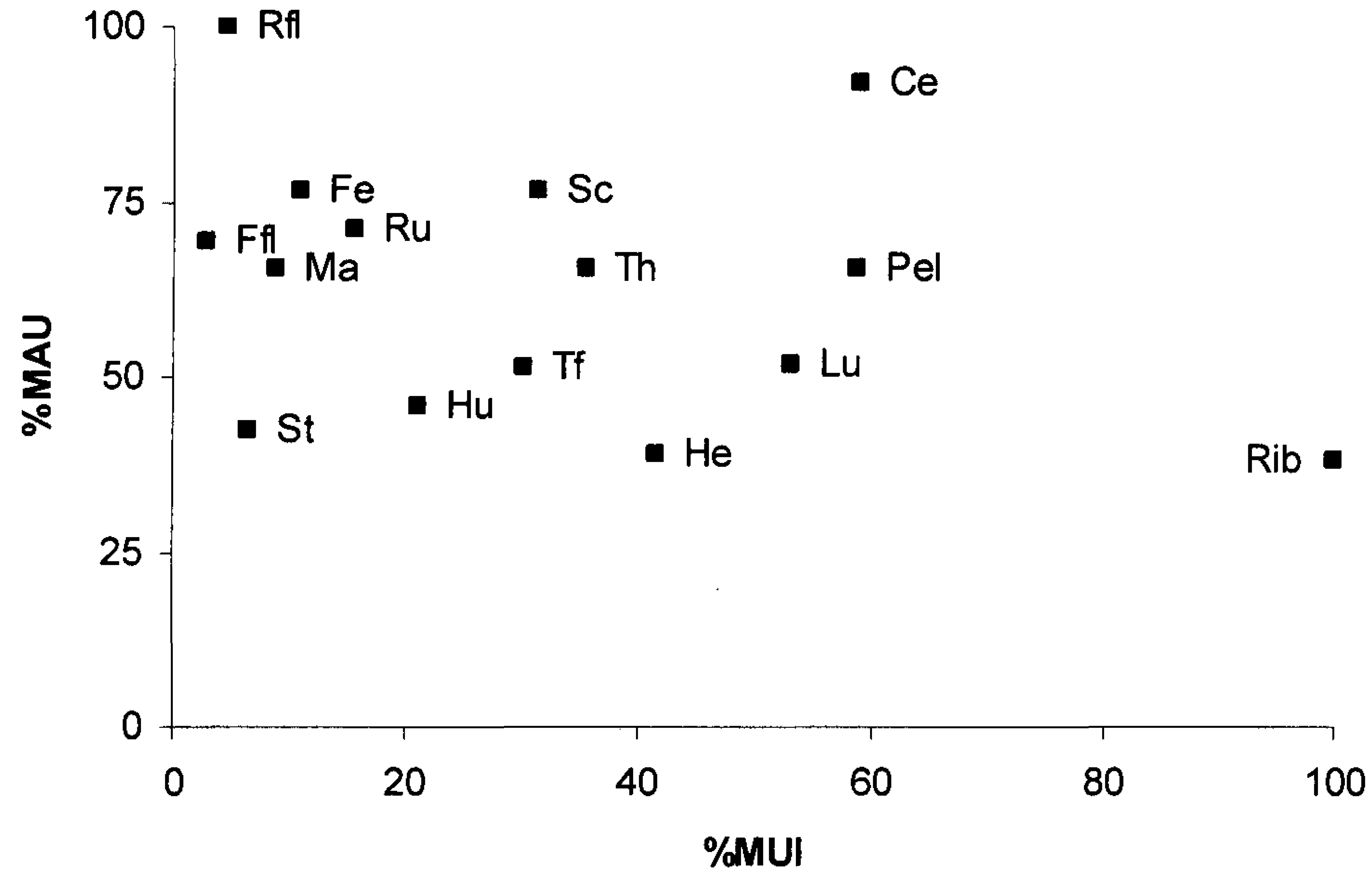

Figure 14: %MUI of Ringed seal skeletal elements versus %MAU (1992) and Diab (1998) for Inuit and Thule Inuit Ringed seal assemblages from the Central Canadian Arctic and Western Greenland.

5.2.4 Discussion

Overall, Ringed seal skeletal elements in the Tiktalik assemblage are present in relatively equal frequencies. Neither density mediated attrition nor human choices based on meat utility were demonstrated to be significant factors in the observed element frequencies. This result indicates that entire seals were transported back to the site where they were subsequently butchered. Those elements that are relatively rare are typically small (e.g. carpals) or difficult to positively identify to species (e.g. rib fragments). It was suggested that low frequencies of crania and flipper elements might indicate the consumption of dried seal meat. Although crania are relatively infrequent, front flipper elements are common and rear flipper elements are abundant. Therefore, it appears that the Thule Inuit who occupied Tiktalik were eating freshly caught seals, or portions of recently frozen carcasses, rather than dried seal meat. The slight differences among skeletal elements are further explored by comparing the results at Tiktalik to other Thule Inuit faunal assemblages. Few published studies are available for comparison, but those that are reported show both differences and similarities with the Tiktalik assemblage.

The observed Ringed seal element frequencies at Tiktalik are different than those from many other Inuit and Thule Inuit sites. The Tiktalik element frequencies are presented alongside frequencies from Sermermiut, a historic Inuit hunting camp in Western Greenland (Mobjerg 1983) in Figure 15. The profiles from Sermermuit represent a pattern similar to that observed in many Thule Inuit faunal assemblages throughout the North American Arctic (Walakpa, North Alaska (Stanford 1976); Porden Point (RbJr-1 and RbJr-4), Devon Island (Park 1989); Hazard Inlet (PaJs-3, PaJs-4 and PaJs-13), Sommerset Island (Iorio 2005); Diana Bay (JfEl-10), Nunavik (Lofthouse 2003); Peale Point (KkDo-1), Baffin Island (Stenton 1983)). Despite the fact that these sites come from

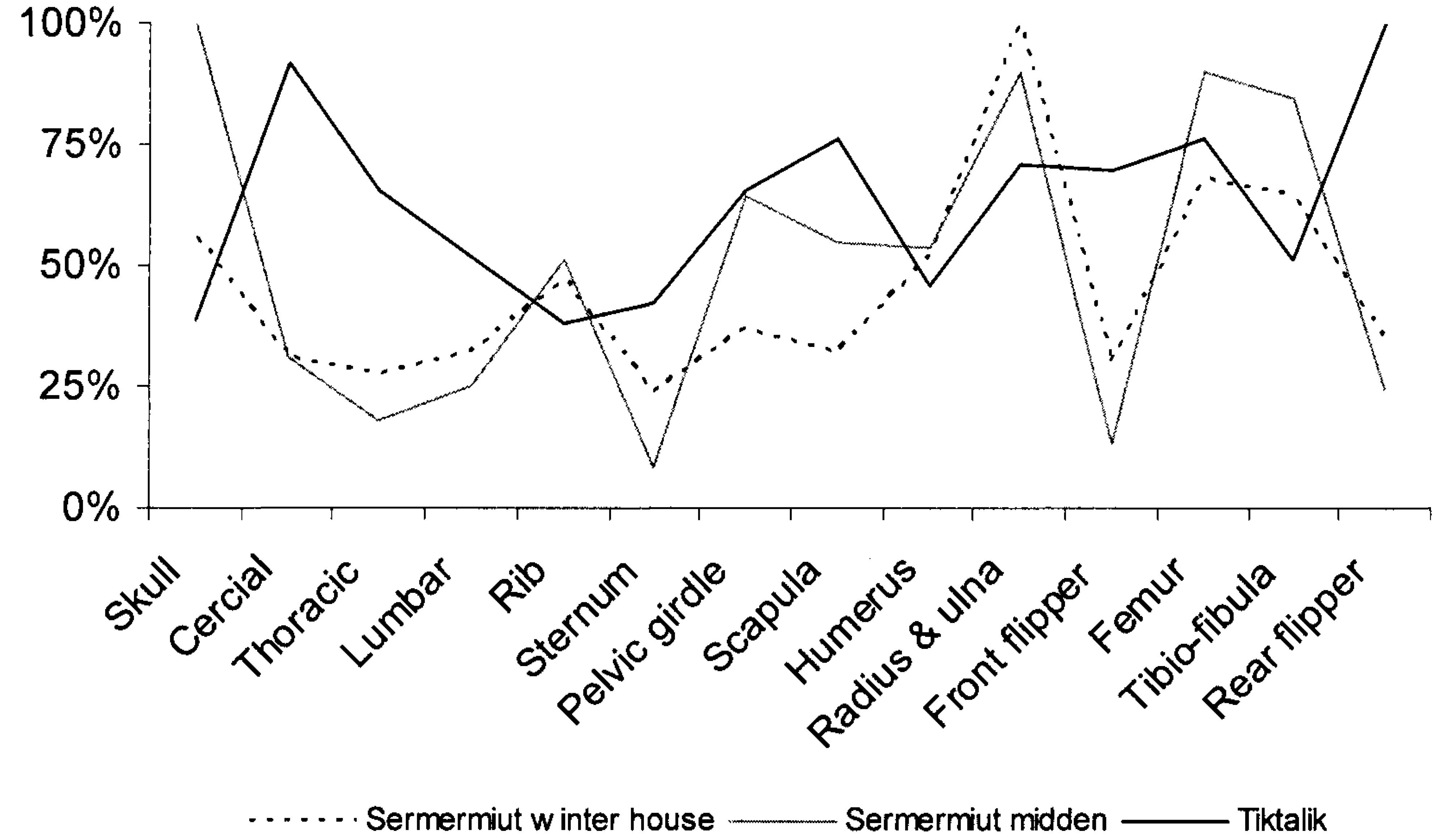

Figure 15: Ringed seal element frequencies from Tiktalik and two assemblages from Sermermuit

very distant areas and represent different seasons of occupation, they share similar Ringed seal skeletal frequencies. Particularly notable are the relatively low proportions of vertebrae and flippers and the relatively high frequencies of limb bones and crania in comparison to the Tiktalik assemblage. The Sermermuit assemblage, like many others that share this skeletal element profile, shows a significant correlation between %MAU and bone density (Diab 1998). That density mediated attrition was a strong process at these sites but not at Tiktalik suggests that natural destructive processes are not uniform in all Arctic archaeological sites. Additionally, the relatively low frequencies of vertebrae and flipper elements suggest that particular processes were actively destroying these elements. The most obvious factor present at these sites, but perhaps largely absent at Tiktalik, is dogs. As mentioned earlier, no artifacts associated with dog sledding were found at Tiktalik, although dog skeletal elements were identified in the faunal assemblage. Only 14 of the 7,737 specimens in the sample exhibited carnivore damage. Because it is difficult to remove meat from them, vertebrae and flippers might be easy anatomical units to feed to dogs.

On the other hand, the Tiktalik assemblage is similar to the Ruin Island phase sites from the High Arctic (McCullough 1989). McCullough presents skeletal portion NISP frequencies for Ringed seals, and these are presented alongside the same measure at Tiktalik in Figure 16. The two assemblages show very similar profiles. Because these values are NISP, they do not reflect the actual relative frequencies of skeletal units in the assemblages and are heavily influenced by the number of times each element appears in the body. This explains why both post-cranial axial and flipper elements are represented in high frequencies. Nevertheless, the two sites do share relatively low frequencies of

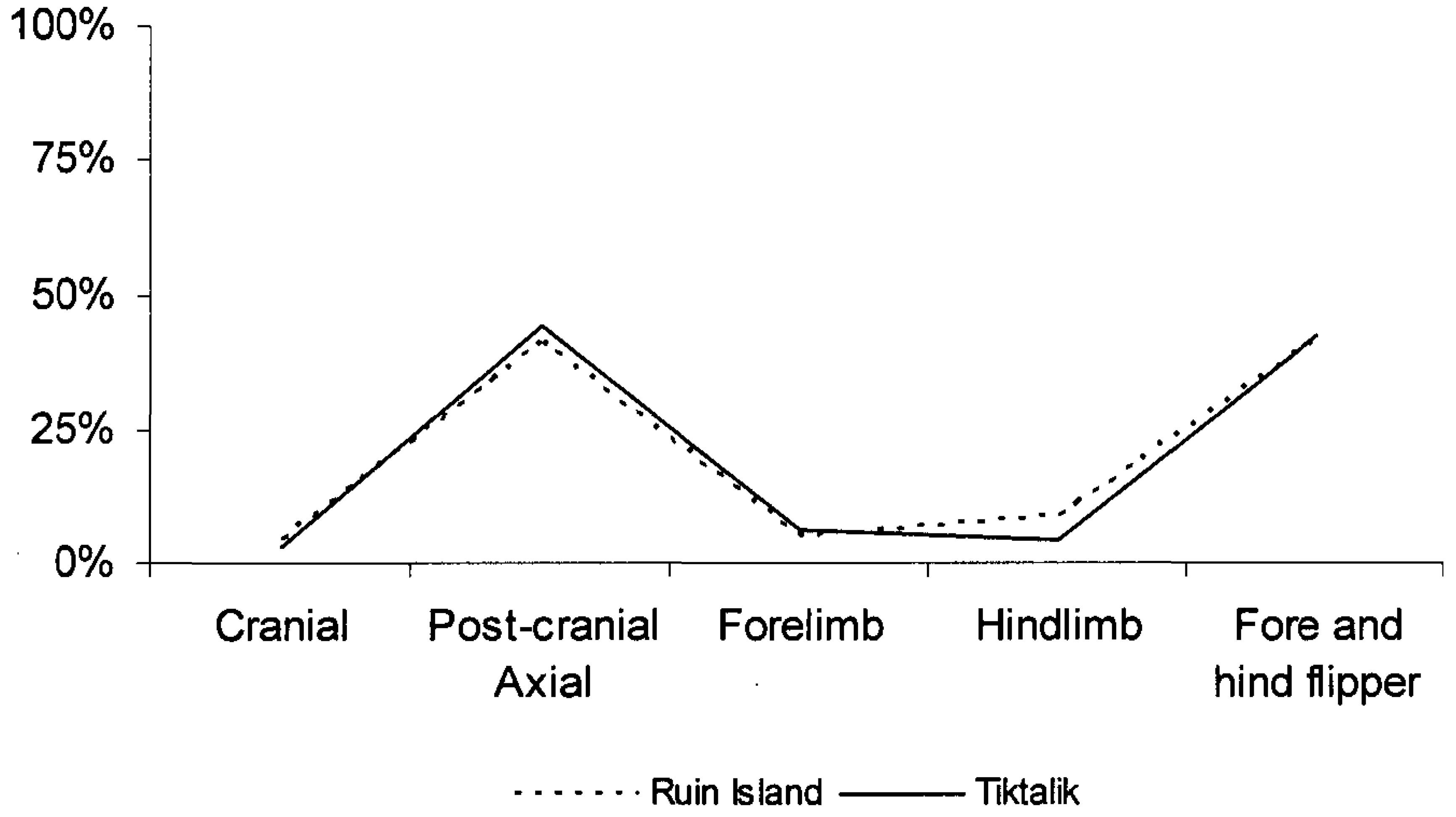

Figure 16: Ringed seal element NISP values for Ruin Island (McCullough 1989) and Tiktalik

cranial elements and high frequencies of flipper elements. As Diab's (1998) analysis demonstrated, in assemblages where density mediated attrition is a major factor crania are generally well represented. At this point, it remains unclear why crania are found in low frequencies at Tiktalik and Ruin Island, but it might be related to differential discard of seal heads (McCullough 1989). Rear flipper elements are more abundant than front flipper elements at both the Ruin Island phase sites and Tiktalik. McCullough (1989: 281) suggests that this might be the result of some front flippers remaining on sealskin floats, or due to a preference for hind flipper flesh noted in ethnographic studies of Inuit.

5.3 Summary

The age-at-death profile of Ringed seals in the Tiktalik assemblage indicates that breathing-hole sealing on fast ice during the winter and/or open-water sealing during the fall were undertaken by the site's occupants. Adult Ringed seals outnumber both juveniles and pups, which closely resembles observed age frequencies in a modern sample of seals within an inshore habitat during the late fall, winter and early spring. As the first pups are born in mid-March, their absence in the Tiktalik faunal sample suggests that the latest the site was occupied was late winter. In the initial analysis of the Tiktalik assemblage, Morrison (pers. comm.) noted a high frequency of foetal seal bone, but these were removed prior to this analysis. Foetal bone is therefore likely underrepresented in the analysed sample. A higher frequency of foetal bone would also indicate winter breathing-hole sealing rather than fall open-water sealing. The absence of open-water sealing gear in the artifact assemblage further suggests the site's occupants relied on breathing-hole sealing.

The results of the Ringed seal skeletal abundance analysis provide strong evidence that Ringed seals were brought back to Tiktalik as complete carcasses. Neither density mediated attrition nor human choices based on the food utility of animal units were strong factors in structuring the Ringed seal assemblage. Comparisons between Tiktalik and other Thule and Inuit assemblages suggest that density mediated attrition is not a uniform process in all Arctic archaeological sites. Some of the patterns in skeletal element abundance observed in the Tiktalik assemblage are also present in the Ruin Island phase assemblages in High Arctic Canada. This suggests that similar choices were being made with regards to the use and discard of Ringed seals at these two early Thule Inuit occupations.

6. Tiktalik in Context

This thesis conceptualizes colonization as a process. In this chapter, Tiktalik will be compared with other Thule sites in the region in an attempt to better understand this process. The six sites used in this comparison are all located on the coast of Amundsen Gulf and were occupied relatively early in the Thule period. Stylistic and other temporally sensitive data facilitate the comparison of sites occupied during the earliest pioneering phase and those occupied slightly later during a settled-in phase. The results of this comparison suggest that the Thule Inuit colonization of the Canadian Arctic and Greenland was not a simple event.

6.1 Amundsen Gulf

Amundsen Gulf is the most easterly region within the Western Arctic (Figure 17). It is formed by the southern coast of Banks Island, the southwestern coast of Victoria Island, and the northern coast of the mainland roughly from Cape Bathurst to Dolphin and Union Strait. To the west, Amundsen Gulf opens into the Beaufort Sea, where the Mackenzie Delta dominates the coast and creates a unique environment rich in flora and fauna (Morrison 1994; Betts 2005). Immediately to the east of Amundsen Gulf, the straits and channels of the Central Canadian Arctic spend most of the year choked by pack-ice. As with Amundsen Gulf, much of the Central Arctic offers a marginal environment for human occupation, at least in comparison to the biologically rich and diverse environments of the Mackenzie Delta region and Eastern Canadian Arctic (Morrison 2000).

For much of the past ninety years Arctic Archaeologists have tended to ignore the

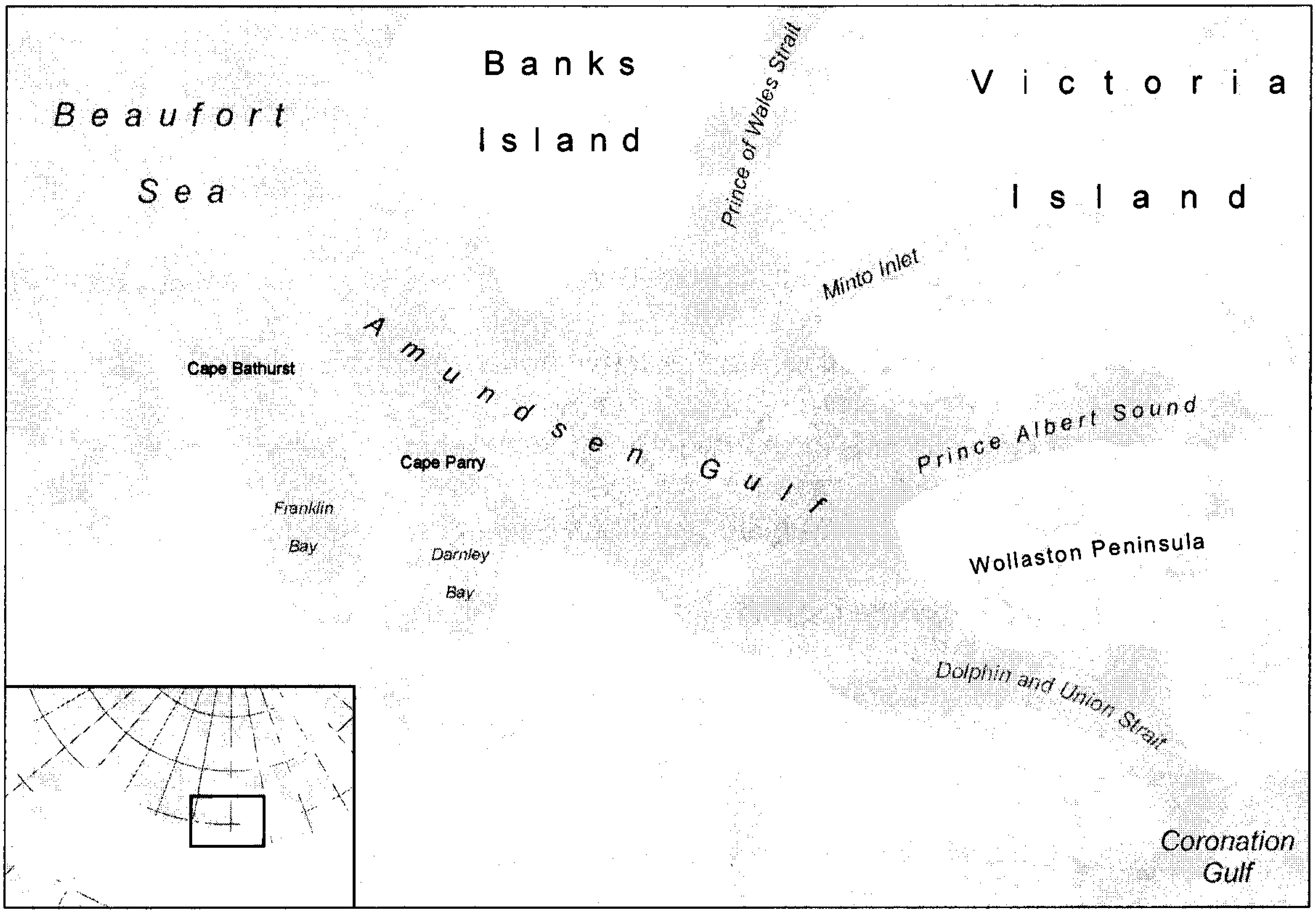

Figure 17: Amundsen Gulf

Western Canadian Arctic in favour of the denser and more diverse archaeological record of the Eastern Canadian Arctic (Morrison 2000). Recent research in the area has been a response to the exploration of Oil and Gas reserves in the Mackenzie Delta region (e.g. Cinq-Mars and Pilon 1991; Pilon 1994). Most excavations have focused on pre-contact Mackenzie Inuit and Historic Inuvialuit archaeological contexts, but a number of Thule culture archaeological sites have also been excavated and the entire cultural record of that region is fairly well understood (c.f. Betts 2008; Betts and Friesen 2004). Limited research has also been conducted in western Amundsen Gulf around Franklin Bay (Morrison 1990, 1997). As early as the 1960s, the region was recognized as being important for understanding both the Thule Inuit and early Paleoeskimo migrations into the Canadian Arctic (Taylor 1963). However, aside from some large-scale surveys, the archaeological record of eastern Amundsen Gulf is relatively little known. Unfortunately, much of the Amundsen Gulf region, especially the mainland, is undergoing subsidence, and many coastal archaeological sites have already been lost to the sea.

Stylistically, the Thule Inuit of Amundsen Gulf are aligned with the Early Western Thule tradition of coastal Alaska. Features of the Early Western Thule tradition include a heavy reliance on driftwood in house construction and as a raw material, extensive use of ceramics, and unique styles of artifacts. The precise chronology of Amundsen Gulf remains poorly understood, and the recent redating of the earliest Thule record has further clouded the picture. The initial Thule Inuit occupation occurred early on in the process of colonizing the Canadian Arctic, likely during the thirteenth century (Friesen and Arnold 2008). The earliest Thule Inuit sites found east of Alaska are widely assumed to be recognized by chronologically sensitive harpoon head types, namely Natchuk and Sicco. The earliest sites in Amundsen Gulf may represent, as Morrison has suggested, the remains left behind by people actively migrating to points further east, rather than longer term residents of the region. Within a few generations a local variant of Thule culture, the Clachan phase, appears to have been resident between Cape Bathurst and the Coronation Gulf (Morrison 1990).

The Late, or Modified, Thule Inuit use of Amundsen Gulf has not been well documented, likely because most archaeological research in the region has focused on finding the earliest Thule Inuit sites. The few whalebone houses reported in the region (e.g. Arnold 1994: 274) hint at occupations with eastern influences from later in the Thule period. However, compared with early Thule sites, later ones are rare, and never occur in large clusters as they do in the Eastern Canadian Arctic. This, in combination with the diverging stylistic and technological traditions between Eastern and Western Thule, has led to the suggestion that Amundsen Gulf was largely abandoned by the fifteenth or sixteenth century AD (Morrison 1991, 1990). Historically, no group is documented as being resident in eastern Amundsen Gulf, although the area was likely visited by Inuvialuit from the west and Copper Inuit from the east.

6.2 The Amundsen Gulf Thule Inuit Archaeological Record

In addition to Tiktalik, six other Thule Inuit sites on Amundsen Gulf have been excavated, and some description of the recovered fauna is available for each. As with Tiktalik, all six of these sites represent winter dwellings and were built along open coastlines (Figure 18). Three are on the mainland (Jackson, Vaughn and Pearce Point), one on southern Banks Island (Nelson River), and two on southwestern Victoria Island

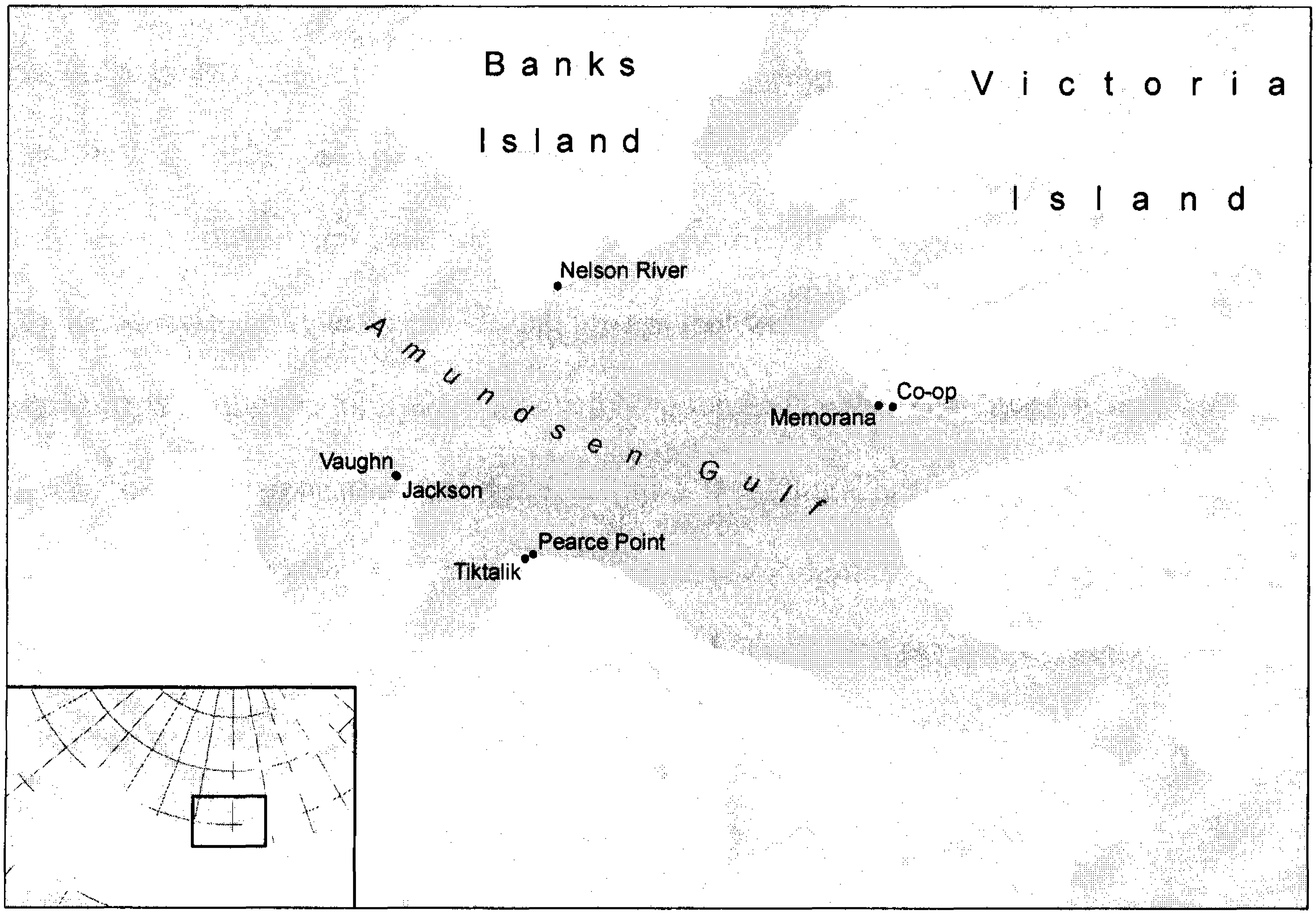

Figure 18: Thule Inuit sites in Amundsen Gulf

(Co-op and Memorana).As the process of colonization can only been seen through changes over time, it is important to establish the relative chronology of these sites. The chronologically sensitive traits and radiocarbon dates from the seven sites included in this analysis are presented in Table 7. However, as noted above, Amundsen Gulf was apparently abandoned (or at least less intensively used) by the Late Thule period, and all of the sites included in this study date to the Early Thule period, approximately between 1200 and 1400 AD.

For simplicity, this study divides the Early Thule Inuit occupation of Amundsen Gulf into two periods: "pioneering" and "settled." These periods are primarily based on harpoon head styles, widely seen to be the most sensitive chronological markers on Thule Inuit sites. Natchuk and Sicco style harpoon heads are used to identify the pioneering period sites. Both have been found at ancestral Thule sites in Alaska and have limited distributions in the Canadian Arctic. Most researchers (e.g. Morrison 1999, 2009; Friesen and Arnold 2008; Arnold and McCullough 1990; McGhee 2009) have assumed they represent styles brought by pioneering groups that were subsequently modified or abandoned during the migration. Derived harpoon head styles (i.e. those that are not present or common on ancestral Alaskan sites), including Clachan open and closed socket, modified-Sicco, and Thule type 3, are used to identify sites occupied during the "settled" period. The presence of drilled lashing holes on Thule type 2 harpoon heads is also seen to be a derived trait.

Other signatures of pioneering Thule include the presence of arrowheads with sloping shoulders and knobbed tangs, and pottery with Barrow curvilinear decoration. Architectural features typical of pioneering period Thule include the external kitchen

Table 7: Characteristics of Thule Inuit sites in Amundsen Gulf, NWT

	Nelson River	**Tiktalik**	**Pearce Point**	**Co-op**	**Vaughn**	**Jackson**	**Memorana**
Extent of excavation	One semi-subterranean house	One semi-subterranean house	One semi-subterranean house	Two single roomed and one join pair of semi-subterranean houses	90% of midden, test pit in the middle of house depression	One semi-subterranean house	Four winter houses, 90% of midden
Source	(Arnold 1994, 1986; Friesen and Arnold 2008)	(Morrison 2000, 2009, 1998a)	(Morrison 2000, 2009) CARD	(J.-F. Le Mouël and M. Le Mouël 2002)	(Taylor 1972)	(Taylor 1972)	(McGhee 1972)
Architecture							
Form	Rectangular	Rectangular	Rectangular	Three circular, one angular	Unknown	Rectangular	Circular and rectangular
Number of rooms	Two	One	One	Two with one, one with two	Unknown	One	One
Kitchen alcove	Present	Present	Present	Present	Unknown	Absent	Absent
Sleeping platform	Present	Absent	Absent	Three present, one absent	Present	Present	Present
Material	Wood	Wood	Wood	Mostly stone, some wood	Wood	Wood, some stone	Mostly stone, some wood
Artifacts							
Harpoon head styles	Natchuk Sicco Thule 2 Whaling	Sicco Sicco-like Thule 3 Thule 2 Thule 4	Sicco Thule 2 (some with drilled lashing holes)	Natchuk Thule 2 (some with drilled lashing holes) Clachan open-socket Nuwuk/Barrow Thule 4 Tasik/Modified Sicco	Thule 2 (some with drilled lashing holes) Modified Sicco Nuwuk	Thule 2 (some with drilled lashing holes) Thule 3 Nuwuk Clachan closed socket Thule 1 B1a	Thule 2 Tasik-like Thule 3
Ceramics	Present, plain	Present			Present, most plain, some Barrow curvilinear	Present, most plain, some barrow curvilinear	Present, plain
Arrowheads	Rounded shoulders and knobbed tangs			Rounded shoulders and swollen tang Slanting with bilaterally knobbed or spurred tangs	Rounded shoulders and knobbed tang	Knobbed and spurred tangs	Sharp shoulders, spurred tangs
Dating							
Phase	Early	Early	Early?	Early and Late	Late?	Late	Late
C14 Normalized (BP) *	740 +/- 40 780 +/- 40 820 +/- 70	680 +/- 40 740 +/- 40 800 +/- 40 800 +/- 40 820 +/- 40	510 +/- 30 630 +/- 40	520 +/- 50 610 +/- 65 690 +/- 100 750 +/- 60			

* Dates on unsuitable materials, including driftwood and material from animals whose diets include marine species, are not included

alcove, driftwood construction and rectangular rooms. The presence of external kitchen alcoves is also used to identify the earliest Thule period in the Eastern Arctic, but this feature is present in almost all of the Amundsen Gulf sites. Radiocarbon dates have been obtained for five of the seven sites included in this analysis (Figure 19). All dates run on unsuitable material, for example marine mammal bones or driftwood (c.f. McGhee 2000; McGhee and Tuck 1976), and those that appear to be anomalously old or young have been excluded. Due to the inherent limitations in using radiocarbon dating in the Arctic, and the relatively coarse dates they provide, they are not relied upon to date the sites, but rather to confirm the relative dates suggested by their stylistic attributes.

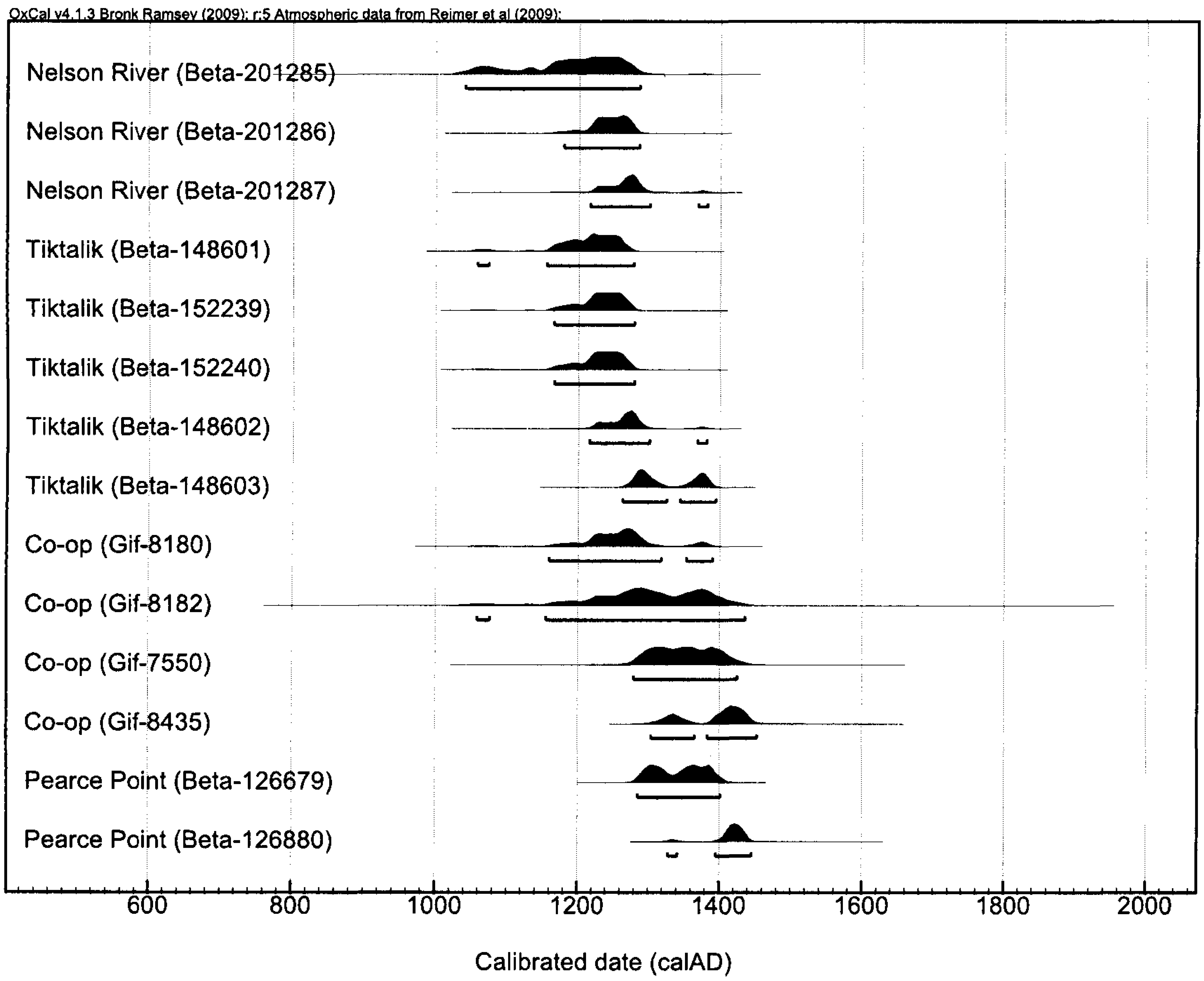

Figure 19: Calibrated radiocarbon dates from Amundsen Gulf Thule Inuit sites

Both Nelson River and Tiktalik clearly date to the pioneering period of Thule occupation in Amundsen Gulf based on the presence of Natchuk and Sicco harpoon heads and other stylistically early traits. The Pearce Point site appears to have been occupied slightly later, and might represent a transitional phase between pioneering and settled-in groups due to a mixture of older and younger features. The Co-op site, the only site where multiple components have been excavated, shows both pioneering and settled traits along with a suite of radiocarbon dates that span the entire Early Thule period. It appears to have been repeatedly occupied. Chronologically sensitive evidence at Vaughn and Jackson is fragmentary, but based on the harpoon head assemblages, which lack Sicco or Natchuk styles but include later types and features, they both appear to date within the settled period. Memorana contains only traits typical of the settled period.

6.3 Description of Faunal Material

Most reports on Thule Inuit sites in Amundsen Gulf touch only briefly on the faunal material, and there is a great deal of diversity in both the amount of information reported and methods used to quantify the samples. The information from published materials is summarized in Table 8. Most samples are from houses, as at Tiktalik, while others include middens and other feature types. Sample sizes are only reported for three of the six sites, one of which (Vaughn) is quite small. Both MNI and NISP were used to quantify the relative importance of species, but no site includes both, and only one report provides absolute abundance and not just relative contribution. Due to the inconsistencies in sampled features, quantification methods and sample sizes, statistical comparisons of the Amundsen Gulf assemblages would be meaningless. Nevertheless, some qualitative comparisons will be discussed below.

Table 8: Faunal assemblages from Amundsen Gulf Thule Inuit sites (* the Co-op data were presented as % of total mammal MNI)

	Jackson	**Memorana**	**Vaughn**	**Pearce Point**	**Tiktalik (NISP)**	**Tiktalik (MNI)**	**Nelson River**	**Co-op**
Context	One house	Four houses, 90% of midden	Test pit in house	One house	One house		One house	At least three houses, one tent ring, some midden
Sample size	?	2,025	203	?	7,737	7,737	2,176	?
Data format	Presence	NISP	NISP	NISP	NISP	MNI	MNI	MNI*
Ringed seal	Almost entire sample	72%	88.55%	90%	94.97%	49.28%	60.30%	76%
Bearded seal		very few	3.05%	occasional	0.15%	1.45%	1.60%	
Bowhead	present	very few	present	absent	0.02%	1.45%	1.60%	present
Beluga				present	0.00%	0.00%		
Caribou		26%		rare	0.52%	2.90%	1.60%	11%
Fox		very few	3.82%	present	1.27%	4.35%	9.50%	present
Bear	present		0.76%	some	0.47%	2.90%	3.20%	present
Dog/wolf			2.29%	present	0.42%	2.90%	3.20%	present
Muskox					0.02%	1.45%	1.60%	present
Hare		very few			0.00%	0.00%	3.20%	
Lemming					0.00%	0.00%	4.80%	
Wolverine					0.02%	1.45%		
Bird	present	very few	0.76%	present	2.11%	28.99%	7.90%	N/A
Fish	present	very few	0.76%		0.03%	2.90%		N/A

The overall species diversity among the sites is remarkably consistent, and reflects the biological diversity within Amundsen Gulf. Ringed seal and whale bone (including bowhead and beluga) are present in all of the assemblages. Fox, bear and birds were found in all but one assemblage each, while Bearded seal, caribou and dog were found in five of seven assemblages. The absence of some of the less common species in some assemblages is likely an artifact of small sample sizes and incomplete reporting.

The clearest similarity among all the Amundsen Gulf Thule sites is the dominance of Ringed seal remains by a large margin over all other species. This is an unsurprising result as Ringed seals usually occur in high frequencies in most Thule winter assemblages throughout the Arctic (Morrison 1983). As mentioned in previous chapters, Ringed seals were an important dietary resource for the Thule Inuit because they are ubiquitous in most Arctic marine environments and are present throughout the year. A primary focus on sea mammal hunting is further suggested by the high frequencies of related hunting equipment in all the reported assemblages.

Bowhead whale bone is present at six of the seven sites, and strands of baleen are common in most. Pearce Point is the outlier, with no reported evidence of Bowhead whale bone or baleen, although the Canadian Archaeological Radiocarbon Database (CARD) indicates that Beluga bone was present (Morlan 2010). As discussed earlier, archaeologists still struggle to determine the relative importance of whales in Thule Inuit subsistence because whale bone is rarely transported back to a dwelling with meat or blubber, but is collected for its own utility as an architectural element and raw material. Nelson River is the only site where the excavator suggested that whaling provided the bulk of consumed meat, based on the presence of a whaling harpoon head preform and other whaling related features (Arnold 1986; Arnold and McCullough 1990). None of the other sites contained artifacts associated with whaling. Clearly, if not of dietary importance, whales were at least a very important raw material source for the Early Thule Inuit of Amundsen Gulf.

Caribou presents perhaps the most interesting pattern in the Amundsen Gulf Thule assemblages. It is rare in all sites except for those on Victoria Island (Memorana and Co-op). Memorana is securely dated to the settled period, while Co-op appears to have at least a later component. The high frequency of caribou at these sites might be the result of a shift in subsistence strategy during the settled period due to increased landscape knowledge, as will be discussed in Chapter 6. On the other hand, the difference in frequencies might represent the easier availability of caribou on Victoria Island. As noted earlier, the frequency of fox and caribou are typically inversely related in Thule faunal assemblages. Although the data are sparse, this pattern seems to hold true for the Amundsen Gulf assemblages. Fox is rare in assemblages where caribou is abundant (Memorana and Co-op), while caribou is rare in assemblages where fox is abundant (Tiktalik and Nelson River).

Based on the reported faunal material, neither birding nor fishing were economically important to the Amundsen Gulf Thule Inuit, with very low frequencies reported in all assemblages where they are present. Nevertheless, fishing and birding implements were reported at all Amundsen Gulf sites except Co-op, which has no published description of the artifact assemblage. This reflects the general trend documented by Whitridge (2001), and likely reflects the social importance of birding and fishing rather than economic importance. It is very possible that, as these sites are winter occupations, birding and fishing were more important resources during the warm season. At both Nelson River and Tiktalik, ptarmigan was the most abundant bird species, suggesting a winter occupation at both sites. Alternatively, this pattern might reflect the lack of screening during the excavation of many of these sites, which can bias a faunal sample against birds and fish. At least at Tiktalik, it does not appear that the lack of screening caused the low frequencies of birds and fish because many other small bones, such as those of small burrowing rodents, were collected.

6.4 Discussion

This thesis has proposed that actively migrating Thule Inuit pioneers would practice a subsistence strategy narrowly focused on the most reliable of Arctic prey species, the Ringed seal. However, the evidence from the earliest sites in Amundsen Gulf suggests that the first Thule Inuit in the region practiced a diversity of winter subsistence strategies. At Tiktalik, hunters were interested in Ringed seals to the exclusion of almost all other prey species, while the hunters at Nelson River focused on Bowhead whales supplemented by Ringed seals. This dissimilarity cannot be explained by differential availability of migrating Bowhead whales, as whales arrive at similar times and in similar abundances near both coasts (Fraker and Bockstoce 1980). Rather, it suggests that the occupants of each were living in Amundsen Gulf for different reasons. A whaling based subsistence would be expected for recent Alaskan immigrants who were attempting to apply a familiar subsistence strategy to a new area. Whaling provided the Early Thule Inuit of Alaska with huge surpluses, which led to complex social structures and hierarchies (Whitridge 1999). Therefore, Nelson River appears to represent a group who were trying to settle in Amundsen Gulf.

Tiktalik, on the other hand, displays the intensive reliance on Ringed seals predicted for pioneering Thule Inuit groups. A subsistence strategy based on Ringed seals does not provide the huge surpluses attainable from whaling, but is much more reliable and adaptable to new areas. The occupants of Tiktalik seemed to have been more interested in feeding themselves rather than gaining the surpluses associated with achieving higher social status. As suggested by Morrison (Morrison 2000, 2009), it seems that some of the Thule Inuit occupation of Amundsen Gulf represents groups who were actively migrating to points further east.

Unfortunately, the sparse faunal data from the settled period in Amundsen Gulf does not permit an in-depth analysis of changes in subsistence after the pioneering period, but some trends are worth noting. Ringed seals are at their highest frequency at Tiktalik, making up over 94% of the identified assemblage. For later assemblages that have reported NISP frequencies, the abundance of Ringed seals decreases in chronological order, making up 90% of the Pearce Point's assemblage, 88% of Vaughn's, and 72% of Memorana's. This corresponds to the predicted trend, where groups who are more familiar with their local environments can harvest a broader range of prey species. The Memorana assemblage suggests that, at least on Victoria Island, this shift involved an increased emphasis on caribou. However, the correlation between age and decreasing abundance of Ringed seals must remain tentative, not only due to the problems inherent in comparing these assemblages as described above, but also because the sites are widely separated geographically and therefore reflect differences in resource availability.

Based on the present evidence, the clearest association between the Thule Inuit occupation of Amundsen Gulf and the process of colonization is the abandonment of the region after the Early Thule period. People passed through on their way east, but did not settle permanently, preferring perhaps the more productive environments of the Mackenzie Delta to the west (c.f. Betts 2008) and the new lands they discovered to the east (c.f. McCullough 1989).

6.5 Conclusion

The faunal material that enters the archaeological record is the result of numerous complex processes, both natural and cultural. Even in an environment where excellent preservation in permafrost means that we can concentrate on human choices rather than natural destructive agents, untangling one process, in this case the affects of landscape learning, is difficult. At least two subsistence strategies were identified in the earliest pioneering phase Thule Inuit sites in Amundsen Gulf, one focused on sealing and one focused on whaling. These differences likely reflect the different reasons people had for inhabiting the area and the different ways in which they adapted to it. Later groups who had settled into the Amundsen Gulf landscape had a broader based subsistence strategy, perhaps as a result of their increased knowledge of the local landscape.

7. Conclusion

This thesis has asked two questions: 1) What were the subsistence practices of an early colonizing group of Thule Inuit? and 2) How did subsistence practices change as the Thule Inuit settled in to their new landscape? These questions were answered by first examining the faunal assemblage at Tiktalik, an early Thule Inuit site in Amundsen Gulf, and then comparing these results to other early sites within the region.

The Tiktalik faunal assemblage is a well preserved representation of the subsistence behaviour of the site's occupants. Ringed seal remains make up over 94% of the identified specimens, and this was clearly the primary prey species. Other species were hunted, including marine and terrestrial mammals, birds and fish, but they made up only a small part of the food consumed at the site. Tiktalik was likely occupied from the fall to the early spring. The age structure of the procured Ringed seals most closely matches the age structure of a living population in a winter fast-ice or fall open-water habitat, demonstrating that hunting was undertaken mostly in the winter. The site's inhabitants appear to have left by the time seals were giving birth in March and April. Breathing hole sealing appears to be the primary method used by Tiktalik's occupants, but open water sealing was probably conducted during the fall and perhaps also the spring. Complete seal carcasses were brought back to the site and then butchered, which resulted in relatively equal frequencies of skeletal elements in the assemblage.

The Tiktalik site appears to represent a group of Thule Inuit who were actively migrating farther east. The artifacts and architecture uncovered during excavation, along with radiocarbon dates obtained from material within the house, demonstrate that the site was occupied early in the Thule Inuit colonization of the Canadian Arctic. Pioneering hunter-gatherers are thought to focus on the most easily obtained and abundant animal and plant resources in order to reduce the risks associated with a lack of specific landscape knowledge. The overwhelming dominance of Ringed seals in the Tiktalik assemblage supports the suggestion that such an adaptation was used by some pioneering groups of Thule Inuit.

However, not all early sites are like Tiktalik and there is diversity in the subsistence behaviours of pioneering Thule Inuit, as shown by the focus on whaling at Nelson River. This diversity hints at the different motives that brought the Thule Inuit into the region and the different ways they were adapting to new landscapes. Sites such as Nelson River might represent groups attempting to settle a new area with the familiar subsistence strategies they had practiced in their homelands. Tiktalik and other Ringed seal-focused sites in Amundsen Gulf, on the other hand, might have been occupied by actively migrating groups, as has been suggested by Morrison (2000, 2009). These groups were hunting the most productive and easily harvested prey species because they were not familiar with their landscape.

During the settled phase of early Thule Inuit occupation on Amundsen Gulf, subsistence shifted from a heavy focus on Ringed seals towards a broader focus on both Ringed seals and caribou, as shown at Memorana and Co-op. Colonization and the requisite landscape learning that accompanied it might have motivated this shift. Barren Ground caribou migrate in huge herds during the spring and fall, and typically follow the same migration routes year after year. Groups who know where these routes are and when the caribou use them are able to set up ambushes that will provide huge surpluses of food with little effort. Caribou are therefore a highly predictable and productive resource, but require specific landscape knowledge in order to be efficiently hunted. Ringed seals, although both predictable and abundant, require much more effort because they do not aggregate in large groups. They also require a large investment of time spent hunting. For example, during breathing hole sealing a hunter might wait hours for a seal to surface. The shift towards a more broadly based subsistence strategy with caribou as another primary prey species might therefore be explained by increasing knowledge about caribou migration routes.

Further evidence for the diversity in early Thule Inuit subsistence strategies and the ways in which they adapted to new areas comes from the Cache Point site in the Mackenzie Delta (Friesen and Betts 2006; Betts and Friesen 2004; Friesen 2009). The site's artifact assemblage does not include the stylistically early forms present in the earliest Thule sites, a sign that it was not occupied during the initial pioneering phase of Thule culture. It does, however, boast relatively early radiocarbon dates, and is certainly the earliest excavated site in the Mackenzie Delta. Cache Point's faunal assemblage is dominated by beluga and burbot, a contrast to later sites in the region that had more diverse subsistence strategies. Friesen (2009) saw this as evidence of adaptation to a new landscape - a similar situation to the Amundsen Gulf Thule Inuit discussed above.

The evidence the Thule Inuit left behind is beginning to show that their migration was not a single grand event. A picture is emerging of multiple communities migrating into the Canadian Arctic and Greenland each with distinct motivations and individual histories. Some groups settled in to new areas with the subsistence behaviours they used in their homelands, while other groups continued to move. Additionally, the scale and speed of the Thule Inuit migration suggests that it was not a one-way process. Groups returning from the east would bring specific knowledge of new landscapes along with trade goods unavailable to groups in the west.

7.1 Future Work

A number of avenues of research on faunal assemblages could be employed to further examine the Thule Inuit colonization of the Arctic, the most productive of which will be to study more assemblages. A greater diversity of geographic locations, especially in the settled phase, might demonstrate whether the observed patterns are simply the result of geographic bias. Additional research could examine other seasons of occupation for both early and later Thule Inuit, as the currently available data is highly skewed towards coastal winter occupations. These studies might demonstrate how mobility changed as a result of colonization because the Thule Inuit are thought to be much more mobile during the summer. It might also show how unique aspects of geography, particularly caribou migration routes and prime fishing areas, were discovered and exploited by pioneering Thule Inuit. Although archaeological evidence for return migrations will be difficult to determine, a possibly productive avenue of research will be to examine the flow of trade goods, such as copper and iron, across the Arctic in the early Thule period.

Although more sites could be excavated, archaeologists will still be hampered by the logistical issues associated with Arctic archaeology, so further analyses of faunal material from previously excavated sites could be conducted. The implication of a Thule migration in the 13th century rather than the 11th century, and the ensuing compression of the Thule Inuit period into 400 years, has not been fully examined. Many sites in other parts of the Arctic date to the 13th and 14th century, but are interpreted as being occupied by populations who were already familiar with the landscape. These sites might now be reinterpreted as being occupied by colonizing Thule Inuit who were new to and unfamiliar with local landscapes.

The Thule Inuit colonization of the Arctic presents a number of challenges for archaeological interpretation. It occurred in a very short period of time and likely involved a large and diverse population. Migration is a complex process which is dependent on the motivations and histories of individuals, which are difficult to determine from an imperfect archaeological record. Understanding the Thule Inuit colonization of the Arctic is complicated by the imprecision inherent in dating Arctic archaeological sites, the challenges associated with surveying huge tracts of land and the erosion of many coastal sites. In order to better understand the Thule colonization of the Arctic, more sites need to be excavated with the goal of obtaining faunal assemblages. However, given the high costs of arctic research and competition for research funds, the re-analysis of previously excavated assemblages will also be a productive avenue for future researchers.

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Appendix 1

Ringed seal skeletal element zones

Skeletal element	Zone	Description
Cranium	1	Ventral portion of left auditory bulla
	2	Lateral portion of left auditory bulla
	3	Left maxillary tooth row
	4	Ventral portion of right auditory bulla
	5	Lateral portion of right auditory bulla
	6	Right maxillary tooth row
	7	Basisphenoid
	8	Palate
	9	Left occipital condyle
	0	Right occipital condyle
Mandible	1	Anterior tooth row (incisors and canine)
	2	Posterior tooth row (post-canines)
	3	Coronoid process
	4	Condyle
	5	Angle
Rib	1	Head
	2	Articular tuberosity
	3	Angle
	4	Distal articular surface
Scapula	1	Supraglenoid tubercle
	2	Glenoid cavity
	3	Acromion process
	4	Spine
	5	Axillary border
	6	Vertebral border
	7	Posterior angle
Humerus	1	Head
	2	Greater tubercle
	3	Lesser tubercle
	5	Deltoid process
	6	Olecranon fossa
	7	Capitulum
	8	Trochlea
	9	Internal condyle
	0	Shaft
Radius	1	Proximal articular surface
	2	Bicipital tuberosity
	3	External portion of distal articular surface
	4	Internal portion of distal articular surface
	5	Lateral portion of distal epiphysis
	0	Shaft
Ulna	1	Olecranon process
	2	Proximal portion of proximal articular surface
	3	Corocoid process
	4	Distal epiphysis
	0	Shaft
Sacrum	1	Third sacral vertebra
	2	Second sacral vertebra
	3	Right lateral wing of first sacral vertebra
	4	Left lateral wing of first sacral vertebra
Innominate	1	Ventral portion of iliac crest
	2	Dorsal portion of iliac crest
	4	Cranial portion of acetabular fossa

	5	Ischial portion of acetabular fossa
	6	Pubic portion of acetabular fossa
	7	Portion of the pubis forming the obturator foramen
	8	Ischial tuberosity
	9	Caudal portion of pubis
Femur	1	Head
	2	Greater trochanter
	5	Medial condyle
	6	Lateral condyle
	7	Patellar articular surface
	0	Shaft
Cruris (Tibia-fibula)	1	Lateral condyle
	2	Medial condyle
	3	Intercondylar fossa
	4	Lateral portion of fibula distal epiphysis
	5	Lateral portion of tibia distal epiphysis
	6	Medial portion of tibia distal epiphysis
	9	Fibula shaft
	0	Tibia shaft