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A Zooarchaeological Analysis of a Late Dorset Faunal Assemblage from the KcFs-2 Site (Nunavik, Quebec).

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Abstract

This thesis presents a zooarchaeological analysis of a faunal assemblage from a Dorset site (KcFs-2) on the Nuvuk Islands in the Canadian Arctic. The faunal data was analyzed through the application of bone density and economic utility indices and bivariate statistical tests. A brief taphonomic study was also undertaken, showing that the assemblage was not heavily affected taphonomically. The faunal analysis revealed a generalized subsistence strategy with an intensified focus on marine mammal exploitation, specifically ringed seals. The predominance of immature ringed seals exposed through the study indicates an abundance of marine resources in the northern Hudson Bay and Hudson Strait regions during the period under study, which correlates well with existing studies concerning Late Palaeoeskimo economy. Occupation of the KcFs-2 site occurred in the Late Dorset period of Nunavik (1500-800 B.P.) and is defined on a multi-seasonal level, from late winter through summer. Analyses of the organic artefact assemblage (harpoon heads and sculpted objects) served to confirm the relative dating of the site and aided in the definition of the cultural affiliation of the inhabitants of the KcFs-2 site.

Key-words: Late Dorset, Nunavik, zooarchaeology, palaeoeskimo, maritime subsistence economy.

Résumé

Ce mémoire consiste en une analyse zooarchéologique d'un assemblage faunique provenant d'un site Dorsétien des Îles Nuvuk dans l'Arctique canadien. Les données fauniques ont été analysées statistiquement en appliquant des indices d'utilité économique et des indices de densité des os. Une étude concernant le niveau de conservation de l'assemblage a révélé peu d'évidence de modification taphonomique des spécimens. Les analyses fauniques ont permis d'identifier une stratégie de subsistance de type généraliste et basée sur l'exploitation de mammifères marins, surtout des phoques annelés, pratiquée par les occupants du site de KcFs-2. Une prédominance d'individus immatures (phoques annelés) dans l'assemblage indique une abondance de ressources marines dans les régions du nord de la Baie d'Hudson et du détroit d'Hudson au moment de l'occupation, ce qui est aussi manifeste dans des études antérieures concernant les économies des peuples du Paléoesquimau tardif pour la période donnée. L'occupation du site de KcFs-2 s'est produite durant la période du Dorsétien récent au Nunavik (1500-800 B.P.), et la séquence est définie comme ayant été multi-saisonnière (de l'hiver à l'été). L'analyse des produits de l'industrie osseuse (têtes de harpons et sculptures en ivoire) a permis de confirmer l'affiliation culturelle des occupants.

Mots-clés: Dorsétien récent, Nunavik, zooarchéologie, Paléoesquimau, économie de subsistance maritime.

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INTRODUCTION

The Arctic is often characterized as a harsh and unforgiving environment that provides bleak living circumstances, and in which survival depends on the stability of these difficult conditions. Regardless of the arduous nature of the environment, the Arctic has provided evidence of a human occupation sequence that spans more than 4000 years and includes numerous hunter-gatherer cultural complexes that are economically, socially and ideologically diverse.

Throughout the sequence of human occupation in the Arctic, and from a materialistic perspective, cultural groups are defined through the study of the economic strategies that they employed. Because economy is intricately linked to social, political and religious organization, investigations concerning subsistence practices are primordial to the understanding of human adaptation, cultural diversity, and culture change in the Arctic region. Zooarchaeological research, which focuses on the analysis and interpretation of subsistence strategies and corresponding faunal assemblages, provides important support for the delimitation of cultural sequences and the interpretation of culture change and economic frameworks of Arctic groups (Palaeoeskimo and Neoeskimo).

Within the context of the Palaeoeskimo period, the Dorset phase can be defined as a time of change in the economic pursuits and the organizational systems of Arctic peoples. A shift in settlement patterns and exploitation strategies of local and regional resources, from the highly mobile and broadly generalized economic practices of the Early Palaeoeskimo period, to a more narrowly focussed subsistence framework with reduced mobility in the Late Palaeoeskimo period (Dorset), becomes visible in the archaeological record as early as 2400 B.P. Regional and temporal variability in material culture and occupation sequences are evident for the entirety of the Palaeoeskimo period (Early and Late phases) but technological and ideological systems appear more uniform in the Dorset period (Maxwell 1985; McGhee 1996). Dating of archaeological sites from the Dorset period therefore relies heavily upon the identification of evidence of period-specific settlement patterns and economic practices, as well as distinctive material cultural assemblages.

The present study consists of a zooarchaeological analysis of faunal remains excavated from a proposed Late Dorset site near the modern village of Ivujivik in

Nunavik. The KcFs-2 site is located on the Nuvuk Islands, in the northern region of the Ungava Peninsula at the junction of Hudson Bay and Hudson Strait. Investigations at the site took place during the summer of 2009, and excavations yielded a large faunal assemblage and sizeable associated lithic and organic artefact collections. The faunal assemblage was analyzed for this work.

The goal of the present research is twofold. The primary objective is to reconstruct the subsistence system of the KcFs-2 site inhabitants and to establish the adaptive nature of that system (*i.e.* marine fauna/coastal vs. terrestrial fauna/continental oriented economies) through an in-depth analysis of the faunal assemblage. Within the given adaptive framework, it is also necessary to determine to what degree the economic pursuits of the group under study were specialized, and in what ways the [potential] specialization is expressed in the assemblage (*i.e.* focal species, focal age groups of prey). The interpretations of the faunal data will also include inferences concerning the season of occupation of the KcFs-2 site and the exploitation patterns of the local and seasonally available resources.

The second function of this research is to incorporate the faunal data and zooarchaeological interpretations into the temporal-cultural sequence for the region with the goal of determining the cultural affiliation of the KcFs-2 site inhabitants. The cultural determination is elaborated through the testing of the hypothesis that proposes a Late Dorset occupation for the site, with a multi-seasonal settlement pattern concerning a large single family, or multi-family group, that implemented a marine oriented subsistence system predicated on the intensive exploitation of seals.

This thesis is divided into seven chapters. At the outset, theoretical and methodological concepts relative to archaeology, Arctic studies, and to the domain of zooarchaeology will be discussed in order to situate the present work in terms of the evolution of these approaches. A general reconstruction of the physical setting of the Eastern Arctic, and a discussion concerning the diversity of environmental and climatic conditions prevalent therein and their influence on culture change on both regional and global levels, will follow. Succeeding the environmental overview, a detailed discussion of the cultural sequence for the Eastern Arctic is given which seeks to expose the inherent variability between regions (of related groups) and between groups of different cultural affiliations across the territory. An examination of the economic and cultural traits of Late Palaeoeskimo (Dorset) groups is then presented with the goal of defining a frame of reference for the site under study. Following that, the site introduction, description of the project, and the preparation procedure of the zooarchaeological analyses are exposed in detail. Finally, the faunal analysis and the taphonomic study of the assemblage from the KcFs-2 site are presented and discussed in detail, followed by an examination of the associated organic artefact assemblage.

Chapter 1: Theory, methodology, and zooarchaeology

The following section provides a brief study of theoretical paradigm shifts and academic movements in American anthropological and archaeological research, from the late 19th century through to present. This discussion is neither all-inclusive nor exhaustive, but strives to situate the methodological and theoretical framework applied in this work in relation to the general trends prevalent in the last century of research in the Americas.

1.1 A review of American archaeological approaches

The central focus of archaeology is aptly described by Renfrew and Bahn (2004) as: "(…) the full range of past human experience – how people organized themselves into social groups and exploited their surroundings; what they ate, made, and believed; how they communicated and why their societies changed." (*ibid.*:19). Within this broad framework of study, economy and subsistence have become central issues in archaeological research, and are intimately 'intertwined' with methodological and theoretical developments in the encompassing discipline of anthropology (Betts 2004:21).

In archaeology, the study of hunter-gatherer societies is dominated by two materialist schools of thought: (1) an adaptational approach which relies primarily on material determinism (environment); and (2) a structural approach which focuses on social determinism (relationships between individuals, families and groups) (see Lee and Daly 1999). The study of subsistence in archaeology has been subject to a number of important changes over time on the level of theoretical frameworks and methodological approaches that can been seen as reciprocal to, or mirroring, changes in anthropological research perspectives, but has tended to espouse an adaptational approach.

Cultural-historical archaeology

Early in the 20th century, American archaeology was predominantly supported by a cultural-historical approach that was heavily influenced by the Boasian (Franz Boas 1858-1942) 'cultural anthropology' school of thought that advocated cultural relativism, historical particularism, and an holistic approach primarily based on ethnology and which firmly rejected cultural evolutionism. The cultural-historical approach essentially involves establishing lists of cultural traits (types, attributes, burial patterns) for different components of a given culture as a means of describing, and thus understanding them. The Boasian description of cultures defined them not as integrated systems, but as collections of traits that had 'come together as a result of random patterns of diffusion' (Trigger 1996:283). Inferences about human behaviour relied primarily on psychological perspectives in early anthropological studies in America; very little attention was paid to the functional significance of the artefacts that were being described. Excavations were undertaken during this period with the goal of recovering artefact samples that could be used to define cultures through the elaboration of trait lists and cultural chronologies; interpretations of stratigraphy were both rare in number and cursory in nature. Culture change, for cultural-historical archaeologists, could best be explained by diffusion and migration (due to the lack of attention to stratigraphic interpretation), and thus the elaboration of short chronologies was widespread under this research paradigm. The most valuable and enduring feature of the cultural-historical approach is its ability to trace lineages of development of material culture, or historical relations, across time and space; this feature, as described by Trigger (1996) is: "the necessary prerequisite for evolutionary generalizations about the process of change" (*ibid.*:313).

The functionalist approach

Alongside the development of the cultural-historical framework in American anthropology and archaeology, a functionalist approach to archaeological analysis grew out of an interest for how artefacts were manufactured and what uses had been made of the artefacts. Functionalist interpretations of artefacts were based on pre-defined categories of possible uses (securing food, preparation of food, habitations, tools for men, tools for women, religious objects, etc.) (see Trigger 1996:361-364). Interpretations of non-utilitarian features are all but absent in this approach. Several academic movements proposing differing methodologies were involved in the development of the functionalist (or early functional-processual) school of thought that attempted to address problems concerning collecting methodologies at archaeological sites, limited consideration of floral and faunal data, inter and intra site variability, and recording and interpretive practices. The 'conjunctive approach' (Walter Taylor 1948) advocated studies of the spatial distribution of finds at sites, inter and intra site relations, the collection of palaeoenvironmental data, and the elaboration of analogies between historically related cultures.

An important new trend towards adaptive interpretations of culture was triggered in Europe in 1939 with Grahame Clark's *Archaeology and Society*. Clark maintained the argument that the function of cultural material could only be understood when examined in relation to society, and that the primary role of culture was to ensure the survival of societies. Clark's ecological approach broke ranks with cultural-historical archaeology by proposing that all aspects of cultures are influenced by environmental constraints. Clark later included interpretations of the symbolic significance of artefacts and their role in the definition of social norms, but underlined that the interpretation of these symbols was based on the adaptive function of culture and its role within the framework of natural laws that govern human behaviour (*ibid*. 1975).

In the American archaeological community, Taylor (1948) proposed a scientific methodology for the search for generalizations about culture change and human behaviour. Taylor's initial impetus came from the belief that cultural-historical archaeology had encouraged poor fieldwork practices; he proposed quantitative methods of analysis and the calculation of frequencies of artefacts in order to better understand inter and intra site relations and to better explain spatial distribution. Taylor also maintained a two-fold system of synthesizing material from archaeological sites: an ethnographic system of integration was used for determining how people had lived at the site, and an historiographic synthesis traced changes over time at sites. Taylor supported the historical–cultural approach to archaeology while at the same breaking from Boasian views by defining culture as a 'pattern of psychologically integrated concepts' (see Taylor 1948; Trigger 1996:371) that must be approached inductively. While his proposals for the implementation of more rigorous fieldwork practices were well received, Taylor's interpretive methodologies would eventually prove to be relatively sterile.

Among the first to accept a materialist view of human behaviour in American archaeological circles were Julian Steward and Frank M. Setzler (1938) who proposed applying ecological research principles to the study of settlement patterns, subsistence economies, and population size. The development of settlement archaeology followed with Gordon Willey's 1953 study of settlement patterns in the Viru Valley (Peru) which took a decidedly different view to the interpretation of data collected at sites and to the analysis of culture change on the level of internal cultural transformations (in opposition to diffusion and migration models).

Processual archaeology

In the early 1950's, the advent of carbon dating methods brought about radical changes in the interpretative approaches to archaeological data, proposed rates of culture change, and the establishing of cultural chronologies. Systematic re-dating and reinterpretation of cultural sequences occurred worldwide which showed that culture change and development had happened over much longer periods of time, and at a much different rate, than previously thought; this in turn brought further support to evolutionist research paradigms that proposed that processes of *in situ* transformation were largely responsible for culture change, as opposed to migration and diffusion.

A growing interest in cultural evolutionism and strong reactions against cultural-historical perspectives (and especially to Boasian historical particularism), brought about an important paradigm shift in American archaeology in the 1960's and 1970's in the form of processual archaeological schools of thought. These approaches incorporated theoretical principles and methodological protocols from a number of other disciplines, namely ecology and micro-economics, as well as theoretical frameworks such as neo-evolutionism and systems theory (Bettinger 1987; Trigger 1996). Processual archaeology focused on broad areas of study such as behaviour, subsistence patterns, trade, social organization, and technology. Initially, processual archaeologists tended towards materialist, positivist, deductive, evolutionist, and ecological research frameworks, but divergence exists [and has become increasingly important over time] concerning the degree to which researchers espouse these governing principles. The concept of 'processual change within cultural systems', originally put forth by Taylor (1948), were revisited in the 1960's and popularized through the works of Joseph Caldwell (1959); this premise gained impetus with the formal debut of *New Archaeology* and through the continuing work of Lewis Binford (S. and L. Binford 1968; Trigger 1996:393). Binford's proposed New Archaeology, or processual archaeology, emphasized the study of differences in cultural behaviour from an adaptive perspective; culture differences, for Binford, could be defined as resulting from human adaptation to differing environmental contexts. Ethnoarchaeology played an important role in Binford's processual approach (e.g. Binford 1978) and he adopted a positivist, empiricist and deductive methodology based on ethnoarchaeology as a source of generalizations for human behaviour that could be used for testing hypotheses against archaeological material (as in the natural sciences). According to Binford, regularities in human behaviour should be visible in the uniformity of the artefacts they produce (Binford 1962, 1965). This normative behavioural model brought about numerous changes in archaeological methodology, specifically concerning the role of cultural taxonomy, interpretations of lineage and inheritance (through ceramic seriation), and the study of kinship and burial practices (see Binford 1971).

Middle-range theory

Middle-range theory, which relates to the construction of bridging arguments between theory and practice, was developed in the social sciences by Robert Merton (1968) and proved an efficient tool in archaeology, but also represented an important break from radical positivist perspectives. Binford, though primarily positivist in his approach to archaeology, applied the middle-range model to ethnoarchaeological studies with the goal of expanding upon the investigation of correlations between human behaviour and artefact typologies by concentrating on particular phenomena (Binford 1977, 1978). The advantage to using middle-range models lies in their ability to avoid the elaboration of too narrow empirical models that seek to give explanations for global systems and are often confronted with problems concerning exceptions to established laws on an inter-regional level. Middle-range models focus on separate, measurable aspects of larger systems and are therefore more apt to providing spatial and temporal correlates of behaviour and ethnographic data that can be shown to correspond with patterns in material culture and allow for inter site comparisons (*ibid.* 1978). Middle-range theories therefore allow for the evaluation of the validity of broad universal interpretive models (hypotheses/theories) that cannot be directly tested against empirical data (*i.e.* hunter-gatherer subsistence models). Middle range models can be used both to establish patterns on lower levels (site location and site structure, and site catchment) and in the analysis of variation in the corresponding environmental contexts (Bettinger 1991; Gamble 1984).

Postprocessual archaeology

Strong criticism in the late 1970's and 1980's of the broad application of normative and predictive models to the study of human behaviour has brought more focus to issues concerning human agency and subjective interpretations of archaeological remains in the form of postprocessual archaeology. In direct opposition to positivist processual approaches, postprocessual archaeologists propose an essentialist position (free-will and human agency in opposition to a perception of passive individuals confronted with various types of determinism) that holds that the inherent idiosyncratic variation in human behaviour and culture does not allow for the development of universal laws for interpreting human adaptation. Cultural relativism and subjective research perspectives, along with a return to Boasian precepts concerning free-will, are the central pillars of postprocessual philosophical positions and methodologies. Postprocessualists often focus on symbolic, structural, and critical approaches to studying archaeological data. Criticism of processual archaeologies' obsession with economic and techno-functionalist constructs is evident in the postprocessual movement towards the study of ideological and symbolic systems of thought and organization and their direct influence on the variability displayed in human behaviour (polysemic interpretations). Ian Hodder (1982) demonstrated the utility of postprocessual research frameworks in his ethnoarchaeological surveys in sub-Saharan Africa, through which he was able to show that material culture not only reflects socio-political organization, but is also a tool that can be used to manipulate, distort, and disguise social relations (*ibid*.:119). According to Hodder, individuals or groups can actively manipulate material culture to legitimize social or political positions, establish hierarchies, signal resistance within groups, and even express inter-family relationships. In American archaeological circles, the postprocessual school of thought was initially adopted with hopes of countering the effects of ethnic prejudice on interpretations of prehistoric and historic societies (Trigger 1984). Postprocessual approaches also allowed for the assimilation of burgeoning feminist domains of study and for confronting problems concerning gender bias in the professional archaeological arena (Wylie 1996). While division persists between processual and postprocessual archaeologists concerning global research perspectives, it is now widely recognized that cultural explanations can be useful for those idiosyncratic aspects of the archaeological record that cannot be comprehensively or exclusively understood through the application of ecological, adaptationist frameworks. Many archaeologists now advocate the use of both approaches, while rejecting the extremist stances of both schools of thought such as radical positivism, Neo-Darwinism, and relativism/contextualism (see Hegmon 2003; Trigger 1996).

1.2 Zooarchaeology

Zooarchaeology focuses on the interactions between humans and animals and the ensuing consequences of those interactions and relationships for humans, animals and the environment. The two ‘basic goals’ of zooarchaeological analysis are: (1) the reconstruction of palaeoecological conditions; and (2) the reconstruction of hominid subsistence patterns (see Lyman 1994:2; Reitz and Wing 1999). Within the framework of theoretical paradigm change and the evolution of dominant methodological approaches described above, zooarchaeology has developed into a multidisciplinary domain of study that borrows from both anthropological and archaeological theory, without having established any pre-eminent, overarching theoretical framework of its own. The three central ‘facets’ of modern zooarchaeological orientations are methodological research, anthropological research, and biological research (Reitz and Wing 1999:27). Due to the fact that none of the broader approaches to subsistence studies described in the previous section is designed for direct application to faunal assemblages (outside of Binford’s ethnoarchaeological models), zooarchaeologists tend to focus on explanatory models relevant only to the interpretation of faunal remains, incorporating a mixture of ecological anthropology and processual methodology with cultural resource management approaches concerning human behaviour and cultural adaptation. Middle-range theory plays an important role in zooarchaeological research, specifically due to its consideration of site formation processes. Especially important to zooarchaeology is research concerning cultural formation processes such as butchery, transport decisions, and functional analyses of sites (kill sites, processing sites, preparation areas, habitations, etc.), as well as predictive behavioural strategies that aid in defining subsistence practices through faunal assemblage analysis (Binford 1978; Lyman 1994, 2008; Reitz and Wing 1999). Both behavioural archaeology (Schiffer 1976) and ethnoarchaeology provide important information for zooarchaeologists, allowing them to analyse site formation along side specific behavioural processes (Binford 1978; Grayson 1984; Lyman 1994, 2008). Site catchment analyses, a middle-range approach which focuses on economic analysis and is based on ecological principles, provides a methodology for interpreting resource management and exploitation patterns for prehistoric groups as well as the development of adaptive models for subsistence strategy analyses (Bettinger 1991).

While postprocessual approaches have not yet greatly influenced zooarchaeological practices, it is becoming increasingly evident that interpretations of subsistence practices lack objectivity in the same way that processual archaeological and anthropological studies regularly do (Amorosi *et al.* 1996:127). Calls for a more objective approach to faunal analyses and the inclusion of studies concerning social and cultural meaning, social stratification, gender studies, and cognitive research are becoming more numerous in zooarchaeology (Reitz and Wing 1999: 29; Thomas 1996:3).

The methodological framework applied in the present work is predominantly processual, inductive and probabilistic, but strives to incorporate interpretive processes concerning symbolism, ideology, and the perception of both the resources and the physical environment of the prehistoric group under study. Ethnographic accounts play an important role in Arctic studies, providing data for the development of middle-range theories. Ethnographic analogies are thus provided where possible as a guide to the interpretation of the faunal assemblage under study. The basic faunal analysis is based upon a quantitative study of abundances and frequencies of species and skeletal elements in the assemblage, along with a taphonomic analysis and the interpretation of subsistence strategies through the application of meat weight calculations, economic utility indices, and bone density indices (Binford 1978; Hesse and Wapnish 1985; Grayson 1984; Lyman 1994, 2008; Schiffer 1976).

Chapter 2: Arctic Prehistory and the Ancient Arctic Cultures

The study of human adaptation to different regions of the world implies not only the analysis of the cultural remains of ancient societies but also an in-depth examination of the environments in which they developed. Hunter-gatherer peoples, or groups whose subsistence practices do not include agriculture or animal husbandry, have successfully migrated to and inhabited most of the world's ecosystems. Due to the wide variety of physical conditions prevalent in these different environments, humans have developed an equally large gamut of adaptive responses to their habitats. Environmental stress is a primary catalyst in the adaptation of human groups to varied habitats and few, if any, ecological regions on the planet can be shown to provide physical circumstances as severe and hostile as those prevalent in the Arctic. The singularly arduous nature of the Arctic environment, extreme in both climate and physical setting, has produced a series of cultures which, through the analysis of their archaeological remains, can be shown to have achieved well balanced economic strategies throughout the span of prehistory and across the territory (Maxwell 1985).

The goal of this chapter is to outline the arrival of human groups in the Arctic environments of North America and Greenland and to give a general overview of the evolution of the ancient Arctic cultures, their occupation sequences, their differing economic strategies, and the factors that motivated culture change in the Arctic sequence. A brief discussion of the history of research in the Arctic is also given with the intention of exposing the difficulties inherent to identifying, dating, and temporally and culturally organizing sites from Arctic contexts.

2.1 The Peopling of the Eastern Arctic

The term 'Eastern Arctic' is difficult to define from an archaeological perspective. The delimitation of the cultural region of influence varies, as is the case for many domains of study in archaeology, and these variations are often based on the delineation of specific regions of interest and differing temporal-cultural approaches. The region defined as the Eastern Arctic by Moreau Maxwell (1976:3) is pertinent for the purposes of this work and delimits the 'eastern cultural configuration' as stretching from the western shores of Banks and Victoria Islands at the westernmost boundary, along the north coast of Canada, through Foxe Basin and Hudson Bay, around the coast of the

Ungava and Labrador Peninsulas, south to Newfoundland, and north to the High Arctic Islands and Greenland (Figure 1 below). The peopling of this region was a complex process and the factors motivating both the initial migration to and the subsequent colonization of the Eastern Arctic remain under study.

2.1.1 The Colonization of the New World

The initial migration of humans to the New World (North and South America) is a process that, despite long-term intensive research, continues to pose problems for researchers. Both the timing of the migrations and the exact route of passage to the New World are subject to vigorous debate within the scientific community. However, there is strong support for the hypothesis that the first groups of migrants to the New World passed through the Bering Strait region, from eastern Eurasia and what is now Siberia (see Maxwell 1985). General consensus also holds that the expansion of modern humans into most western regions of North America and into South America was accomplished by between 15,000 and 13,000 years ago (Goebel *et al*. 2008). Exactly how these first migrants traveled through the Bering Strait region, and by which routes they expanded into North America and across the Arctic, are questions that continue to present problems to researchers.

Portions of the north-eastern reaches of North America remained uninhabitable until about 6500 years ago due to the presence of Pleistocene glacial ice fields, notably in the regions of Foxe Basin and Hudson Bay. Archaeological evidence indicates that the initial colonization of the Eastern Arctic did not occur until near 4500 B.P. (*terminus post quem*), well after the retreat of the remnant glacier ice (6500 B.P.), and during a period of climatic warming (Subboreal Holocene phase 5700–2600 B.P.) (see Maxwell 1985). Currently, sites from the earliest human occupations in Greenland, the easternmost point of migration of early Arctic groups, date to 4450 B.P (Mobjerg 1986). Once it had begun, the process of colonisation of the Eastern Arctic was rapid and was most likely completed within a period of 500 years (Maxwell 1985:37 and 48).

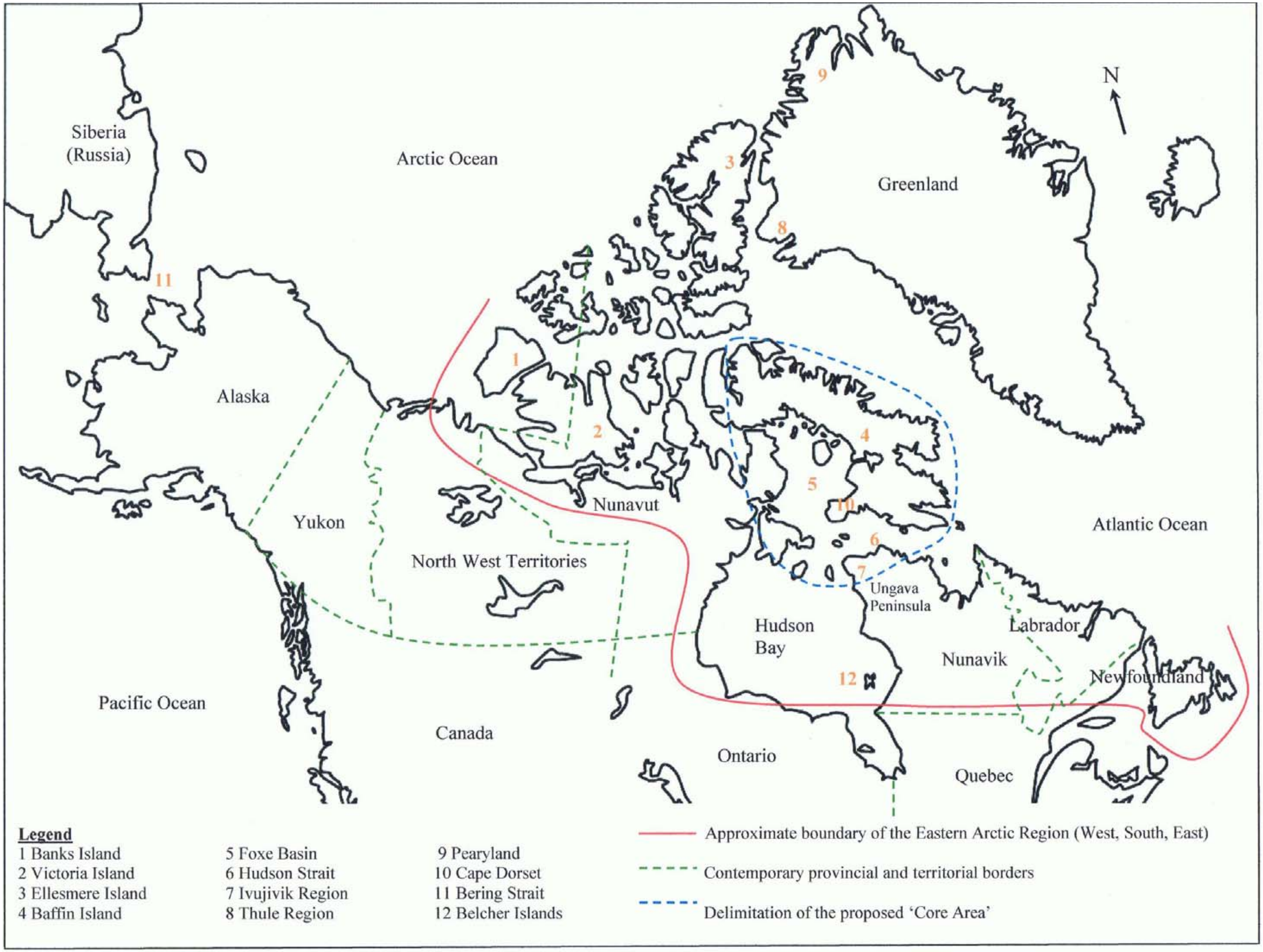

Figure 1: Map showing locations of places mentioned in the text.

2.1.2 Migration to the Eastern Arctic

Possible motivating factors behind the movement eastward are both plentiful in number and hypothetical in nature. Suggestions that climate change prompted early Arctic groups to move from Alaska and the Western Arctic are highly plausible but difficult to demonstrate through a study of the archaeological record. However, major climatic fluctuations can be shown to have occurred over the past 5000 years and reconstructed environmental conditions for the period of initial migration to the Eastern Arctic indicate that the prevalent air and water temperatures were warmer and drier than in the 4000 years since (Barry *et al.*1977; Mudie *et al.* 2005). These favourable climatic conditions, along with the diversification of eastern flora, could have brought about an influx of both humans and animals into the east, which would have created an optimal subsistence environment for the early Arctic migrants. Population pressure in the Western Arctic region, due to the prevalent climatic warming trends, could also have played an important role in triggering a movement eastward. An increase in demographic pressure could have motivated early Western Arctic groups to follow eastwardly migrating animal herds in order to reduce the stress on local environments (Knuth 1967; Maxwell 1985:52; Steensby 1917). Expanding populations in the west and improving environmental conditions in the east both appear to have been important factors motivating an eastward migration of early Arctic peoples; however continuing research in palaeo-environmental and palaeo-climatic domains is necessary in order to provide more supportive evidence for these hypotheses.

2.1.3 The Origin of the Eastern Arctic Palaeo-eskimos

Three possible regions of origin have been proposed for the early peoples that migrated to the Eastern Arctic of North America. Firstly, it has been suggested that the initial occupants of the Eastern Arctic could have descended from prehistoric Amerindian groups that moved northward and adapted to the Arctic climate (Collins 1937; Mathiassen 1935, 1936; Steensby 1917; Strong 1930). Second, several researchers postulate that Eastern Arctic groups originated on the western coast of Alaska and are ancestral to maritime hunter peoples who gradually moved eastward while adapting to different regional environmental conditions (Collins 1934; Seltzer 1933). The third place of origin proposed for early easterly migrating groups is a relatively undefined region spanning from the central coast of the western Arctic in Alaska to the northern interior of the Central Canadian Arctic (Birket-Smith 1929; McGhee 1976; Steensby 1917). Theories that propose a link between early Amerindian groups and the initial inhabitants of the Eastern Arctic suffer primarily from a lack of supportive evidence. Elmer Harp (1964, 1974), William Fitzhugh (1972, 1976) and James Tuck (1976), have shown that, given the dates available for early Eastern Arctic sites and their spatial distributions, only limited contact (and little to no cultural exchange) between Arctic and Amerindian groups could have occurred (see also Rasmussen *et al.* 2010). Evidence to support an initial eastern migration from either the interior of Alaska or the north coast of Alaska and the Central Arctic region, is both more abundant and more convincing (see Giddings 1964; Irving 1957; McGhee 1976). It is now generally accepted that the Arctic was initially populated by peoples originating from eastern Siberia who migrated to the Alaskan coast and then moved eastward as far as Greenland and south as far as Newfoundland while adapting to regional climates and environments. The link between Western Arctic and Eastern Arctic cultures is exposed in greater detail in the following section that deals with the Palaeoeskimo period.

2.2 The Prehistoric Arctic Cultures

Studies concerning the earliest Arctic cultures were initially, and for a considerable period, dominated by a cultural-historical approach that was basically descriptive in both nature and function. Developments and shifts in theoretical and methodological approaches to studying culture change in the Arctic can be loosely divided into the three following periods: 1) the inception of the cultural-historic approach that lasted from the late 1800’s until the 1950’s, wherein the first veritable ethnographic studies of modern Inuit groups (Franz Boas 1888) coincided with initial studies concerning the definition, description and temporal organization of Arctic cultures, which lead to; 2) the development of the cultural-historic approach accompanied by the multiplication of field research projects and the consistent re-tooling of chronological boundaries (specifically after the advent of carbon dating methods) between the 1950’s and the 1970’s, and finally; 3) the general adoption of processual archaeological methods of study that included (among others) settlement pattern analyses, use-wear studies, typological comparisons, and complex statistical methods of analysis that remain the basis of archaeological studies today (for detailed examples see Desrosiers 2009: 111-119).

The colonisation of the New World was brought about through a series of 'waves' of migration from the Eurasian continent. These successive migrations resulted in the adaptation and development over time of groups of different cultural origins to the Arctic. In order to distinguish between the pioneering groups that initiated the migration and settlement of the Arctic, and groups that arrived later, archaeologists have adopted the terms 'Palaeo-Eskimo' and 'Neo-Eskimo'. This terminology was first introduced in the literature by the Danish ethnographer H.B. Steensby in 1917, in an early attempt to differentiate between the origins of modern Inuit groups and those of the earliest Arctic peoples. Through the application of geographical principles (seasonal adaptations and the movements of peoples through differing geographical and climatic regions), Steensby elaborated a general scheme of movement for Palaeoindian and Palaeoeskimo groups. Steensby described the peoples of the Palaeoeskimo period as mobile Palaeoindian 'musk-ox hunters' who had become 'Eskimo' peoples by adapting to the Arctic environment while following migrating animal herds (musk ox) northward and across the Arctic territory. In contrast, the Neoeskimo period groups were characterized as highly organized 'whale hunters' originating from a later wave of migration (*ibid.*). The terms now refer to both the people (Palaeo-Eskimos and Neo-Eskimos) involved in the migrations across the Arctic, and to the cultural periods (Palaeoeskimo and Neoeskimo) within which different regional and cultural occupation sequences are defined. The greater antiquity of the Palaeoeskimo cultures has been well demonstrated and universally accepted within the scientific community. The spatio-temporal boundaries for the cultures that fall within the two periods, however, are far from fixed within the discipline.

Chronologies for Palaeoeskimo and Neoeskimo cultures must be defined on a regional level due to the extent of variation in both the material culture and the suites of radiocarbon dates for differing regions. This regional variation fuels an ongoing debate within the research community and has thus far only served to further emphasize the incompatibility of the existing temporal sequences. Problems concerning the overlap of separate cultural entities, both within specific regions of study and between regions, have caused many researchers to develop individual terminologies and chronologies, a practice that has greatly complicated the study of the Arctic cultures as a whole. Definition of, and agreement on, a specific terminology and temporal framework for Arctic studies is both long overdue, and imperative to the continuation of the discipline. The Palaeoeskimo and Neoeskimo periods, for the purposes of this work, are defined regionally (see Figure 2 below). Generalized shifts in settlement and subsistence patterns for groups of cultures have also been described in order to facilitate the outlining of the history of research in the Arctic and the basic trends in culture change over time. Succeeding sections of this work will endeavour to present precise regional sequences within these two broad periods where possible.

Today, it is generally agreed that the term Palaeoeskimo refers to a group of ancient Arctic cultures that were present in portions of the Canadian High Arctic, Nunavut, Nunavik, Central and Northern Labrador, and both the High and Low Arctic regions of Greenland. The Palaeoeskimo period can be further divided into Early Palaeoeskimo (4500–2500/2200 B.P.) and Late Palaeoeskimo (2500/2200–1000/650 B.P.) sequences; the early phase includes a number of culture variants that will be exposed in the following section; the late phase is associated specifically with the Dorset culture. The Neoeskimo period, which is equated with the Thule culture, dates to between 1000 B.P. and 350 B.P. As stated earlier in this chapter, the Palaeoeskimo and Neoeskimo cultures are representative of the migrations of culturally distinct peoples across the Arctic territory. Palaeoeskimo cultures can be shown to have a certain degree of interrelatedness regardless of the regional variations that the different occupations present; the Neoeskimo Thule culture is a similar but unrelated cultural entity that appears later in the archaeological record and is shown to be based on unique settlement patterns and subsistence strategies.

2.2.1 The Palaeoeskimo Period

Because the elaboration of a precise chronology for the Arctic is so greatly hampered by regional variation, a regional chronology is given here that shows the Arctic as divided into six areas of study and gives the regional cultural taxonomies; this temporal framework will serve as the basis for inter-regional comparison for the remainder of this work (Figure 2).

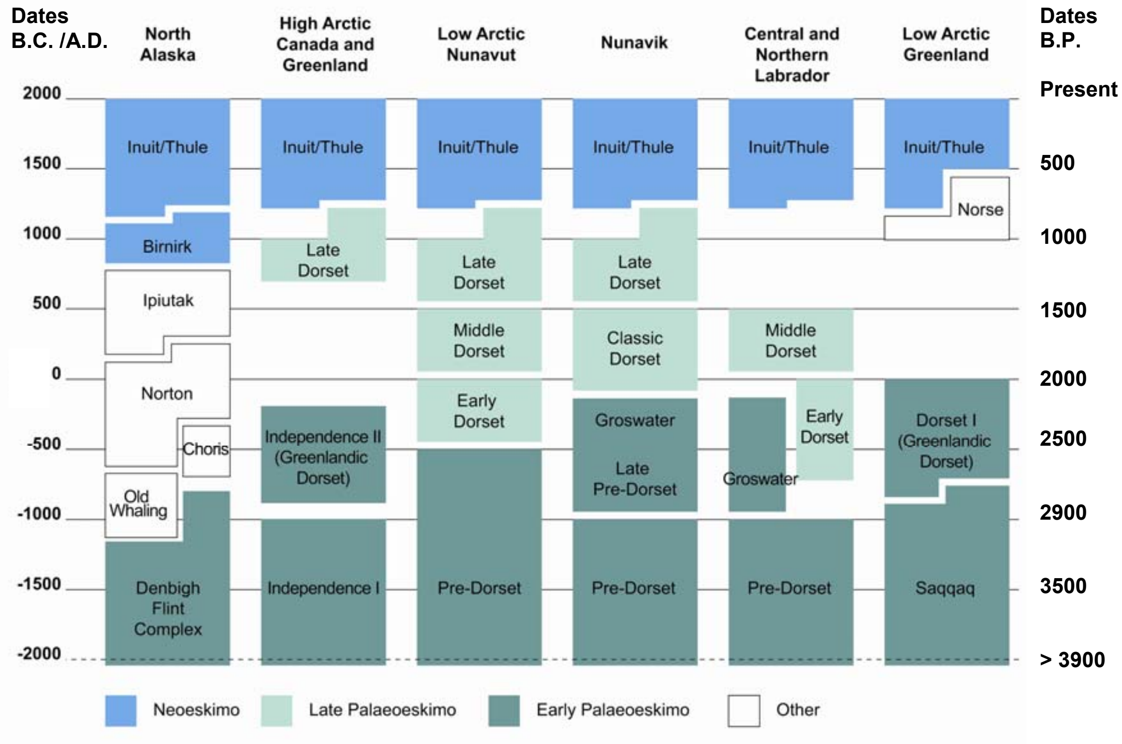

Figure 2: Arctic chronology with taxonomic categories (Avataq Cultural Institute 2011: http://www.avataq.qc.ca/en/Institute/Departments/Archaeology/Discovering-Archaeology /Arctic-Chronology). ***Dates given are approximate.***

The Early Palaeoeskimo period includes the Independence I & II (High Arctic of Canada and Greenland), the Pre-Dorset (Low Arctic of Canada, Nunavut, Nunavik and Labrador), the Denbigh Flint Complex (Alaska), and the Saqqaq (Low Arctic of Greenland) cultures, which date to approximately 4450 B.P. at the earliest. The Late Palaeoeskimo period is equated primarily with the Dorset culture[1]; sites pertaining to the Dorset sequence can be found across the Eastern Arctic and Greenland and can be loosely chronologically delimited to between 2500 B.P. in Nunavut, Labrador and Greenland and 2200 B.P. in Nunavik at the earliest, and 650 B.P. at the latest (Desrosiers *et al.* 2008).

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[1] Taxonomic terminologies for the Dorset period also differ between regions of study. The different terms will be exposed in the section pertaining to the Dorset culture later in this chapter.

2.2.2 The Arctic Small Tool Tradition

Prior to the late 1950's, only the Dorset culture was recognized as predating Thule culture in the Arctic sequence. The work of Louis Giddings (1964) at Palaeoeskimo sites in Alaska (Choris Culture), brought to light the Denbigh Flint Complex in the early 1960's which, in conjunction with the works of Eigil Knuth in Pearyland (1954) and Jorgan Meldgaard in Greenland (1952, 1960a, 1960b), gave way to the definition of a single primary microlithic tradition (or cultural source) for the entire spectrum of material from sites that predate the Dorset culture (Early Palaeoeskimo period), and span the Arctic territory from Alaska to Greenland. That primary cultural tradition, defined by William Irving in 1957 as the Arctic Small Tool Tradition[2], includes a number of distinctive elements, namely the spalled burin (Irving 1957, 1962; Maxwell 1976, 1985). The spalled burins of the ASTt toolkit are of a wide range of shape, size, and function and, aside from their spectrum of possible uses, also serve to distinguish Early Palaeoeskimo assemblages from those of the Late Palaeoeskimo period and from prehistoric Amerindian assemblages (in which spalled burins are absent). A number of theories concerning cultural exchange between Amerindian groups and Palaeoeskimo groups have been put forth during the development of the Arctic cultural sequence, but all have since been discounted in the scientific community (Collins 1937; Mathiassen 1935, 1936; Maxwell 1976, 1985; Steensby 1917; Strong 1930). The question of relatedness of ASTt material with Amerindian assemblages, and with sites across the Arctic, not only served as the catalyst for separating Amerindian sequences from Arctic ones, but also motivated the movement towards the study of relatedness between Arctic groups of the Palaeoeskimo period. Numerous aspects of material culture are seen to differentiate Early and Late Palaeoeskimo sequences, namely bow drills, bow and arrow technology, and spalled burins, all of which are conspicuously absent from later Dorset assemblages (in which only ground or polished burins and burin-like tools are evident). The exclusion of the Dorset culture from the ASTt complex was outlined simply by Irving as follows: "Dorset culture is chronologically later than most of the Arctic Small Tool tradition sites, it has a different albeit overlapping geographical distribution and its technology in bone and ground stone is readily distinguishable from anything found in the Arctic Small Tool

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[2] The Arctic Small Tool Tradition is hereafter referred to as ASTt.

tradition. Therefore, Dorset is not included in the tradition.” (Irving 1970: 340). The basic components of the ASTt toolkit can be found at Early Palaeoeskimo sites distributed across the Arctic from the Bering Strait region to north-eastern Greenland, with minimal differences in artefact form between regions (Maxwell 1985).

2.2.3 Early Palaeoeskimo

The Early Palaeoeskimo period is, first and foremost, characterized by variation on the level of regional cultural sequences that are visible through the analysis of material culture remains, site distributions, and temporal discontinuities (see Figure 2). This variability can be explained in part through fluctuating demographics and population movements that were part of the mobile and flexible settlement pattern and social system structure characteristic of groups from this period. The population movements of early Palaeo-Eskimos brought about an expansion into regions of the Arctic that differed in terms of both the availability and the abundance of resources. Seasonal nomadism was the predominant settlement and subsistence strategy of Early Palaeoeskimo groups and inconsistencies in the material cultures from this period tend to reflect differing adaptations to regional conditions (see Maxwell 1985; Nagy 1997).

The study of Early Palaeoeskimo expansion has produced a number of approaches and models that attempt to explain the variability between the cultural entities. The highly controversial ‘core area’ model proposes that Palaeoeskimo groups show a more continuous intensive occupation in a specific resource-rich region of 1000 km in diameter that covers Hudson Strait and upper Hudson Bay, Foxe Basin and both Fury Strait and Hecla Strait (see Figure 1) (McGhee 1976; Meldgaard 1960a). Demographic pressure in the ‘core area’ would have resulted in some groups moving into peripheral ‘fringe areas’ where they were forced to adapt to poorer economic conditions and thus the differences in the material culture can be seen as the product of regional development of inherently related groups. The ‘core area’ model has been shown to be the product of a lack of conclusive research in the regions defined as the ‘fringe areas’. The proposal that climate change (warming and cooling trends), and the subsequent fluctuations of animal resources, affected an expansion of populations in the Early Palaeoeskimo period, and a deterioration leading into the Late Palaeoeskimo period, was put forth by Fitzhugh in

1976. A retreat from the ‘fringe areas’ back to the core area would have, according to Fitzhugh, brought about social and demographic imbalance within the ‘core area’ and resulted in the changes in settlement and subsistence strategies that mark the transition to the Late Palaeoeskimo period. Continuing research in the High Arctic and Newfoundland has, however, shown that Palaeoeskimo occupation of the proposed ‘fringe areas’ was both long-term and substantial, thus disproving the proposal that occupation was discontinuous in peripheral regions (Helmer 1992; Renouf 1994; Schledermann 1990). Demographic models continue to play an important role in the study of Early Palaeoeskimo expansion, and variations on environmental and population movement models remain under debate within the discipline, but the environmental-demographic applications of the ‘core area’ model have today been largely discounted.

Population movements and cultural exchange on a smaller regional level can perhaps better explain the differences between groups during the Early Palaeoeskimo period. Exchange between peripheral regions and the general stability of local populations could account for the technological innovation in the previously discussed ‘fringe areas’ that would be recognizable when compared with the ‘core area’ material (Schledermann 1990). Continuing research in the ‘fringe areas’ will hopefully help to spread light on the unique nature of Early Palaeoeskimo cultures, their spheres of interaction, and their inter-regional development.

2.2.4 Radiocarbon dating and the transition to the Late Palaeoeskimo period

The advent of radiocarbon dating (C_{14}) in 1949 was an important factor in the development of new approaches to the study of culture changes that occurred between the Early and Late Palaeoeskimo periods in the Eastern Arctic. Radiocarbon dating procedures supplied the initial impetus for the re-defining of the Arctic chronology during a period when researchers were in search of features that could help explain both the timing of the migration to the eastern Arctic and the relatedness between western and eastern complexes. However, radiocarbon dates for sites from Arctic contexts can be highly unreliable due specifically to a lack of organic material that is suitable to testing, and to known discrepancies of corrective factors between marine and terrestrial sources (reservoir effect) and problems dating driftwood (Maxwell 1985:42). Collecting difficulties and differing approaches to statistical analysis also complicate the process of dating Arctic sites. These problems are even more acute in the Eastern Arctic where a number of the earliest sites identified contained no organic material that could be tested (Maxwell 1985*:* 42-45). Specific regional radiocarbon dating sequences have, however, been successfully corrected using laboratory derived approaches that discriminate against the manipulation of data to conform to personal theories. Several suites of carbon dates for Pre-Dorset and Dorset sites are available and most have been either corrected or re-calibrated at least once, if not several times (and by different researchers) (see Arundale 1981; Desrosiers 2009: 129–132; Maxwell 1985:77; McGhee and Tuck 1976: 8-12). This being said, Arctic chronologies continue to rely heavily upon relative regional chronological sequences developed through the analyses of distinct artefact styles and inter-site comparisons concerning altitude (elevations of beach ridges), stratigraphy, technological complexes, and associated faunal assemblages.

2.2.5 The Pre-Dorset to Dorset Transition

Meldgaard's research in Foxe Basin (1960), in conjunction with the proposal of an *in situ* development of Dorset groups by Laughlin and Taylor (1960), mark the first steps in the attempt to define the relationship between Pre-Dorset and Dorset cultures in the heart of the Dorset sphere of influence. Widespread acceptance of a link between Pre-Dorset cultures and Dorset culture came with William Taylor's work on the Tayara and Arnapik sites in 1968. Taylor was able to give a detailed report of Dorset stratigraphic deposits at Tayara, and showed a continuity of artefact classes between the Tayara site (Dorset) and the Arnapik site (Pre-Dorset), therefore giving strong support to the *in situ* development hypothesis (Murray 1996; Taylor 1968). The nature of the link between Early Palaeoeskimo cultures and the (Late Palaeoeskimo) Dorset culture, however, remain under question with certain parties supporting the hypothesis that the two complexes form a cultural continuum (Maxwell 1985) or that the two are part of the same cultural complex but are arbitrarily separated in the literature (Desrosiers 2009), and others proposing that they are "distantly related but separate entities" (see Murray 1996; Tuck and Ramsden 1990).

The Late Palaeoeskimo period, which is equated primarily with the Dorset culture, can be loosely chronologically confined to between 2500 B.P. and 650 B.P. in the Low Arctic of Nunavut, High Arctic of Canada and Greenland, and to between 2200 B.P. and 800 B.P. approximately in Nunavik (Desrosiers *et al.* 2008; Desrosiers 2009). The shift from Early Palaeoeskimo ways of life to the more structured economic organization of the Dorset people is, however, difficult to define both spatially and temporally. Certain researchers support the definition of a 'transitional period' between the Pre-Dorset and Dorset cultures that is proposed to have taken place between 2800-2500 B.P. (see Nagy 1997:2-3, 2009:6-7). The concept of a 'transitional period' in the Palaeoeskimo sequence has met with a certain amount of resistance in the research community and, while there is general agreement about a degree of relatedness between Early and Late Palaeoeskimo groups, there is no consensus concerning the question of whether a 'transitional period', and the classification of 'transitional sites', can be considered theoretically relevant (*ibid.* 1997, 2009).

As exposed in the previous section, the nature of the link between Pre-Dorset and Dorset cultures is difficult to define. What is obvious to researchers now is that, nearing the end of the Early Palaeoeskimo period, changes in subsistence strategies and settlement patterns become evident in both the material culture and site distributions, as well as in the faunal remains collected at archaeological sites. The lack of general consensus focuses on several aspects of the shift to Dorset ways of life but is most notably concerned with two specific points of debate, namely: 1) which sites can be labelled as transitional, and; 2) the nature and the timing of the transition.

As is the case for Early Palaeoeskimo sequences in general, the transition from the Pre-Dorset culture to Dorset culture is also highly variable on a regional level. The emergence and disappearance of various cultural traits during the proposed 'transitional period' have most often been linked to important environmental changes that would have lead to the new technological and economic adaptations apparent in the proceeding Dorset occupations (see Nagy 1997). Explanations for this transition are numerous and include: the adaptive adjustment of human groups to diminishing caribou herds (Fitzhugh 1976); climate change and population decline in the Eastern Arctic near 2800 B.P. and expansion again at 2400 B.P. (McGhee 1981); the merging of land mammal and sea mammal hunting economies during a time of climatic cooling (Maxwell 1976) and even; the possibility of influences on Dorset groups emerging from groups living in the Western Arctic (Arnold 1981; Taylor 1968). Another plausible sequence of cultural adaptation, put forth by Renouf in 1993, combines certain elements of the aforementioned proposals and suggests that cooling climatic conditions after 3000 B.P. (peaking between 2600 and 2500 B.P.) brought about a generalization in subsistence practices and a reduction in group size to allow for better mobility during the proposed ‘transitional period’. Renouf completes the sequence by proposing that a climatic warming trend that stabilized resources near 2200 B.P. brought about renewed specialization in subsistence practices in the form of intensive marine mammal exploitation which characterizes Early Dorset occupations (Renouf 1993: 205).

While climate change and shifts in resource availability can plausibly be said to have affected culture change in the transition between Pre-Dorset and Dorset periods, more data is necessary to complete the definition of the sequence of events that brought about the shift to Dorset ways of life. Continuing field research is necessary in order to identify sites that show ‘transitional’ traits, and the elaboration of more precise carbon dating sequences for the different regions concerned will undoubtedly bring about changes in the understanding of this process.

2.3 The Dorset Culture

Within the framework of the debate concerning the Pre-Dorset to Dorset transition, several proposals have been made that attempt to explain the process of development of the Dorset culture. First, as mentioned earlier, several researchers have suggested that the Dorset culture developed from local Pre-Dorset cultures, or through *in situ* development (Maxwell 1985; Nagy 1997; Schledermann 1990; Taylor 1968); secondly, the proposal of a diffused influence from a High Arctic transitional complex has also been put forth (see Knuth 1981; Maxwell 1985:117-118); and it has also been suggested that initial development of the Dorset culture took place in one culture centre (Foxe Basin) and was then carried outward by diffusion and migration (Mary-Rousselière 1976).

The Dorset culture first appeared in the literature in 1925 when Diamond Jenness introduced what he then called the ‘Cape Dorset Culture’ in a work concerning the newly identified Thule complex. Jenness, having analyzed a collection of artefacts from several sites in the region of Cape Dorset (Baffin Island) that were of mixed cultural affiliations, was able to distinguish the Dorset material from that of the Thule by means of an analysis of the differences in harpoon head manufacture, and degree of preservation. Jenness suggested that the Dorset culture was ‘more primitive’ than that of the Thule and also underlined that the Dorset was not the ‘culture of the first Eskimos’ who settled the Eastern Arctic region (Jenness 1925:435-437). In the 85 years since Jenness’ initial identification, the Dorset cultural sequence has been redefined in terms of its representative cultural traits, chronological boundaries, and the distribution of sites pertaining to the sequence. The following section includes a discussion of the Dorset period chronology and terminology, a general outline of Dorset life ways and material culture traits, and a brief analysis of the unique style of art that has come to define the Dorset people.

2.3.1 Chronology and Terminology

Certain researchers propose that the Dorset period can be separated into early (2500–2000 B.P.), middle (2000–1400 B.P.), and late phases (1100-650 B.P.) (see Maxwell 1985), while others support a ‘transitional period’ between Pre-Dorset and Dorset culture sequences with intermediate and later manifestations of the Dorset culture (Nagy 1997). These temporal boundaries are, of course, dependant on methodological perspectives and regional variation. Regional manifestations of Dorset culture are classified based on visible changes in the material culture and associated faunal assemblages. Depending on the region of study, the initial manifestations of the Dorset culture are often labelled differently and can fall into either the Early Palaeoeskimo or the Late Palaeoeskimo period boundaries. In the Hudson Strait region, these ‘transitional’ sites are termed ‘Late Pre-Dorset/Groswater’ or ‘Terminal Pre-Dorset’ (Desrosiers *et al.* 2008; Ramsden and Tuck 2001), while in Labrador the terminology commonly used is either ‘Early Dorset’ (Cox 2003) or ‘Groswater Dorset’ (Fitzhugh 1972) depending on the site, and in both the High Arctic and Low Arctic of Canada and Greenland the transitional phase corresponds with the 'Independence II' and 'Dorset I' cultural sequences (see Figure 2) (Desrosiers *et al.* 2008; Knuth 1968, McGhee 1981). Suggestions for renaming the final phase of occupation as 'Terminal Dorset' were also put forth by Maxwell (1985) in order to address the question of contact between Dorset and Thule groups (see also Pinard and Gendron 2009).

Recently, Pierre Desrosiers has suggested classifying Early and Middle Dorset together as one temporal phase called the 'Classic Dorset', covering the period between 2200 B.P. and 1500 B.P. for the Nunavik region (Desrosiers 2009). This proposition comes on the heels of a period of intensive research concerning Palaeoeskimo and Neoeskimo occupations in Nunavik. According to new radiocarbon dates, Early Dorset sites dating to the 2500 – 2300 B.P. range are absent in Nunavik. New dates for the Tayara site, originally identified by Taylor in 1968 and subsequently used as the holotype for defining the Early Dorset, now show that this site is temporally situated between the Early and Middle Dorset range (2200 B.P.). This date therefore marks the beginning of the Dorset sequence in Nunavik. The failure to tie the Nunavik Dorset sequence in with the earliest Dorset manifestations in other areas is, according to Desrosiers, good cause to create a new chronological category that could effectively incorporate all early Dorset sites while retaining the use of the Late Pre-Dorset taxonomy for sites occurring earlier than 2200 B.P., and specifically to sites that date to the proposed 'transitional period' (*ibid.*). This development is particularly pertinent to this present work because it concerns the specific region in which the site under study (KcFs-2) is located. The Nunavik Palaeoeskimo sequence, which is the chronology applied to the present study, can be broadly summarized as Pre-Dorset (3900 B.P – 2900 B.P.), Late Pre-Dorset/Groswater (2900 B.P. – 2200 B.P), Classic Dorset (2200 B.P. – 1500 B.P.), and Late Dorset (1500 B.P – 800 B.P.) (see Figure 2).

The most recent re-working of the Dorset occupation sequence (Figure 2, page 19), outlines the regional Dorset sequence as follows: the High Arctic of Canada and Greenland show no intermediate or 'Middle' phase Dorset occupation between the Independence II and Late Dorset periods; the Low Arctic of Canada and Nunavut have a continuous occupation sequence from the Pre-Dorset period through to the Late Dorset period; the Nunavik region shows general continuity between the Late Pre-Dorset period, the Groswater period, and the Classic Dorset through Late Dorset sequence; Labrador shows two early Dorset occupations (Groswater and Early Dorset) and a Middle Dorset sequence, but no Late Dorset period occupation; and finally the Low Arctic and Greenland has only one early sequence: the Dorset I period (Avataq 2011; Desrosiers *et al.* 2008).

What becomes obvious in the above description is that the same problems that plague the study of Early Palaeoeskimo cultures apply equally to the Dorset sequence. As is the case with the Early Palaeoeskimo period, the Dorset period presents a number of problems concerning the temporal overlapping of Early Palaeoeskimo occupations with Dorset occupations, and discontinuity of Dorset occupations in the different regions of Dorset activity. Regardless of the difficulties in precisely delimiting the spatio-temporal framework for the Dorset period, it is possible to define the Dorset culture both in relation to earlier Palaeoeskimo cultures and to the later Thule culture, and also with regard to the different phases of development within the Dorset period itself.

2.3.2 Settlement and Subsistence

The first in-depth study of Dorset settlement patterns came in the form of Fitzhugh's 1972 work in Labrador. Fitzhugh described the Dorset settlement strategy as a 'modified-maritime system' in which Dorset peoples were adapted to year-round marine mammal exploitation, with no more than 30 to 50 individuals living in the same subsistence region, and with the formation of living groups being predicated on the nuclear family unit (Fitzhugh 1972:161). Evidence that indicates a shift towards intensive fast-ice hunting and marine-mammal exploitation appears in the archaeological record at the time of the transition from Pre-Dorset to Dorset ways of life. Distinctively Dorset items such as ice creepers, snow knives, and hand-pulled sleds all indicate an adaptation to the cooling period that occurred at the time of the transitional phase and caused a change in economic organization (Maxwell 1985:167).

From the late Pre-Dorset period to Early Dorset period, differences in settlement size and location are visible, with Early Dorset settlements being somewhat larger than late Pre-Dorset ones, and sites being situated increasingly in exposed reaches of outer coastal areas and less often in sheltered coves. Dorset sites are found across the Eastern

Arctic region and in Greenland, and the vast majority are located on the coast of both mainland and Island habitats, with very few sites being identified in the interior of the territories. The work of Claude Rocheleau (1983) concerning Dorset settlement patterns in Québec proposes that winter occupation sites were situated along the coasts in protected areas with access to open water and surrounded by sea ice (polynya); spring occupations are found along the coasts near points of access to islands and capes; summer camps were situated near the entrance to bays and river mouths; and in autumn sites were located deeper into bays with some sites being located inland but with easy access to the coast (*ibid.*1983:211-216). The location of Dorset sites, according to Rocheleau, was strategically motivated in accordance with the intensified subsistence strategy of the Dorset, aptly described as following:

> " (…) *la côte offre beaucoup plus de potentiel énergétique que l'intérieur des terres. L'adaptation aux ressources maritimes est en mesure d'assurer une stabilité d'exploitation annuellement. En contrepartie, une adaptation aux ressources intérieures est beaucoup plus précaire en étant basée sur l'accessibilité à des espèces présentes en grand nombre à certains moments précis de l'année alors qu'elles sont très dispersées sur le territoire en d'autre temps*" *(ibid.*:216).

Dorset groups appear to have been less mobile than Pre-Dorset peoples; this reduction in mobility is expressed through a greater range of types of dwellings for Dorset sites, and increased variability in the size of structures and differences in associated features at sites. Tent rings at Dorset sites are interpreted as short-term dwellings occupied in warm seasons, while semi-subterranean houses, boulder walled-houses, and cut-sod structures are most likely associated with cold season or multi-season (winter through spring/summer) multi-family occupations (Nagy 1997; Maxwell 1985; Murray 1999). Axial elements within house structures and associated features such as external hearths, caches, traps, graves, and scatters of lithic material are common finds at Dorset sites; sites can include any one, or all, of these elements (Maxwell 1985; Murray 1996, 1999). Late in the Dorset sequence, evidence for long-house construction has been found throughout the regions of Igloolik, Victoria Island, Bathhurst Island, Hudson strait, Ungava Bay and Diana Bay (Maxwell 1985:157).

Transportation devices in Dorset times are poorly defined in the archaeological record and questions concerning Dorset transportation technology remain unanswered on the whole. Evidence of the presence of dogs, for Palaeoeskimo groups of both the Early and Late phases, is severely limited (Morey and Aaris-Sørensen 2002). Whether this problem is linked to insufficient zooarchaeological investigations of Palaeoeskimo faunal assemblages, or whether the general absence of dogs was a reality for groups predating the Thule, is unclear. What is known at this point is, evidence for dog-sled technology is so rare that it is thus far impossible to postulate that that mode of transportation existed in the Dorset period (see Desrosiers 2009: 46 and 47). Evidence for travel by watercraft is equally scarce for the Dorset period, though examples of kayaks have been found in the form of miniature carvings at Dorset sites (McGhee 1974, 1975). This being said, it is difficult to imagine that Dorset peoples did not use watercraft of some sort, specifically considering the numerous Dorset sites found on islands and along the coast, and so the real problem is likely taphonomic.

2.3.3 Dorset Material Culture

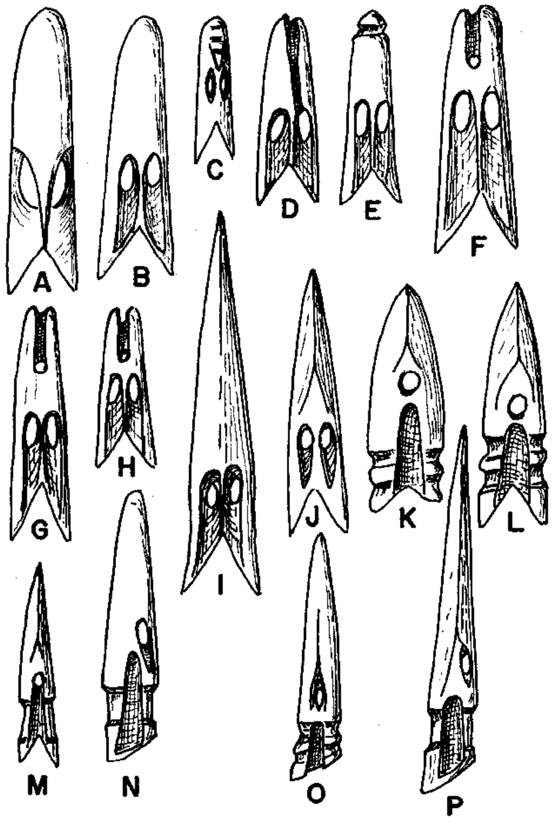
Changes in subsistence and settlement strategies are expressed trough differences in dwelling structures and seasonal movements of groups, and also in the material culture generated by the groups concerned. Pre-Dorset groups disposed of a wide variety of lithic tools that corresponded with a broadly generalized subsistence strategy (hunting of both terrestrial and marine species). Dorset groups, on the other hand, produced lithic tools with a smaller range of uses, and focussed more on the manufacture of organic tools (ivory, antler and wood) that were designed for use in a more narrowly focussed economic framework based primarily on marine mammal hunting (see Maxwell 1985; Murray 1996). Differences in both the types of materials used and the manner of manufacture are evident in the Dorset tool kit. Small ‘microlithic’ types of blades and points become widespread during the Dorset phase and the use of more scarce lithic resources such as slate and nephrite, which becomes evident at the end of the Pre-Dorset period, near 3000 B.P. (personal communication, Pierre Desrosiers 2010), is evident in Dorset assemblages. Evidence of polishing and grinding, as well as extensive notching of stone tools, is markedly increased in Dorset tool kits. While inter-site variation in tool kit composition does occur between Dorset sites, general material cultural traits for the Dorset culture can be outlined as follows: 1) there is extensive use of slate for knives and quartz crystal and nephrite for points, adzes and burin-like tools (Ramah chert for end blades in Labrador), and; 2) the presence of small triangular projectile points (often with fluted tips) predominantly used for sealing, as well as; 3) the appearance of two distinctive forms of harpoon heads, one type for small seals, and one type for larger animals such as walrus and bearded seal, and; 4) an increase in stone lamp use and the production of stone bowls, as well as; 5) the virtual absence of bow and arrow and bow-drill technology, accompanied by; 6) widespread evidence of a symbolic art style, representative of the Dorset people, and visible in the miniature carved human and animal forms (made of ivory and antler) that are found at Dorset sites across the territory of occupation (Maxwell 1985:123 and 197). The method of production of harpoon heads through 'gouging' or scraping, as opposed to using a drill, is particularly obvious from the Early Dorset on and remains characteristic of the Dorset phase in its entirety.

The Middle Dorset phase is somewhat more difficult to delineate on a cultural/material level. Maxwell proposes that the Middle Dorset phase is best represented by the barely perceptible substitution of closed socket harpoon head types with 'sliced' types (*ibid*. 1985). Desrosiers *et al.* (2006) have suggested that this distinction is false, due to the recent re-dating of the Tayara site material, and propose that the sliced type is not 'representative' of the Middle Dorset phase but is instead part of a gradual development of organic technology over time (throughout the Classic Dorset period). Odess (2005) explains changes in harpoon head manufacture during the Dorset period as a function of regional variation. The difficulty in isolating a manufacture style, or tool type, for this phase has lead researchers to define the Middle Dorset period instead through an analysis of occupational structures and more recent radiocarbon dates (Desrosiers *et al.* 2006). In some regions, it is proposed that Middle Dorset groups responded to increasingly cold climatic conditions by constructing communal dwellings and by building sites in more protected areas. Specific differences in the construction of dwellings include an increase in the frequency of axial features and tunnel entries (see Maxwell 1985:216).

The Late Dorset period produced many of the distinctive artefact types that are the best known of the Dorset materials. Maxwell (1985) lists these Late Dorset ‘hallmarks’ as the following:

> “(…) harpoon heads with double line holes, triangular end blades with deeply concave basal margins and serrated lateral sides, and side-notched, angular edge knives or scrapers steeply bevelled on one face. (…) the late variants [of the Dorset Parallel harpoon head] are long and narrow with parallel sides and basal margins that angle steeply towards the midline.” (*ibid.*1985:217-218).

Examples of these Late Dorset harpoon head types are visible in Figure 3 below.



Late Dorset Harpoon Head Types

A.	**Type Dorset Parallel**
B-H.	**Type G**
I, J.	**Type F**
K-M.	**Type Ha**
N-P.	**Type J**

Figure 3: Late Dorset harpoon heads, not to scale (Maxwell 1985:219)

These particular harpoon heads come from several Late Dorset sites: Kikertardjuk (A and C); Abverdijar (B); the Bell site (D,F and K); the Joss site (G); Resolute (H); the Dundas Harbour site (I); the Crystal II site (J,M,N and P); and the Boothia Peninsula (L and O).

2.3.4 Dorset Art

Perhaps the most characteristic feature of Dorset culture is its distinctive art style that is expressed through miniature sculptures carved in bone, wood, ivory, antler and soapstone, and which have been recovered at Dorset sites across the Eastern Arctic. Maxwell (1985) describes Dorset art as:

> "Pieces [that are] usually small but accurately proportioned and often have great anatomical detail. (…) Three-dimensional carvings may be naturalistic, with minute detail, or highly stylized in an impressionistic manner. They may be abstracts in which a single anatomical element, such as a caribou hoof or mandible, stands for the whole animal.(…) Dorset carvers depicted virtually every animal, bird and fish in their environment, even the lowly sculpin. More than half of all the recovered pieces, however, illustrate what must have been considered the most dangerous beings, humans and polar bear. " (*ibid*.:160).

Maskettes or representations of human-like faces, carved in ivory, wood and antler, are also common finds and are most often embellished with incised 'x-ray' motifs or cross hatching covering the face. Some miniaturized tools such as harpoon heads (example in Figure 4), and little carvings of animals and human figures (see chapter 7) are also common and have been associated with burials at some Dorset sites.

Figure 4: Miniature ivory Dorset harpoon head recovered at the KcFs-2 site (Avataq 2010a).

Little is known of Dorset ritual and mortuary behaviour but the presence of stylized carvings, human and animal figurines, amulets, and decorative 'jewellery' all indicate that Dorset peoples had a strong ideological belief system that was diffused throughout the territory of occupation. Distinctive Dorset carvings and art pieces also play an important role in identifying Dorset sites and assemblages and, as will be exposed in the section concerning the site under study here, KcFs-2, (chapter 7), these carvings and human/animal representations are important to interpretations concerning subsistence practices for the Dorset period.

2.4 The Neoeskimo Period

The Neoeskimo period (1000 B.P. to 350 B.P), essentially refers to the Thule culture, the most recent of the ancient Arctic cultures. Neoeskimo groups were part of the last prehistoric 'wave' of migration to the Arctic and Greenland. Danish archaeologist and ethnographer Therkel Mathiassen first identified the Thule culture in 1925 on the basis of typological and functional comparisons between archaeological collections from the "*Fifth Thule Expedition*" in north-eastern Greenland, and material from Siberia, Alaska, and the Arctic regions of Canada (Mathiassen 1927). Thule culture developed out of maritime-oriented cultures that existed around 2000 B.P. in the Alaska/Bering Strait region. The Thule people migrated east around 1000 B.P. along the Arctic shores of North America to Greenland where early Thule sites date to near 800 B.P. (Gulløv 1997, McGhee 1996). Thule groups appear to have been economically complex and artistically more sophisticated than preceding Arctic groups and their social organization was apparently more uniform (Maxwell 1985; McGhee 1996). Thule settlements are typically larger than those of earlier cultures and their social structure appears to have been based primarily on co-operative subsistence practices that centered on whaling and caribou hunting. Long-house structures are typical of later Thule sites and semi-permanent winter dwellings and summer camps are numerous in the archaeological record. This variety in the types of dwellings and seasonal occupation strategies indicates that the Thule had a well defined, year-round subsistence economy and regularly formed larger groups than earlier Arctic dwellers during the Palaeoeskimo period. Along with co-operative whale and caribou hunting, Thule subsistence practices included fishing and the hunting of small marine mammals, terrestrial animals, and local and migratory bird species. Lithic and organic tools associated with the Thule culture are more diverse in form and function than those of preceding Palaeoeskimo groups. Complex equipment for open-water sealing and walrus hunting, and evidence of bow-drill and bow and arrow technology, are all features of the Thule technological complex that distinguish them from the Late Palaeoeskimo Dorset. Evidence of boating (kayak and umiaq) and dog-sledding activities, which are either rare or absent from earlier Dorset sites, are also common for sites dating to the Neoeskimo period. Exchange and contact between groups also appears to have played an important role in Thule socio-economic organization (Gulløv 1997, Mathiassen 1927, 1930; McGhee 1996).

The differences between Neoeskimo and Palaeoeskimo cultures were not immediately obvious to early researchers who struggled in particular with the interpretation of sites that contained a mix of Thule material and artefacts from earlier occupations. Initial proposals for the separation of Palaeoeskimo and Neoeskimo (Thule) cultures came during the late 1930's and 1940's when Lethbridge (1939), Wintemberg (1939), Rowley (1940), Holtved (1944) and Leechman (1943) found evidence of isolated components of the Dorset culture at sites ranging from the High Arctic to Foxe Basin and across northern Quebec and Newfoundland. There continues to be a lack of agreement on whether contact between Palaeoeskimo and Neoeskimo groups can be conclusively proven, though contemporaneous occupation sequences can be shown for the two groups in several regions through the analysis of overlapping radiocarbon dates (Friesen 2004; Maxwell 1985). Sites with mixed Dorset and Thule assemblages and technological associations do exist, but consensus on whether they indicate actual contact between the Dorset and Thule groups, as opposed to the re-occupation of Dorset sites by later Thule groups, is as of yet out of reach. The discovery by Collins in 1950 of a Dorset deposit separated from a subsequent Thule deposit by a layer of sterile soil at the Crystal II site on Frobisher Bay served to solidify the greater antiquity of the Dorset culture.

The Thule people are now known to be the direct ancestors of modern day Inuit people living in Alaska, the Canadian Arctic, and Greenland. Evidence for the link between Thule and modern Inuit groups is based on cultural, biological and linguistic premises (Mathiassen 1927, 1930; McGhee 1996; Rasmussen *et al*. 2010).

Chapter 3: Palaeoeskimo in Nunavik

The distinct ecological zone that is the Arctic is, on many levels, the central factor in the evolution of the unique and complex cultures that developed there (both ancient and contemporary). The physical traits of the Arctic environment, along with the fauna and flora existing therein, differ regionally on the level of accessibility and abundances of resources as well as in landscape formations and seasonal climate fluctuations. As seen in the previous section, these differences between regions are often central factors in the development of regional cultural traits and inter-regional discontinuities. Understanding the environmental conditions of the Ivujivik region, both in the past and today, is therefore primordial to the comprehension of the archaeological sequence for the site under study and for the region as a whole.

This chapter focuses on the physical setting of the KcFs-2 site and gives an overview of the past and present environmental and climatic conditions in the Ivujivik region and the surrounding Ungava Peninsula. Previous archaeological investigations in the region are detailed along with a brief overview of archaeological work that has been done in the neighbouring Hudson Bay and Labrador regions.

3.1 Environmental Setting

Within the context of the Canadian Arctic, the Ungava Peninsula can be seen as being strategically interesting from a subsistence perspective. The Ivujivik region where the KcFs-2 site is located, at the northern tip of the Ungava Peninsula, is at the intersection of northern Hudson Bay, Hudson Strait, and the Foxe Channel and is thus at the crossroads of the Arctic and Labrador sea currents (Figure 5 below). This mix of cold water from the Arctic sea and warmer currents from the Labrador coast provides conditions that are propitious to maintaining rich and varied marine life in the region (Nagy 1997); the Ivujivik area is therefore economically appealing to hunter-gatherer groups.

Numerous sites covering the spectrum of Arctic cultural periods have been identified along the whole of the Ungava Peninsula coast and neighbouring Labrador and Hudson Bay coasts, as well as to the north on Baffin Island and throughout the Foxe Basin area. The region in question shows intensive occupation throughout prehistory and into the historical period; an abundance of both marine and terrestrial resources in the region could partly explain the basis for this intensive settlement pattern.

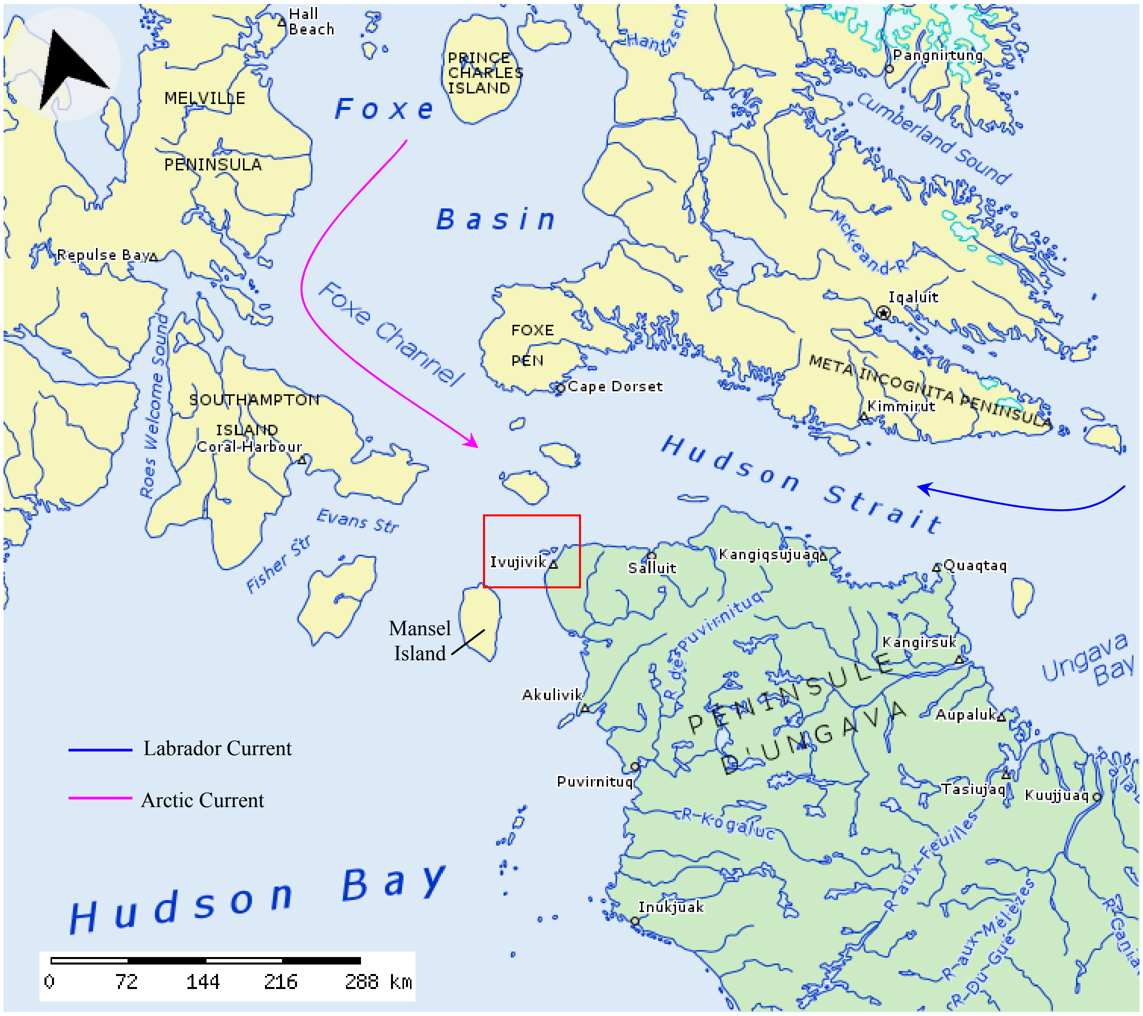


Figure 5: Map of the Ungava Peninsula showing the Ivujivik region in red and prevailing sea currents (Atlas of Canada: http://atlas.nrcan.gc.ca/site/english/maps/topo/).

3.1.1 Geography and Geology

The KcFs-2 site is located on the Nuvuk Islands, in the Canadian Arctic Archipelago, at approximately five km to the west of the modern Inuit community of Ivujivik (Figure 6). Ivujivik and the Nuvuk Islands are found on the north-western tip of the Ungava Peninsula, near the western outlet of Digges Sound. The Nuvuk Islands are included in the Baffin administrative region of Nunavut but are geographically much closer to the east coast of Hudson Bay and the mainland communities of Nunavik. Residents of Ivujivik hunt and fish on the islands and, because of the close physical proximity to mainland Nunavik, the islands are considered by locals as being integral to their traditional subsistence framework.

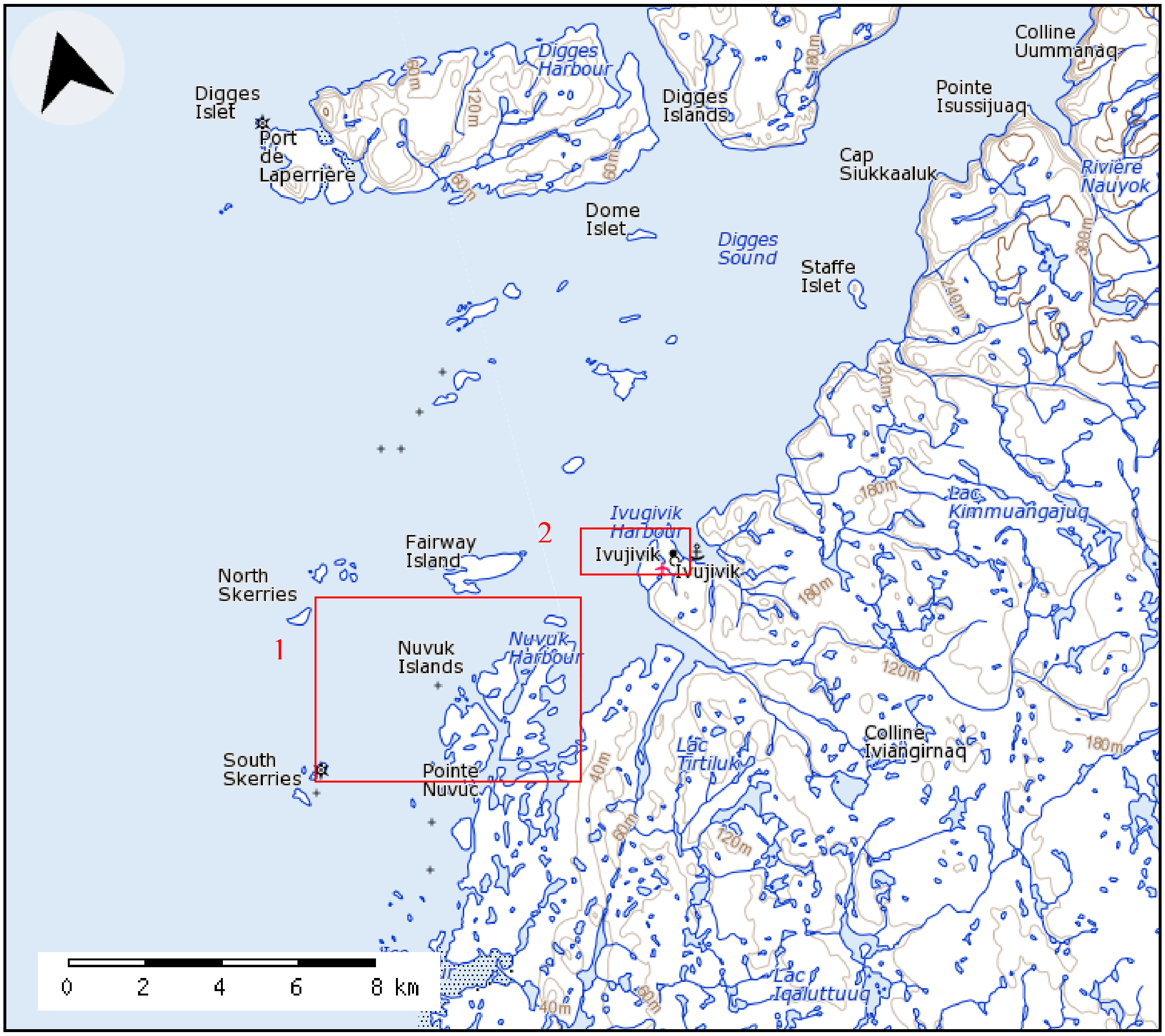


Figure 6: Map indicating the location of (1) the Nuvuk Islands and (2) Ivujivik (Atlas of Canada: http://atlas.nrcan.gc.ca/site/english/maps/topo/).

The Nuvuk Islands, and nearby mainland of the northern Ungava Peninsula, are part of the Canadian Shield physiographic region and are situated in the area defined as the Suguk Plateau (Bostock 1972; Stockwell *et al.* 1972). The Canadian Shield consists of a broad area of Precambrian rock that encircles Hudson Bay and covers much of central, eastern and north-eastern Canada, and a small portion of the upper mid-west of the United States (Li and Ducruc 1999). The Ungava Peninsula is included in the James physiographic province of the Canadian Shield, a region which is characterized by a granite and tonalite bedrock substratum which contains a number of sedimentary rock deposits, namely: sandstone, quartz, quartzite, dolomite, chert, argillite, limestone, and some volcanic rock intrusions (Bostock 1972). The landscape of the northern portion of the Ungava Peninsula is typically comprised of rolling hills and low plateaus formed through glacial erosion in the interior, and fjords and granite cliffs on the coast.

The northern region of the Ungava Peninsula is composed of treeless tundra which is due to a layer of continuous permafrost that prevents tree roots from penetrating the soil. The soil deposits of the Ungava Peninsula and island archipelago are remnant of formations from the Archaean geologic eon (3800 Mya – 2600 Mya) during which volcanic activity was markedly higher than at present and the accumulation of metamorphic and igneous rock strata resulted in the formation of the Archaean crust. The crystalline remnants of the Archaean crust, predominantly granite, schist and gneiss, combined with glacial till (sand, clay, limestone, shale, argillite, sandstone and some volcanic rock) are what comprise the soils of the present day tundra in the Ungava Peninsula (Low 1896). A thin layer of vegetation covers the bedrock mantle across the tundra zone and is generally limited to grasses, mosses, lichen, willow, heather and dwarf birch (Ritchie 1987). Peat bogs are common and usually found in the areas surrounding lakes, ponds formed through snow melt, and sandy plateaus.

3.1.2 Climate

The Ungava Peninsula lies below the limit of the Arctic Circle but falls within the southern boundary of the 10 degree Celsius isotherm line; this isotherm boundary isolates the region in which the mean temperature of the warmest months is 10 degrees Celsius (Environment Canada 2010; Maxwell 1985:6). The average annual temperature for the Nuvuk Islands region is -5 degrees Celsius and there are approximately 20 frost-free days per year. Average annual precipitation levels for Ivujivik and the Nuvuk Islands is in excess of 40 cm, more than half of which is snow (Aménatech 1985; Environment Canada 2010; Nagy 1997). Long, cold winters and short, cool summers are characteristic of the northern Ungava Peninsula and are also the basis for the region being categorized as a Polar Tundra Climatic Zone. The Nuvuk Islands area, and specifically the location of the KcFs-2 site on the north-eastern edge of the island, is also known for high winds and rough waters throughout the year.

3.2 Archaeology in the Ivujivik Region

The village of Ivujivik has been the focus of a number of archaeological investigations and field research projects, among the first were a series of surveys undertaken by Douglas Leechman in 1935 and 1936 in the McLelan Strait and on the Nuvuk Islands, during which he recorded and sampled the KcFs-1 and KcFs-2 sites (Leechman 1943). Leechman describes several structures as 'igloos' and one 'double igloo' at the KcFs-2 site, descriptions which correspond well with the structures found during the 2009 field season. All the sites identified by Leechman produced Dorset period material through test pitting.

During the late 1950's and through the1960's, William Taylor also did extensive research in the Hudson Strait region and the area surrounding Ivujivik and Mansel Island. In the area immediately surrounding the village of Ivujivik, Taylor identified five sites, three of which he categorized as Pre-Dorset occupations (Meeus, Pita and Mungiuk), and two sites from the Early and Middle Dorset periods respectively (Ohituk and Eeteevianee). Taylor also sampled the KcFs-1 and KcFs-2 sites in 1958 and located seven Palaeoeskimo sites on Mansel Island, two of which dated to the Pre-Dorset period and five to the Dorset period (Taylor 1959, 1960).

In her study of Palaeoeskimo cultural transition, Murielle Nagy (1997) provides an inventory of sites identified in the area surrounding Ivujivik; she describes a total of 12 sites, including those identified by Leechman and Taylor (outside of Mansel Island). Of the twelve sites described by Nagy, three are identified as dating to the Pre-Dorset period, two to the transitional period between the Pre-Dorset and Dorset periods, and three sites to the Dorset period. The remaining four sites are of mixed cultural affiliation, of which two are described as "(…) containing the whole spectrum of Palaeoeskimo and Neoeskimo occupations", and two are labelled "undetermined Palaeoeskimo" occupations (Nagy 1997). Nagy also mentions that several more sites are known to local inhabitants both in the area surrounding Ivujivik and on the islands directly to the southwest of the village. The sites described by local inhabitants do not appear to have been inventoried in any official capacity at the time of the publication of Nagy's work in 1997.

The 2009 survey of the Nuvuk Islands region, carried out by the Avataq Cultural Institute, recorded 34 new sites and revisited 3 previously identified sites. The survey covered an area of 24 km^2 that encompasses the Nuvuk Islands, Fairway Island, and the undeveloped terrain immediately surrounding the community of Ivujivik on the mainland. Dates are not currently available for the newly inventoried sites but initial interpretations of the 614 archaeological features recorded during the survey do indicate a high concentration of prehistoric (Palaeoeskimo and Neoeskimo) components. An abundance of Qaggit (Thule ceremonial structures) found in the region is likely indicative that the region served as a ritual centre for groups from the Hudson Bay and Hudson Strait regions during the Neoeskimo period (Avataq 2010b).

The archaeological material recovered during early and recent investigations in the Ivujivik area, and along the west coast of the Ungava Peninsula, shows that people occupied this area throughout the Palaeoeskimo and Neoeskimo periods (Aménatech Inc. 1985; Avataq 1987, 2009; Desrosiers 2009; Leechman 1943; Nagy 1997; Taylor 1959, 1960, 1962, 1968). The presence of steatite and quartz quarries is also mentioned in several works concerning the Ivujivik region; these quarries are important resources for the production of lithic tools and stone lamps and give credence to the intensity described for the prehistoric occupation of the region. The quartz quarry is located at 2 km to the southeast of Ivujivik, and the steatite Quarries at 105 km to the southeast of the village, near Saaraqjaaq (Nagy 1997; Roy 1971b; Taylor 1960).

The Ivujivik region continues to be an important centre of activity for modern Inuit people and has the second highest density of 'place names' (toponyms) of the western Nunavik coastline; this indicates a continuation of intense land use by the Ivujivimiut (modern Inuit people of Ivujivik) and by people inhabiting the northern Ungava Peninsula (Muller-Wille 1990:41).

3.2.1 Investigations in Hudson Bay, Ungava, and Labrador

Numerous archaeological investigations have also been undertaken in the areas neighbouring Ivujivik that have helped to expose the intensive nature of the occupation of the Hudson Bay, Ungava Peninsula, and Labrador coast regions as a whole (Figure 7). As detailed previously in this work, occupational and cultural sequences tend to differ from region to region, a problem which greatly complicates the elaboration of chronologies and settlement pattern analyses for larger territories of influence. Investigations in the above regions do however suggest basic trends of occupation and movement that can be shown to persist through the entirety of the prehistoric and historic periods. These investigations are important for the understanding of the interactions between groups and the diffusion of cultural traits across the Eastern Arctic territory. A brief summary of these investigations is given here, drawing extensively on the detailed published descriptions of archaeological work done in the region (Desrosiers 2009; Lofthouse 2003).

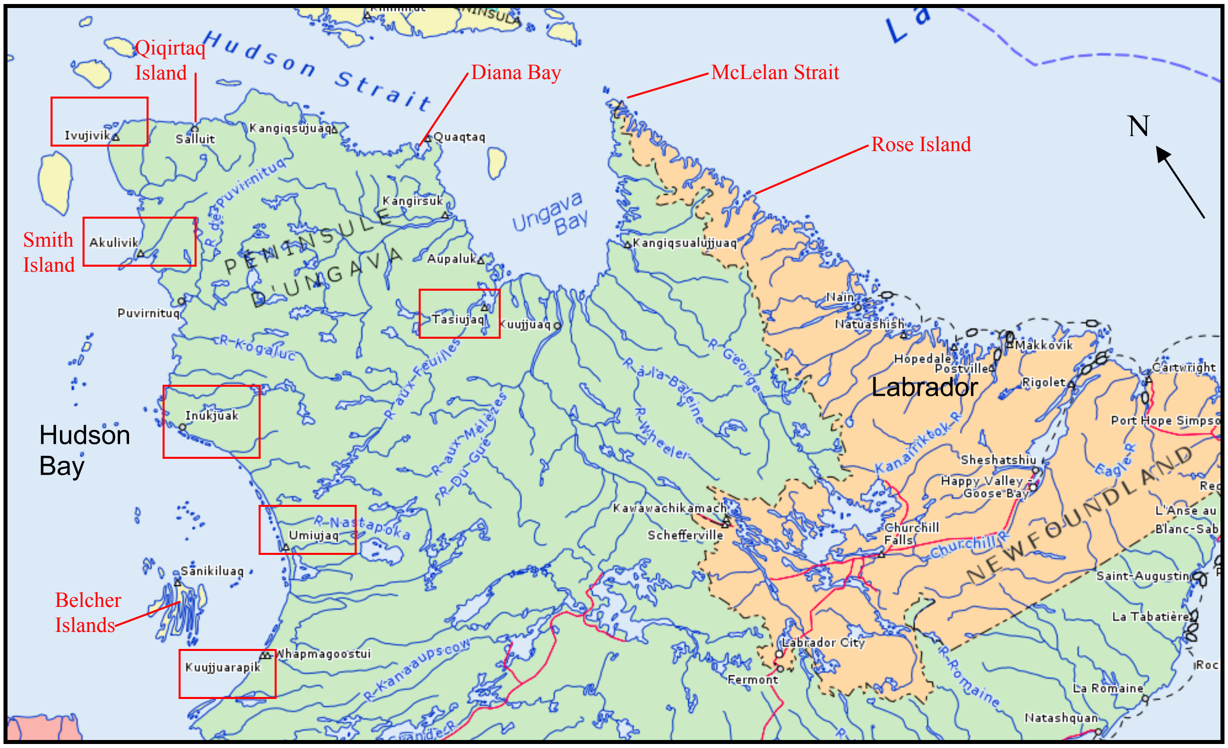


Figure 7: Map indicating locations of sites mentioned in this section in red (Atlas of Canada: http://atlas.nrcan.gc.ca/site/english/maps/topo/).

Hudson Bay

The Avataq Cultural Institute has undertaken a series of archaeological field projects in the Hudson Bay, Hudson Strait and Ungava Bay regions over the last two decades. In 2000, Daniel Gendron and Claude Pinard published a synthesis of the research done in the Nunavik region that identified three Early Palaeoeskimo regional complexes for the area spanning the eastern Hudson Bay to Tasiujaq in the interior of Ungava Bay. The first of the Early Palaeoeskimo complexes stretches from Kuujjuarapik to Inukjuak in south-eastern and central Hudson Bay; this first complex is characterized by coastal occupations, including both semi-subterranean and tent structures, built in natural boulder fields, and displaying a mix of traits such as axial features in house structures and the use of local chert for lithic tool manufacture. The second complex is described as Pre-Dorset and encompasses the region between Ivujivik and Salluit including Mansel Island (as originally outlined by Taylor in 1968). This second complex features primarily 'bi-lobal' structures built with or without axial elements, and extensive use of marbled chert. The third complex, which extends from Kangiqsujuaq to Tasiujq in the Ungava Bay region, is described only in terms of the presence of 'milky quartz' tools and assemblages characterized as an 'Independence sub-tradition' (Gendron and Pinard 2000:138).

Earlier archaeological work in Hudson Bay was undertaken by Thomas Manning in 1951 on Smith Island, near the village of Akulivik, where sites of mixed Dorset-Thule cultural affiliation were identified. Avataq Cultural Institute continued work on Smith Island in 1991 and sampled at the Dorset-Thule site JeGn-3 (Avataq 1992). Excavations on the Belcher Islands by Benmouyal in 1954 (1978), Harp in 1974 and 1975, and Aménatech in 1984, also revealed numerous Thule occupations.

To the south of Ivujivik, in the area surrounding the village of Inukjuak, numerous Thule sites were identified between 1987 and 1996, through survey done by Tommy Weetaluktuk and the Avataq Cultural Institute (Avataq 1987, 1992, 1993, 1996).

Hudson Strait and Ungava Bay

Important research has also been ongoing in the region of the Hudson Strait for the majority of the last decade, particularly concerning the key site of Tayara (KbFk-7) on Qiqirtaq Island near Salluit. Originally identified and dated by Taylor (1968), the Tayara site produced the initial definitive Dorset stratigraphy as well as the 'Tayara sliced' and 'Tayara pointed' harpoon head types that have since been considered holotypic of Early Dorset culture. Recently, new radiocarbon dates from this site have shown it to be of a later date than originally thought; Tayara now fits into the 'Classic Dorset' sequence discussed in the previous section (Desrosiers 2009). Several other Dorset, Thule and historic Inuit sites have been identified in the Hudson Strait region, the first of which was the JiEv-4 site in Joy Bay (mixed Dorset-Thule) (Barré 1970). In the years between 1987 and 2002 additional mixed affiliation sites were recorded in Joy Bay and on Ukiivik Island (Labrèche 1987, 1989, 1990; Aménatech 1984; Avataq 2002), as well as on Assuukaaq Island (see Lofthouse 2003, Avataq 1997). Also in the Hudson Strait region, excavations were undertaken in the Diana Bay area through the 1970's in conjunction with the Tuvaaluk project run by the UQAM Laboratoire d'Archéologie (JfE1-10 and JfE1-3, mixed Dorset-Thule sites) (Plumet 1979, 1994; Gosselin *et al.* 1974), and again in 2002 through the CURA project run by the Avataq Cultural Institute (JfE1-10) (Lofthouse 2003).

In the Ungava Bay region and interior, and along the Labrador coast, sites of both Thule and mixed Dorset-Thule affiliation have been recorded and excavated. In 1977, the JeEl-5 and JeEj-7 sites in Rozière Bay (west coast Ungava Bay) yielded mixed Dorset-Thule assemblages and carbon dates ranging from 1750 B.P. to 350 B.P. (Aménatech 1984). One exclusively Thule site (JbEc-1) was identified in the north-central area of Ungava Bay by Salaun in 1975, and one other mixed Dorset-Thule site (JcE0-1) further inland near Robert's Lake was recorded in 1978 (Aménatech 1984). The Cartier and Black Spruce sites, both found in the interior of the northern Ungava region, date to the Dorset and Thule periods respectively, with minimal intrusive Thule elements in the Cartier assemblage that were attributed to 'a brief visit by local Thule' (See Lofthouse 2003:50; Lee 1979; Vézinet 1980). The eastern coast of the Ungava Bay has recently produced five sites (IfDk-2, IgDj-1, IhDk-1, IhDk-2, and IdDi-1) which are all of mixed Dorset-Thule affiliation, except for IdDi-1 for which no excavation was undertaken and surface finds at the site indicated a uniquely Thule presence (Avataq 1992, Plumet and Gangloff 1991).

The Labrador Coast

Mixed sites with assemblages containing elements from Pre-Dorset, Dorset, Thule and historic Inuit sequences have been recorded along the northern Labrador coast, from the McLelan Strait to Rose Island. The JcDe-1 site, in the McLelan Strait region, was visited by Leechman (1943), Fitzhugh (1977), Aménatech (1984), and Plumet and Gangloff (1991), and spans the entire spectrum of occupation sequences from Pre-Dorset to modern Inuit. The JcDe-6 site on Killinik Island, along with the JeDd-2 and JaDb-2 sites (on smaller islands off the Labrador coast), all yielded mixed assemblages (Fitzhugh 1977). Finally, the Rose Island site, excavated by Schledermann (1971) produced a mix of Thule and historic Inuit material and represents the late phase of the prehistoric period and the early historic period for the region.

What is made obvious through a brief analysis of the history of archaeological investigations in the regions surrounding the Ungava Peninsula is that the sites that have been recorded are representative of the entire spectrum of cultural sequences that have been identified for the Eastern Arctic. The region, or group of regions, in question can therefore be seen to represent continuous occupation over a span of more than 3000 years (Pre-Dorset to historic Inuit), and include hunter-gatherer groups from differing cultural affiliations and economic frameworks in the region. The re-occupation of sites, visible in the mixed assemblages found at numerous sites across the territory, indicates a certain continuity of occupation that could be linked to stable resources and environmental conditions on a smaller regional level. While the elaboration of temporal and cultural frameworks that could encompass the entire Eastern Arctic remains problematic due to discrepancies in radiocarbon dates and material culture analysis, continuous and intensive occupation can be shown for the group of regions discussed above that covers both the Palaeoeskimo and Neoeskimo phases.

Chapter 4: Site Introduction and Assemblage

Located on the northernmost Island of the Nuvuk Islands group, the KcFs-2 site occupies an area of approximately 250m by 50m (not including the recent cache structures) and includes two groups of archaeological features. The site is situated on an undulating plateau comprised of sand and humic soil covered with a thick layer of peat moss 'sod'. The plateau fills a shallow glacial valley that is delimited to the north by an expanse of granite bedrock, and to the south by bedrock and cliffs that fall abruptly to the waters edge at approximately 180m from the two groups of features. To the west the site is bordered by a small pond that is surrounded by a fringe of mossy bog, and to the east the plateau slopes gently towards a sandy beach. The two groups of semi-subterranean structures appear to have been dug into two separate flat portions of ancient palaeo-beaches (Figure 8).

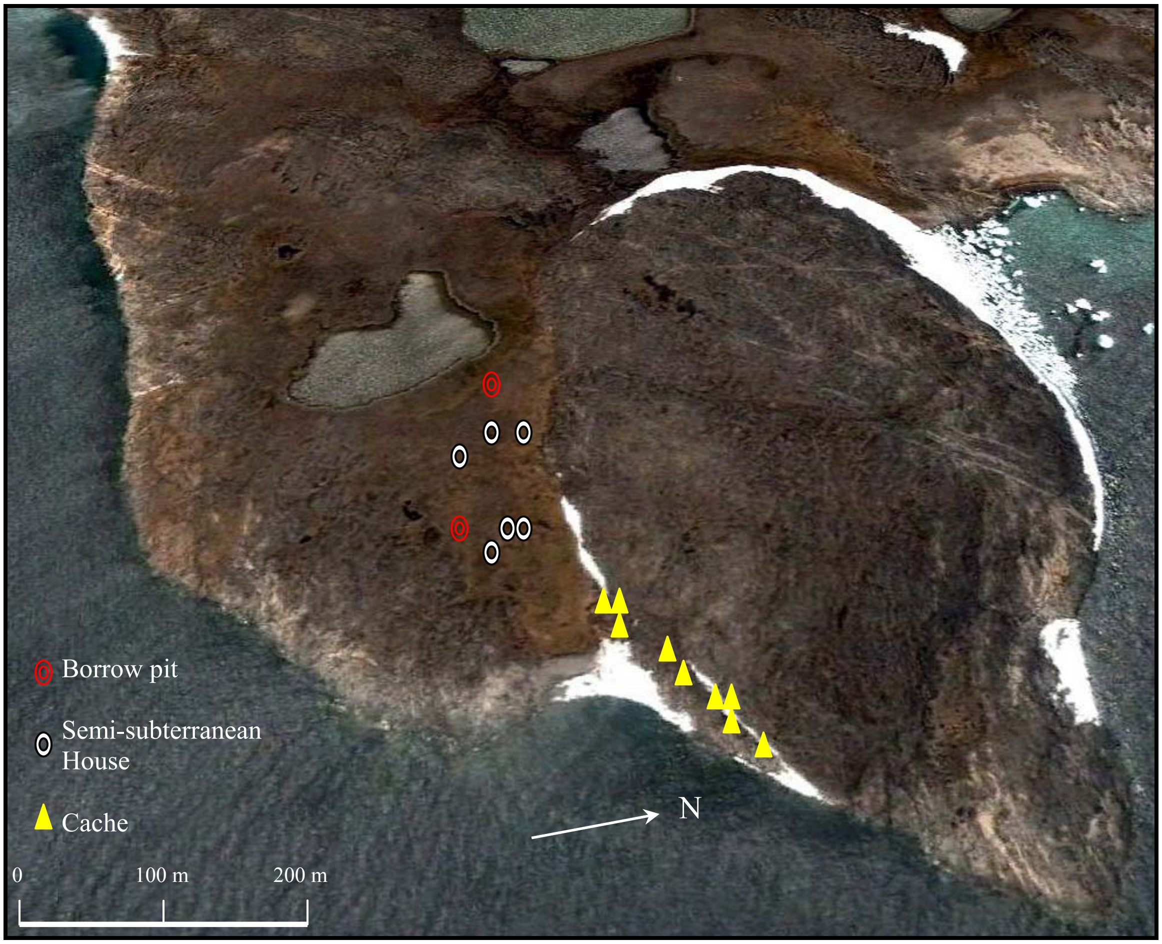


Figure 8: Aerial view of the KcFs-2 site, from the east (Google Earth).

The first group of structures (2, 3 and 4) are found at approximately 150 meters to the west of the beach, and the second set (structures 1, 5 and 6) at approximately 100 meters due west of the first group (Figure 9). Leechman (1943) identified a total of 19 features at the KcFs-2 site, all of which he labelled as ‘houses’ or ‘igloos’; which he divided into two groups, the first includes five features at the ‘northerly’ portion of the site, and the second contains 14 features at the more ‘southerly’ area of the site. A total of 17 archaeological features were identified and recorded at the site during the 2009 field season. A series of nine caches were found along the rock cliff facing the water to the southeast (not pictured), six semi-subterranean structures were identified in two groups of three (2, 3, 4 and 1, 5, 6, Figure 9) and two ‘borrow pits’ (sod excavations) were associated with the semi-subterranean structures (numbers 7 and 8, Figure 9). Taylor’s description of the KcFs-2 site is extremely cursory and no detailed information is given about either the features or the house structures, nor are measurements of any type given for the site. Taylor does describe test pitting that revealed ‘excellent middens’ but fails to indicate exactly where the test pits were located (Taylor 1960:1).

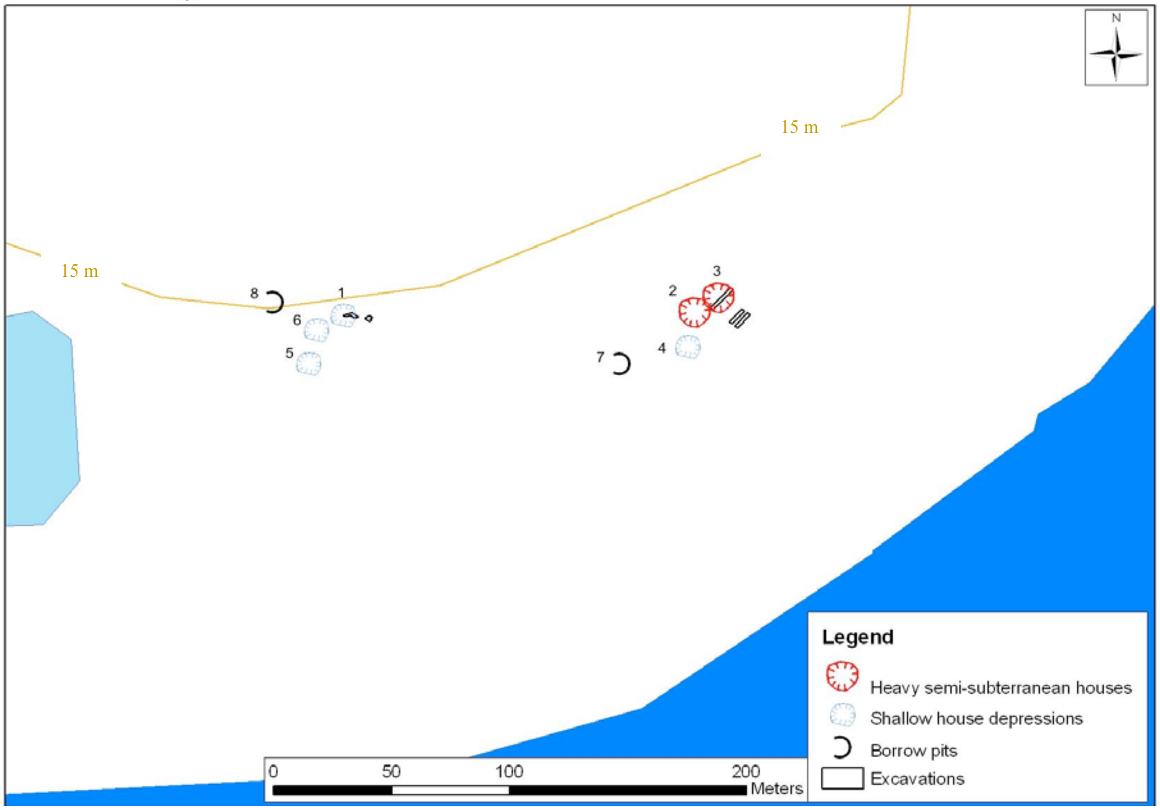


Figure 9: KcFs-2 site map showing semi-subterranean house structures, borrow pits and excavation grid (Avataq 2010b).

The cache features appear to be more recent and were most likely associated with Leechman's 1935 archaeology field camp (Avataq 2010b). The semi-subterranean house structures, with the exception of Houses 2 and 3, are all circular or semi-circular in form. Houses 2 and 3 (hereafter labelled House 3) appear to have been merged into one long, rectangular shaped structure; this merging is most likely due to either looting activity at the site or to early unrecorded archaeological exploration (Avataq 2010b). The House 3 structure is the most obvious feature at the KcFs-2 site and is the most robust of the semi-subterranean excavations, the associated house midden measures approximately 19 meters in length and 10 meters at its widest (visible extent of the walls) (Figure 10).

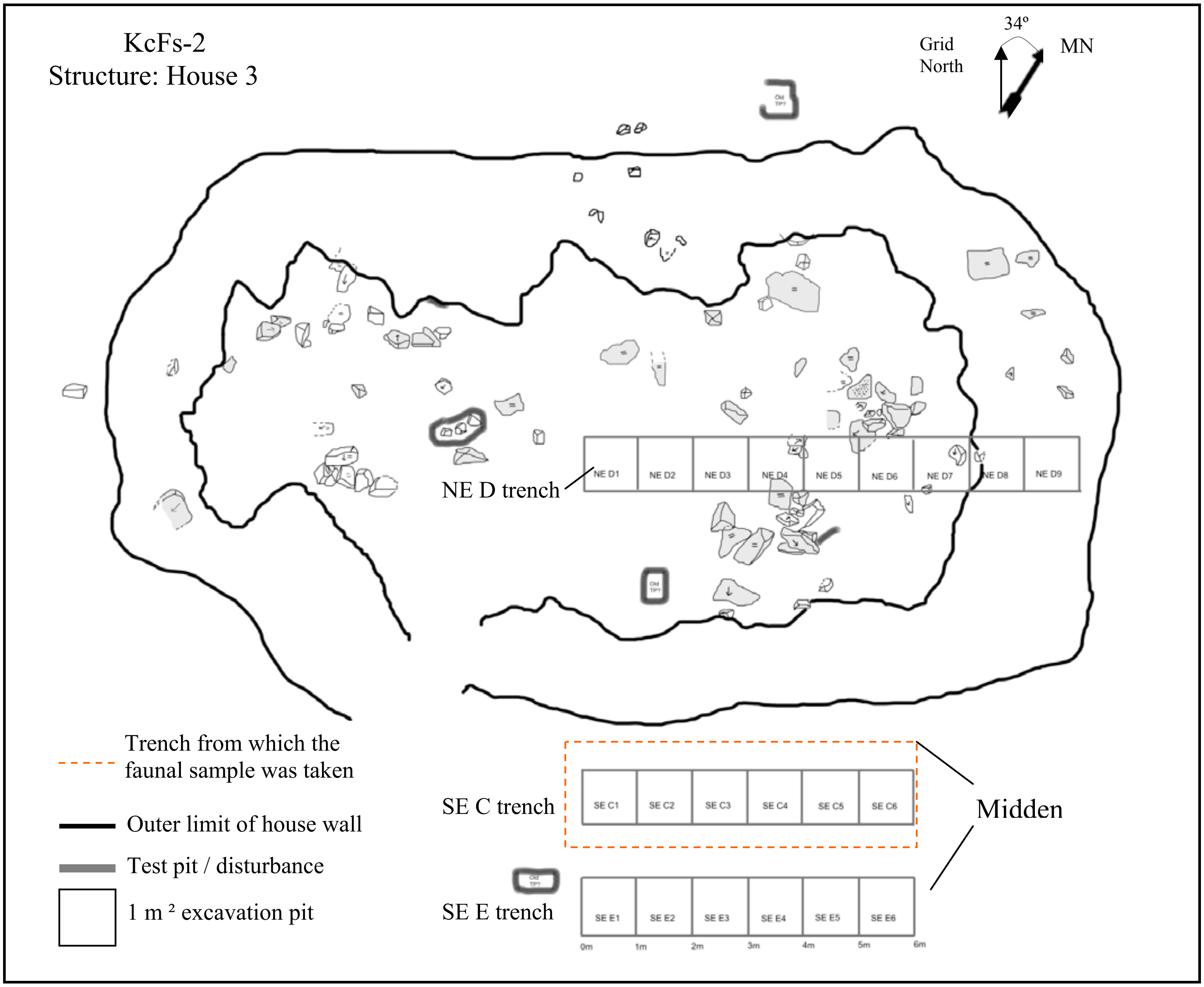


Figure 10: Map of House 3 showing excavation grid and test pits (Avataq 2010b).

The maximum depth of the midden excavation (SE C trench) was approximately 38cm, in the NE quadrant of the C3 square; in the SE E trench, maximum depth was measured at approximately 32cm at the centre north of square E3. It appears that the House 3 structure served as a cold season or multi-season habitation, the robust walls and excavated floor correspond well with semi-subterranean structures from Late Dorset sites elsewhere (Maxwell 1985:153-158; Murray 1996, 1999). The large size of the merged structure could also indicate a multi-family occupation. No obvious axial elements were identified but evidence of some disturbance in the interior of the house was clear. It was evident that two small areas had been disturbed in the house where sod had been removed and some larger stones also seemed to have been displaced. The two test pits inside the house structure (dark grey, Figure 10) are most likely remnant of Leechman's 1935 investigations. The south-western corner of House 3 also appeared to have been disturbed, either through looting or animal activity. Evidence of old test pits outside of House 3 to the northwest and to the southeast, have been attributed to Taylor's visit in 1958 (see Figure 10, Avataq 2010a).

The faunal collection analyzed in this work was excavated from House 3 midden. The test pit at the western edge of the midden (Taylor 1958) is the only evidence of disturbance and, as luck may have it, it appears to have been dug at the south-western limit of the midden and so not only aided in the locating of the midden but also served as a 'marker' for the excavation. No other disturbance, looting, or animal activity was found in the midden and it is therefore considered intact.

4.1. Project

At the outset of the 2009 field season, the KcFs-2 site had been identified as a new and undocumented site; very soon after arrival however it became clear that archaeological investigations had previously taken place at the site. With the help of Sites Officer Lucie Johanis, of the Canadian Museum of Civilization, the identification of the site and the presence of previous excavations by Leechman (in 1935) and Taylor (1958) were confirmed and the project was resumed.

The House 3 and House 1 structures of the KcFs-2 site were excavated by the members of the 2009 archaeology field school that was organized through the Avataq

Cultural Institute and funded by SSHRC (Social Sciences and Humanities Research Council) and the Community-University Research Alliance (CURA) project. The project was co-directed by Susan Lofthouse (archaeologist, Avataq) and Marie-Michelle Dionne (PhD candidate, Université Laval). Five graduate students from southern Québec universities were involved in the excavations, surveying, geomorphology fieldwork, and organization of the field school; Sarah Aubé-Michaud, Félix Gagné, Daphné Marquis, Andrée-Anne Pharand from the Université Laval, and Andrea Thompson from the Université de Montréal, were grouped with high-school students from the community of Ivujivik for the six week duration of the project. High-school students from Ivujivik involved in the excavation were: Lydia Audlaluk, Tumasi Audlaluk, Moses Idlout, Maina Iyaituk, Levina Kanarjuak, Megan Kasudluak, Roxanne Kristensen, Lucassie Matt Mark, Makusie Naluiyak, Johnny Padlayat, Siaja Paningajak, and Lukasi Qavavauk. Avataq Cultural Institute staff involved in the 2009 CURA project included: Elsa Cencig, Andrew Epoo and Tommy Weetaluktuk. One post-doctoral researcher with the Avataq Cultural Institute, Jessica Giraud, was also involved in excavation and survey, and was also responsible for the G.I.S. mapping of the survey portion of the 2009 CURA project.

Work was undertaken at the KcFs-2 site during the months of July and August 2009. An exact count of the bones, or fragments of bone, that were recovered during the excavations, was impractical to determine due to the very large size of the faunal assemblage. Sampling of the faunal assemblage was done for the purposes of the faunal analyses described in this work, a detailed discussion of which follows in the assemblage preparation section. The sampled faunal material was cleaned, catalogued and analyzed beginning in the fall of 2009 and continuing into the spring of 2010 at the Avataq archaeology laboratory and at the archaeozoology laboratory at the Université de Montréal.

4.1.1 Excavation Procedure

The House 3 structure and associated midden were staked over with a 16m by 9m squared grid oriented to 34 degrees west of magnetic North; this orientation was chosen in order to position the excavation trenches in accordance with the long axis (greatest length and width) of the House 3 structure. The House 3 interior was designated the north-eastern quadrant, and the midden the south-eastern quadrant. The grid covered the entire north-eastern half of the House 3 structure and the majority of the midden. Each meter row of the grid was assigned a letter; the letters continued in ascending alphabetical order northward in the northern quadrant, and southward in the southern quadrant. The first row of the House 3 grid was thus labelled NE A 1-9, and the first midden row SE A 1-9. One row measuring 9m long was excavated inside the House 3 structure (pits NE D 1-9), and two rows of 1m by 6 m squared were excavated in the midden (SE C 1-6 and SE E 1-6), separated by 1m (Figure 11).

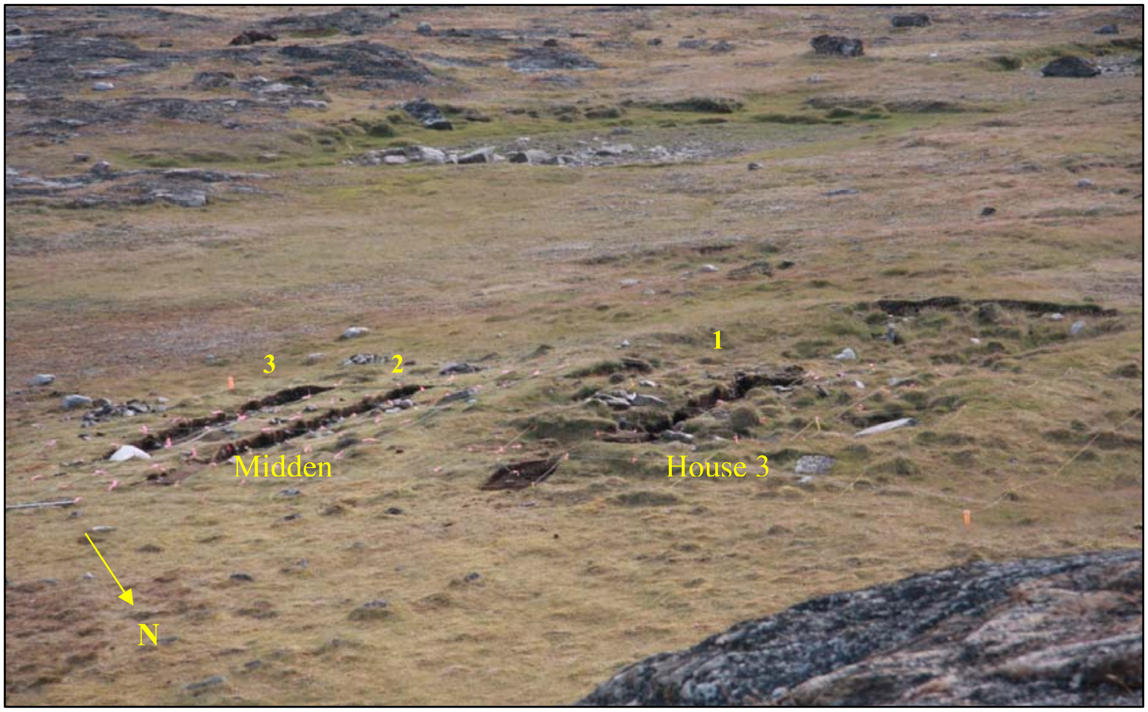


Figure 11: KcFs-2 excavations viewed from the north showing the grid, the NE D trench (1) in the House 3 structure, and the SE C (2) and E (3) trenches in the midden (Avataq 2010b).

Each meter square was divided into four 2500cm² compass-oriented quadrants (50cmX50cm); bones and lithic flakes were collected and labelled according to these quadrants (NE, NW, SE, SW). Other artefacts (lithic and organic tools, retouched flakes, and sculpted objects) were recorded in accordance to their three dimensional spatial position within the square and quadrant; depths were measured to the surface altitude of the square (taken with a theodolite). Excavation involved the use of trowels, brushes, dustpans, buckets, line levels, GPS equipment, a theodolite, and measuring tools (rulers, squares and measuring tapes). All sediment removed from the pits was screened through 1/8th-inch mesh; screening was done by quadrant and bones recovered through screening were then added to the corresponding quadrant containers.

Excavations inside the House 3 structure and the midden furnished uniquely Late Dorset period material. The House 3 midden excavations did not reveal any discernable stratigraphy, the absence of which was also noted by Taylor (1960:1). The faunal analyses in the present work focus solely on the bone assemblage that was excavated from the two trenches that bisect the midden and do not include the faunal material excavated in the House 3 structure.

4.2 Assemblage

Leechman's 1935 excavations at the KcFs-2 site, though cursory in nature, yielded Late Dorset material comparable to that which was recovered during the 2009 field season. In his brief report concerning the KcFs-2 site material, Leechman describes a total of eight harpoon heads (among other artefacts) recovered at the site, all of which exhibited double line holes typical of Late Dorset types (examples Figure 12).

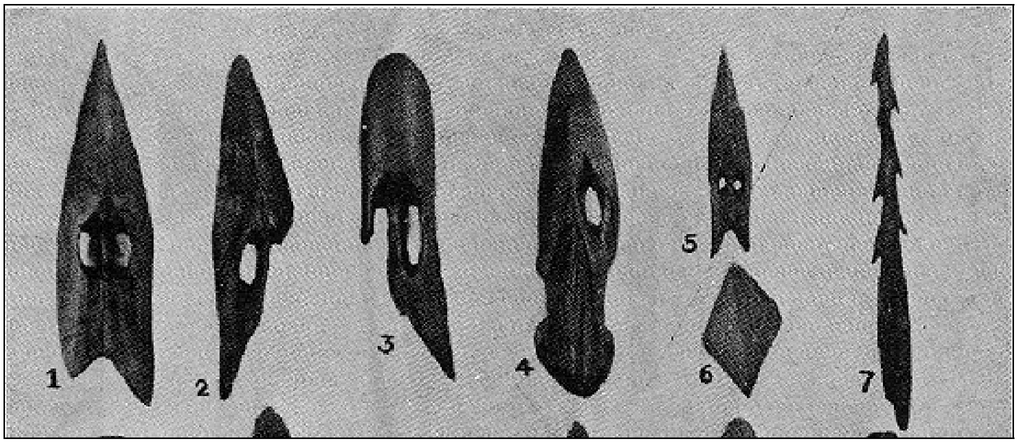


Figure 12: Harpoon heads from the KcFs-2 site recovered by Leechman (1943:375). These harpoon heads are attributable to the Late Dorset Type F group (1 and 2), Type G group (3), and Type Ha group (4) (Maxwell 1985:219, Figure 3).

Leechman also describes 2 miniature harpoon heads and three figurines (bear, bird and human figure) carved in ivory. The lithic tools and projectile points described in Leechman's work (scrapers, notched scrapers, barbed points, and 'ground implements') are all of similar material and manufacture style as those described below from the 2009 excavations (*ibid.*1943). There is no indication of the presence of any artefacts of other cultural affiliation in the Leechman's collection. The 2009 excavations of the House 3 structure and midden produced a very large faunal assemblage and a sizeable artefact assemblage; no intrusive artefacts of Pre-Dorset or Thule association were recovered. Artefacts other than bone excavated at the site include: 1455 lithic specimens (chert, hyaline quartz, quartzite, Ramah quartzite, nephrite, serpentine, siltstone and slate); 49 steatite lamp fragments; 39 worked ivory specimens including 12 harpoon heads or preforms of harpoon heads (of which 2 were miniatures); and 3 fragments of worked antler. Samples of burnt fat and some charcoal were also found throughout the excavation, in the midden as well as in the House 3 structure. Organic artefacts excavated from the House 3 structure and midden, all of which confirm the Late Dorset association, include ivory harpoon heads (Late Dorset Types F and G, Maxwell 1985:219), miniature harpoon heads, miniature ivory statuary, and an ivory maskette (details in chapter 7 concerning worked bone and ivory). Organic artefacts other than bones, namely the harpoon heads, were packed in peat moss and wrapped in plastic in order to avoid drying and cracking. The harpoon heads were then cleaned and slow-dried at the Avataq archaeological laboratory under the supervision of conservator Louis Gagnon. The lithic and organic artefact assemblages (other than bone) from the KcFs-2 site have been cleaned, counted, and catalogued. No radiocarbon dates have been obtained for the KcFs-2 site.

4.2.1 Assemblage Preparation

On site, the bones were brushed or screened to remove as much soil as possible, and then put into paper or plastic bags with provenience information written both on the bags and on tags placed inside the bags. Bags were stored in open plastic containers in a canvas tent on-site during excavation, and then in closed plastic bins at the Ivujivik airport for three weeks awaiting transport to Montréal. Several of the paper bags in which the bones were placed at the time of excavation decomposed during storage and transport due to humidity in the storage area and the presence of soil in the bags themselves. Upon opening the plastic cases in Montreal, it was discovered that a large portion of the bags containing faunal material from the SE E trench had deteriorated badly and bones from the E1, E3, E4, E5 and E6 pits were mixed together and provenience information was lost for that portion of the assemblage. The SE C trench materials, along with the SE E2 pit, had remained intact; the study sample was therefore taken from the C trench and the northern quadrants of the E2 pit (Figure 13).

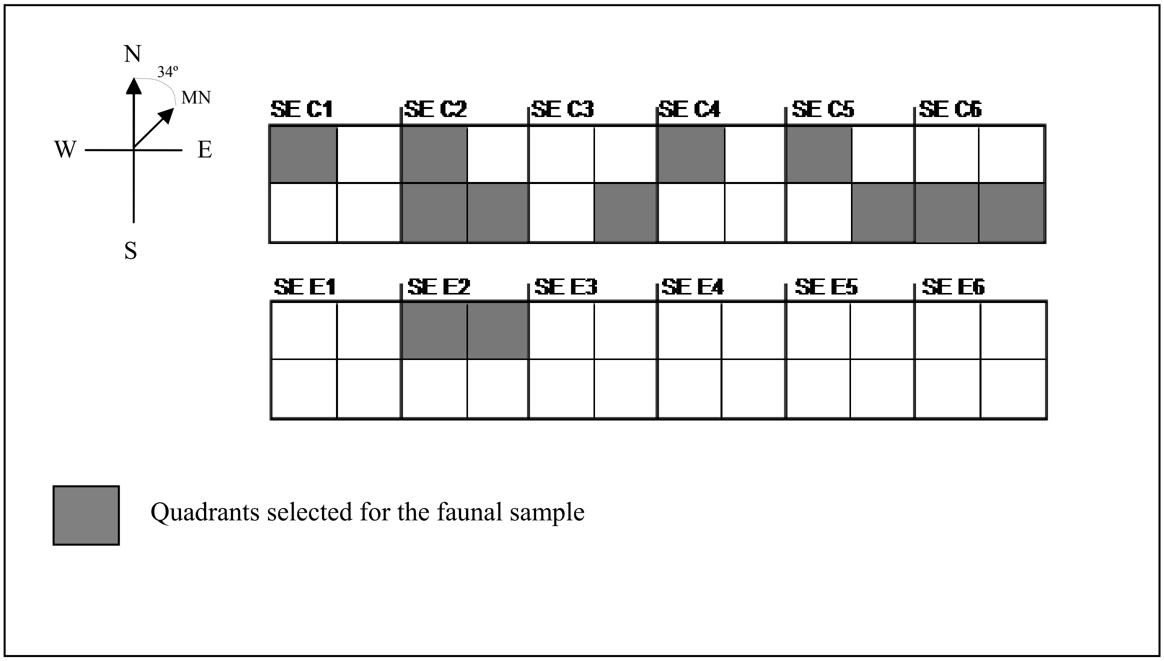


Figure 13: Trenches SE C and SE E in the House 3 midden showing quadrants selected for the faunal sample.

The sampling strategy was designed to randomly sample a minimum of at least one quadrant of each square in the SE C trench. The E2 pit was included for comparative purposes, in order to determine possible similarities and differences between the two areas in the midden. As seen in Figure 12, the faunal sample included 10 of the 24 quadrants in the C trench (42%), and 12 out of a total 48 quadrants for the whole of the midden excavation (25%). Because the C2, C5 and C6 pits were substantially richer than the C1, C3 and C4 pits, the sample probably represents more than half of the faunal assemblage from the C trench and at least 30% of the whole assemblage for the two trenches. Unfortunately, due to the size of the assemblage, all of the bones have not been counted and so it is impossible to determine the precise percentage that was analyzed.

A total of 10 879 bones and bone fragments were analyzed for this thesis. Preservation of the faunal material is considered generally to be good, with minimal flaking of the periosteum for most of the identified specimens, and with very little gnawing and no discernable calcination. Cleaning procedures in the laboratory included dry brushing of dried specimens, and wet cleaning (water and brush) of any specimen showing signs of mold or fungus. Provenience information was written on individual tags and specimens were marked with a catalogue number where possible; specimens were bagged with their provenience tags and catalogue numbers. Catalogue information was recorded manually on the tags and then transferred to a computer database.

Chapter 5: Faunal Analysis

Identification of faunal specimens was done to the most precise taxonomic category possible, generally species, although certain specimens could only be securely identified to family or genus. In addition to taxonomic classification, determination included skeletal element, portion of skeletal element, side, age, and sex where possible. Information concerning cut marks, gnawing, calcination and taphonomic modification (humic staining, root etching, and foliation) was also recorded for each specimen where applicable. The taphonomic analyses are presented and discussed in chapter six.

5.1 Quantitative Methods

Relative taxonomic abundance is assessed here using NISP (number of identified specimens present) and MNI (minimum number of individuals), the most fundamental and universally employed units used for tallying faunal remains. The NISP is the number of skeletal elements (including bones and teeth) or fragments of skeletal elements that have been identified to a taxon (or lowest taxonomic category possible). In response to weaknesses inherent in the application of the NISP to fragmentary faunal assemblages (see below), the MNI is also calculated using the most commonly occurring skeletal element of each taxon in the faunal assemblage; for example, if for one taxon in the assemblage the tibia is the most commonly occurring skeletal element, with a total of four right and three left tibiae, the MNI for that species will be four. The MNI is called a *minimum* measurement because, as is obvious in the example given, unless the element can be matched it is possible that there are actually seven individuals represented by the tibiae. The inherent difficulties in determining (in each case) which left element goes with which right element make the calculation of a more precise count of individuals impossible in most cases.

NISP measurements suffer from a number of weaknesses as a means of assessing the relative abundance of a given taxon, the most commonly cited are: (1) intertaxonomical variation (different taxa have different frequencies of a given element); (2) differential recovery of faunal specimens (larger specimens are easier to identify and record than smaller ones); (3) differing transportation and butchering patterns of skeletal parts according to taxon (see Binford 1978); and (4) differential preservation and fragmentation (some taxa are less affected by taphonomic processes than others). Methodological problems concerning the use of NISP include: differences in the calculation used between observers, particularly with respect to teeth; the interdependence of specimens (an individual is counted several times); stratigraphic lumping of assemblages; and finally, the ordinal scale measurement of NISP precludes certain interval scale statistical analyses (due to possible specimen interdependence) (Grayson 1984; Lyman 1987, 2008:29-30). Several of the problems with NISP as a quantitative method exposed above can be dealt with analytically (e.g. by taking MNI into account) although researchers should be aware of these potential problems. NISP remains a useful tool for estimating the relative abundance of taxa specifically due to the cumulative nature of the count (the fundamental nature of the NISP count in that each specimen equals '1' and the tally increases as identifications are done).

MNI is a particularly useful quantification tool in that it solves several of the problems inherent in the application of NISP, namely differential fragmentation (moderate fragmentation will not affect MNI but will increase NISP) and specimen interdependence (MNI specifically avoids counting the same individual animal twice). Problems with the MNI concern specifically: (1) difficulty in calculation (MNI is not additive); (2) differences in methods of calculating MNI (and reduction of comparability); (3) interpretation of MNI values in terms of a thanatocoenose (collection of dead life forms) or the biocenose (living collection of life forms); (4) MNI values exaggerate the importance of rare taxa or taxa with very low NISP values; (5) MNI values are minimums and therefore do not allow for the calculation of ratios; (6) MNI is affected by sample size, or NISP (as NISP increases, so does MNI); and, (7) different samples from the same assemblage will produce different MNI values (Lyman 2008:45-46). Several of the weaknesses of MNI are also either avoidable or solvable on an analytical level by taking NISP into account.

In addition to the NISP and MNI tallies, and partially to offset some of the problems mentioned above, zooarchaeological analyses also generally include a study of the relationship between NISP and MNI which indicates the effects of fragmentation in a given assemblage. As assemblage size (NISP) increases, so does the number of individuals (MNI) that contributed to the assemblage, and generally this relationship is expressed in a curvilinear trend on a scatter plot. Exceptions arise when fragmentation is either very high or very low.

The calculations of meat weights for those species in the assemblage that served as food prey can also be used to show patterns and trends in the subsistence practices under study. Here, meat weights are derived for the small seals through an adjustment of the average weight for adult ringed seals and harbour seals taken from Friesen and Arnold (1995:26) which is 91kg per individual; due to the fact that 81% of the individuals determined through MNI were immature, a conservative weight of 45 kg per individual was used for the present meat weight calculations. The same adjustments were made for the walrus for which the average weight for an adult is estimated at 665 kg; 400 kg per individual was applied for this study in order to take into account the one immature individual and the two juveniles. Polar bear and fox meat weights (including sub-adult and immature) were derived from average weights provided in Banfield (1974:363). Beluga weights were taken directly from Friesen and Arnold (1995:26) who had already reduced the average weight (from 875kg to 400kg) in order to include the numerous juvenile individuals in their assemblage.

Several species were excluded from the meat weight analysis for different reasons. The lemming, for which only a small fragment of mandible was recovered, is considered to be intrusive and has been excluded from the study. The wolf is represented by both low MNI and low NISP values (only teeth were recovered) and therefore cannot be considered as having an impact on dietary subsistence. Animals such as bear and wolf in particular would have been extremely dangerous to hunt and are far less numerous in the region of study than the marine species, their presence is most probably due to chance encounters and their pelts were probably high value items. The polar bears do, however, appear to have been of high caloric value (see figure 17, page 66)

Five age categories were applied to the assemblage: foetal/newborn, juvenile, immature, sub-adult and adult. Foetal/newborn bones are identified by the presence of porous juvenile cortex, very small size, total absence of fused epiphyses, and lack of distinct morphological traits. Juvenile bone also features juvenile cortex and generally lacks epiphyseal fusion, but is of a larger size and presents more defined morphological features than newborn bone. Immature bone lacks juvenile cortex, is larger than juvenile bone, may show partial fusion in certain elements (dependant on fusion-timing of the species), and is morphologically distinct. Sub-adult specimens are of adult size and morphology but show incomplete or partial fusion. Adult bone is fully fused and exhibits morphologically discernable traits. Dental specimens such as mandibulae and teeth can also be used to age specimens through the application of stages of eruption and wear tables (Grant 1982).

The small seal age classes used in the analyses of the KcFs-2 assemblage were defined as follows: adult (6-8 years, fully fused, adult proportions); sub-adult (4-6 years, close to adult proportions, partial fusion of tibia/fibula, humerus, radius, sacrum, phalanges); immature (1-4 years, no juvenile cortex, smaller than sub-adult, partial fusion only of pelvic acetabulum, metacarpals, metatarsals, phalanges); juvenile (first year of life, generally unfused but partial/incomplete fusion of metatarsals is possible, presence of juvenile cortex, small size, minimal morphological traits) and; newborn/foetal (under 4 months, totally unfused, very small, presence of juvenile cortex, lack of morphological features). The age groups given here were loosely elaborated on the fusion sequences and skeletal ages for ringed seals given by Stora (2000:222) but have been modified to include larger age spans. The small seal age categories are defined here based solely on epiphyseal fusion, bone morphology, and bone cortex analysis and are consequently less precise than those given by Stora, which were based on mandibular canine thin sections analyzed under polarized light microscopy (*ibid*. 2000:200-201).

Selective transport decisions based on economic strategies are reflected in the relative representations of skeletal elements. Utility indices can provide a means of identifying selective behaviour and culling strategies. The concept of an economic utility index was first formalized by Lewis Binford (1978) in his work involving traditional Nunamiut hunting practices (Inupiaq, Alaska), the basic premise of which is that biological variables of animal anatomy will condition hunter-gatherers' decisions concerning the transport of carcass parts from kill sites to other locations (butchery/processing sites, camps, etc.). Ultimately, this approach can also aid in the identification of site function. The selection of parts of carcasses and their transport away from the kill site are based on the utility (caloric value of meat, grease and marrow) of each part of an animal. Decisions about food utility also concern food preferences that are related to seasonality, the condition of the prey animal, the technology involved in transport, and the distance to the butchery site or residence (Binford 1978; Diab 1998; Lyman 1994; Lyman, Savelle and Whitridge 1992). Metcalfe and Barlow (1992) aptly describe transport decisions as ‘trade-offs’ between nutritional considerations, carcass part weight, and the processing efficiency of carcass parts. In short, anatomical parts that are difficult to deflesh, such as axial skeletal elements (vertebrae, scapulae, innominates), are most often transported to a residential site for processing, while larger, more easily butchered parts of the appendicular skeleton (limbs) are processed immediately and the bones abandoned at kills sites (Diab 1998). Butchering and transport decisions do, of course, vary in relation to the size of the prey animal and the inherent differences in muscle (meat) weight per skeletal element.

The utility indices (meat, grease or marrow) are based on average flesh weights, bone marrow volumes, or the percentage of grease rendered for each skeletal portion of the species under study. The definition of utility varies greatly for skeletal parts between species, specifically because carcasses can have uses other than food. The measured values of utility for skeletal parts (ex. skull, mandible, scapula, proximal and distal long bones, etc.) are plotted against the frequency of the same skeletal parts in a given assemblage in order to expose patterns in skeletal part frequencies. The skeletal part frequencies in the assemblage under study are produced by calculating the minimum number of each skeletal element by ascertaining how many of a particular skeletal element or part are present (ex. three overlapping fragments of distal femora indicate a minimum number of three distal femora); this calculation gives an MNE, or minimum number of elements, value. Once MNE values have been determined for a given species, the values are then divided by the number of times that anatomical part occurs in one complete skeleton to produce an MAU, or minimum animal unit, value. For example, if three distal femora are divided by two (two femora per skeleton) then the MAU for distal femora will be 1.5 (Lyman 1994:227). The normed MAU values (%MAU) are then plotted against the normed meat utility index values (%MUI) using a Spearman’s rho rank order correlation to produce bivariate scatter plots that can expose patterns of frequencies of skeletal parts.

Relationships between MAUs and MUIs can be interpreted in terms of the dominance of skeletal elements of different values, *i.e.* if an assemblage is dominated by high utility elements it indicates a 'gourmet' utility strategy, whereas an assemblage in which low utility elements are most numerous will be termed a 'reverse' utility strategy, as shown in Figure 14 (Grayson 1989:644; Lyman 1994:228).

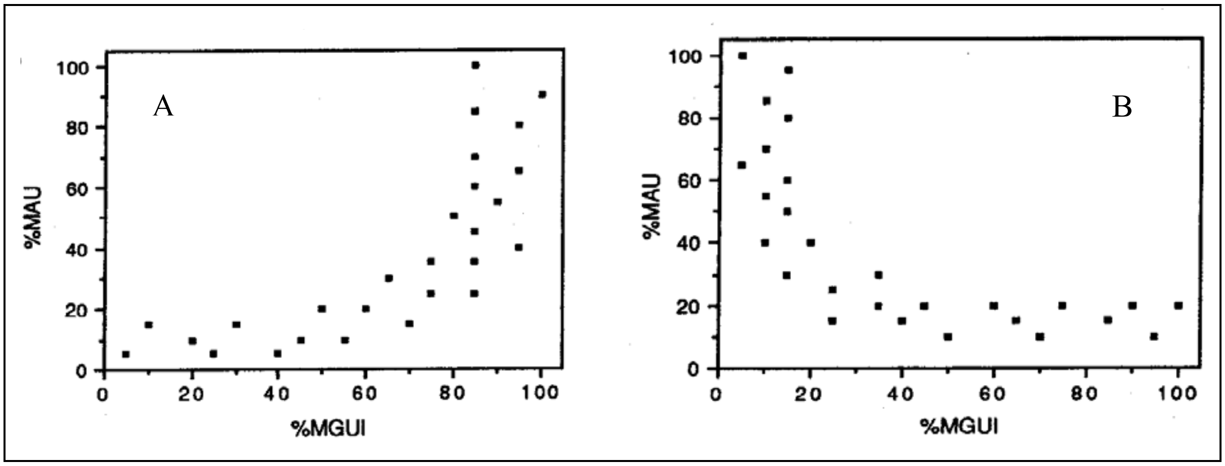


Figure 14: Scatter plots indicating (A) a gourmet utility strategy, and (B) a reverse utility strategy (Lyman 1994:228).

Comparisons can be made between assemblages that show discernable patterns of element selection and those that do not; results are meaningful in both cases (selective patterning vs. no patterning) because the presence of all skeletal elements (*i.e.* no patterning) is still indicative of the economic behaviour (choices made) of the group under study. In the years following Binford's elaboration of the meat utility index for caribou and sheep, the use of utility indices has been universally adopted within the zooarchaeological community and indices are now available for a number of animals that are commonly found in archaeological assemblages.

In the following section, utility indices will be applied to those species present in the KcFs-2 assemblage that have numerous enough specimens, in order to determine whether selective transport of animal parts has affected the composition of the assemblage. A detailed discussion of the relative importance of each species identified in the KcFs-2 assemblage will also be given with the goal of providing a plausible model for the subsistence practices of the inhabitants of the site as well as for determining the seasonality of occupation of the site through the seasonal fluctuations and migratory movements of the species identified.

5.2 Results

5.2.1 Relative Species Contributions

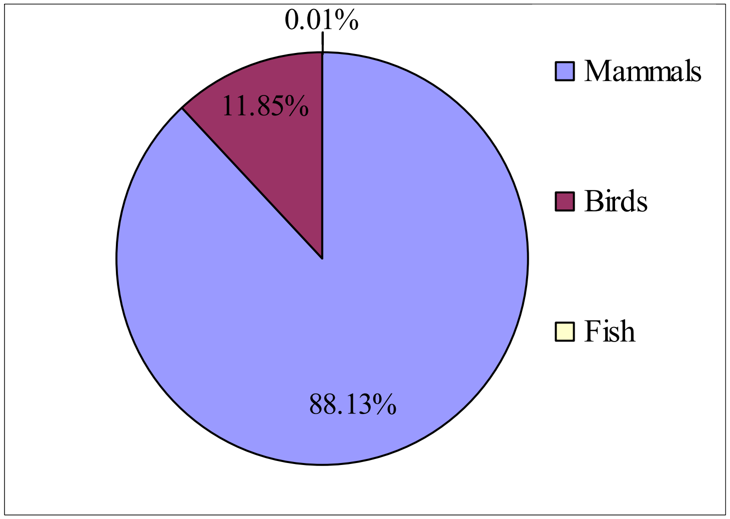
Of the 10879 specimens (bones and teeth) analyzed for this research, a total of 8933 (82%) were identified to family or species; these 8933 identified specimens are the focus of the present work. Table 1 and figure 15 show the relative contribution of each taxon in the KcFs-2 assemblage by NISP and MNI, and by percentage respectively.

Table 1: Species distribution based upon NISP and MNI for the KcFs-2 assemblage.

TAXON	NISP	%NISP	MNI	%MNI
Mammal				
Small seal (ringed/harbour)	7199	80.6	42	35
Harp Seal	101	1.13	6	5
Walrus	53	0.6	5	4.2
Beluga	33	0.37	2	1.7
Bearded Seal	2	0.02	1	0.8
Polar Bear	24	0.27	2	1.7
Cervidae*	288	3.22	n/a	n/a
Caribou	120	1.34	3	2.5
Fox (arctic/red)	47	0.53	5	4.2
Wolf	5	0.06	1	0.8
Lemming/vole	1	0.01	1	0.8
Bird				
Murre	782	8.75	37	31
Auk	271	3.03	11	9
Goose	2	0.02	1	0.8
Eider Duck	4	0.04	2	1.7
Fish				
Actinopterygii (marine)	1	0.01	1	0.8
TOTAL	**8933**	**100**	**120**	**100**

* The *Cervidae* fragments could not be determined to skeletal element, thus MNI could not be calculated.

1



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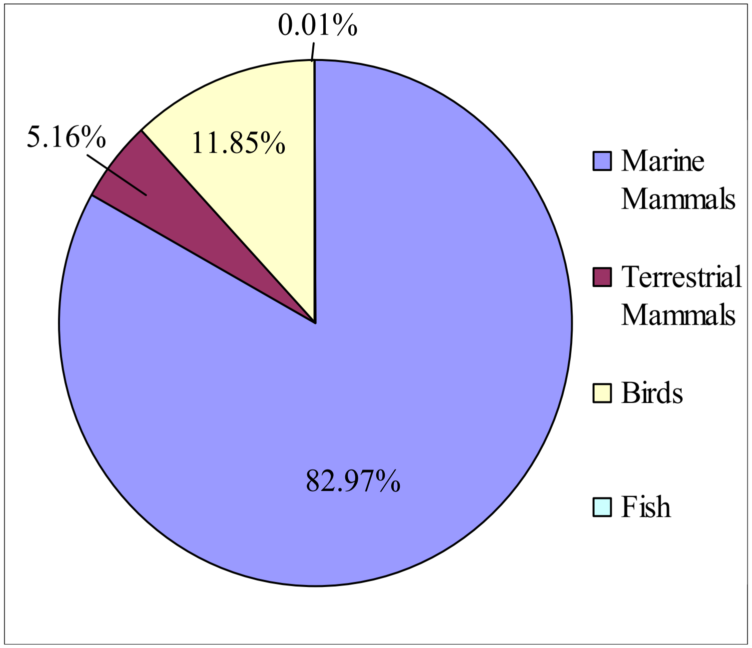

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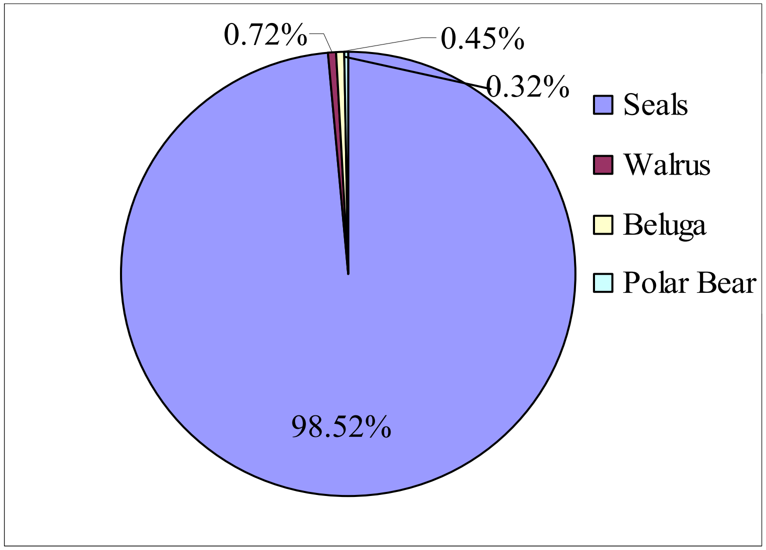


1. Pie chart showing relative abundances (%NISP) by taxonomic class.

2. Pie chart showing relative abundances (% NISP) by class and within the class of mammalian species two sub-categories are shown (marine and terrestrial mammals).

3. Pie chart showing relative abundances (% NISP) within the class of marine mammal species.

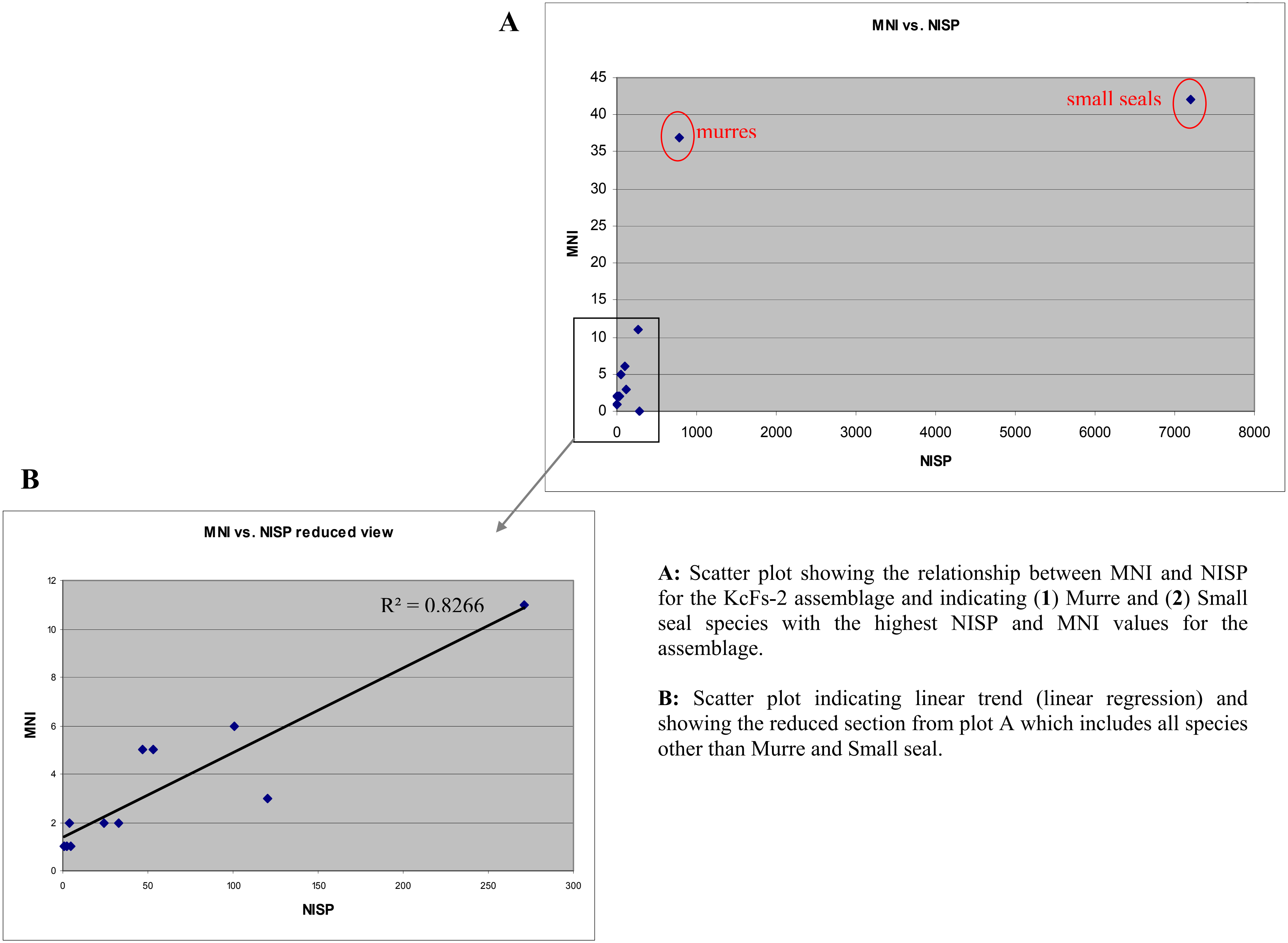
Figure 15: Pie charts showing relative percentage abundances of classes and species of the KcFs-2 assemblage.

The KcFs-2 assemblage is largely dominated by specimens of the mammalian class; mammals account for 88% of the total NISP. Bird and fish specimens together make up the remaining 12%, with only one specimen identified as fish. Marine mammals (seals, walrus, beluga and polar bear) account for 94% of the NISP for mammals, and terrestrial mammals tally 6%. Seals account for almost 99 % of the marine mammal NISP and are considered the focal species of the sample (see Figure 15 above).

5.2.2 Fragmentation (NISP:MNI)

Figure 16 shows the plotted values for MNI and NISP from the KcFs-2 assemblage in two parts, the first (plot A) contains the entire faunal assemblage, and the second (plot B) indicates all the species other than small seals and murres, which are outliers in plot A due to their relatively high NISP counts. The murres were probably transported whole to the site and their bones are mostly intact (low fragmentation), the small seals are dominated by immature individuals with unfused skeletons, a fact which has produced an inflated NISP count for the taxon. The small seal NISP contains an extremely high number of unfused epiphyses, specifically from the flippers. Both the ringed seal (*Phoca hispida*) and the harbour seal (*Phoca vitulina*) have a total of 56 flipper elements (anterior and posterior phalanges and phalangeal epiphyses) and another 20 metacarpal and metatarsal bones per individual; this on top of the unfused long bones of the forelimbs (humerus, radius and ulna) and hindlimbs (femur, tibia and fibula) and the unfused vertebral epiphyses, makes for a much higher count (NISP) than would be the case for an adult with full bone fusion. Age categories and distributions are exposed and discussed in further detail in the proceeding section concerning age data (section 5.2.4, page 67).

Differential fragmentation does not appear to be affecting any one taxon more than another. The murres are an exception in that the bones did not undergo any obvious butchering and show both high NISP and high MNI counts. Plot B was produced in order to show that, once the outliers are removed, the relationship between MNI and NISP is linear, this is as expected since the larger the sample the greater the chances of identifying more individuals.



A: Scatter plot showing the relationship between MNI and NISP for the KcFs-2 assemblage and indicating (**1**) Murre and (**2**) Small seal species with the highest NISP and MNI values for the assemblage.

B: Scatter plot indicating linear trend (linear regression) and showing the reduced section from plot A which includes all species other than Murre and Small seal.

Figure 16: Scatter plots showing the relationship between MNI and NISP for the KcFs-2 faunal assemblage.

5.2.3 Meat weights

Table 2 shows the dietary contribution of taxa based on meat weight for the KcFs-2 assemblage.

Table 2: KcFs-2 species distribution based upon dietary contribution.

TAXON	MNI	WGT per Individual (kg)	Edible tissue by % WGT	Available meat (kg)	% Total available meat
Mammal					
Small seal	42	45	70	1323	28.36
Harp seal	6	140	70	588	12.6
Walrus	5	400	70	1400	30.0
Beluga	2	400	70	560	12.0
Polar bear	2	420	70	420	9.0
Bearded seal	1	280	70	196	4.21
Caribou	3	95	50	142.5	3.05
Fox	5	5	50	9	0.20
Bird					
Murre	2	1	70	1.4	0.03
Eider duck	37	1	70	25.9	0.55
Total				**4665.8**	**100**

All meat weight values, with the exception of walrus, polar bear, fox and murre were taken from Friesen and Arnold (1995:26). Walrus, polar bear and fox meat weights were derived from average weights provided in Banfield (1974:363) and then adjusted for the appropriate age groups. Meat weight values for Small seal were adjusted for age. Murre meat weight values were taken from Spring (1971:10).

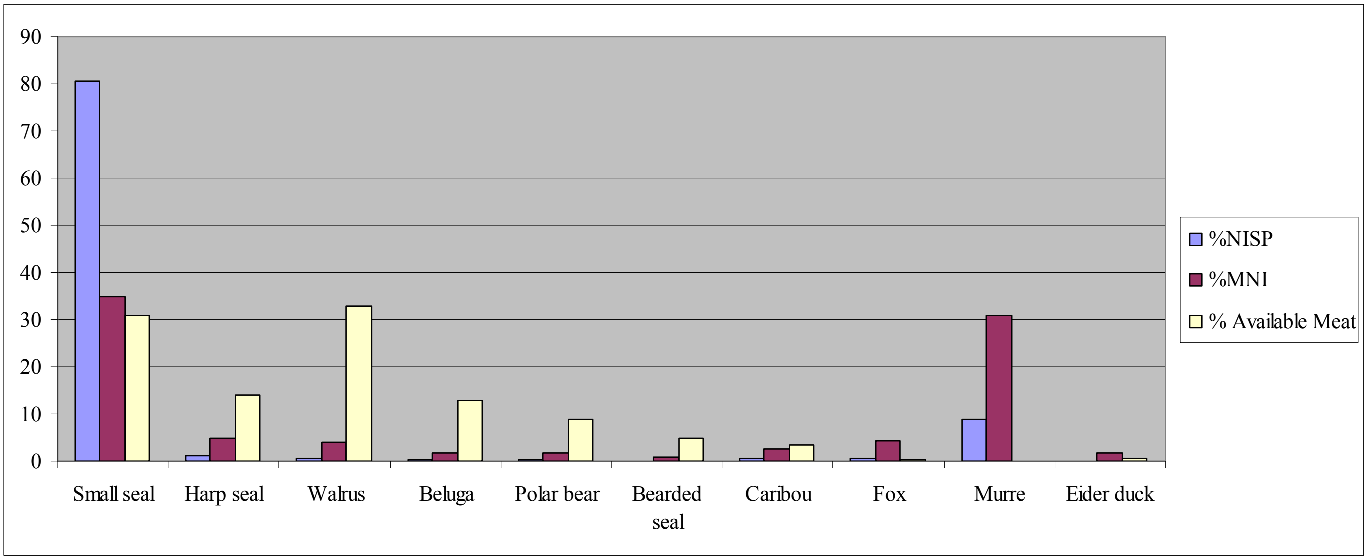


Figure 17: Comparison of species distributions and available meat weights for the KcFs-2 assemblage.

The meat weight analysis can be compared with the relative species distributions in order to expose those taxa that contributed the most meat to the diet (Figure 17 above).

Figure 17 clearly shows that the marine mammal species made up the major part of the dietary foundation of the inhabitants of the KcFs-2 site. Walrus were the most interesting from a subsistence perspective with just five individuals providing 30% of the available meat. Small seals follow close behind with 28% available meat, and beluga, harp and bearded seal constitute another 28% collectively. Polar bear are interesting as well seeing as only 2 individuals provided 9% of the available meat. Caribou do not appear to have contributed in any pertinent fashion to the dietary framework as they only provided 3 % of the available meat; is important though to note here that the *Cervidae* specimens could not be included in the meat weight analysis due to their high level of fragmentation, which was the result of marrow cracking. The caribou therefore provided a source of nutrition not taken into account in the meat weight analysis. Had it been possible to include the *cervidae* specimens in the meat weight calculation the caloric impact of the caribou would likely be increased. The avian species murre shows the second highest MNI of the entire assemblage, second only to small seals, and yet the murre do not appear to have contributed to the dietary needs of the group under study; in fact, the two duck individuals provided more meat (0.5%) than did the 37 murre (0.03%).

5.2.4 Age data

Several adjustments were made concerning average meat weights for the species that included immature and juvenile specimens, particularly for the small seals. Figure 18 shows the relative ages of specimens from the focal taxa.

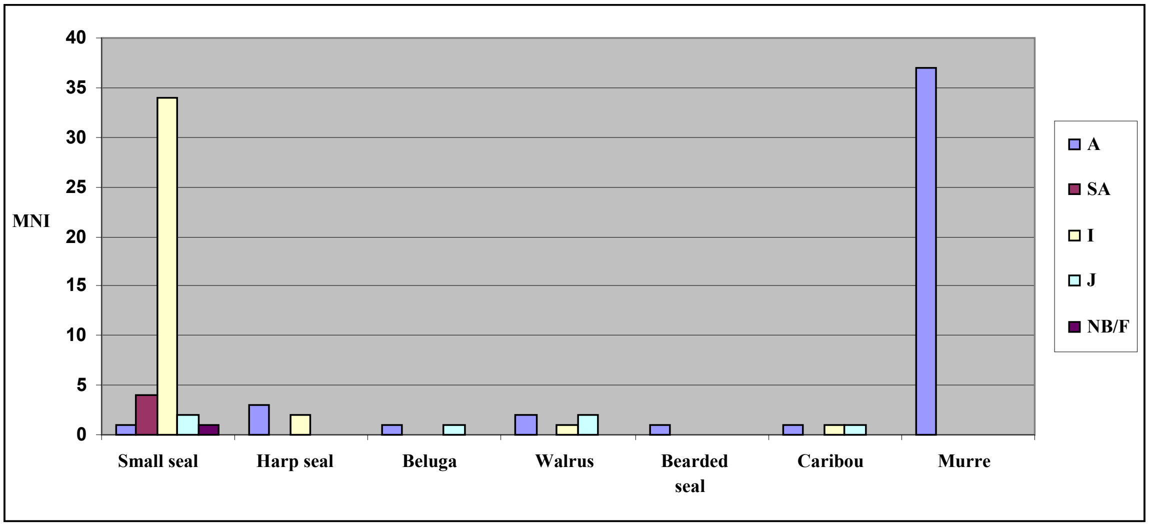


Figure 18: Relative ages of main taxa.

Tables 3 and 4 show the age distributions for all the identified taxa from KcFs-2 tallied through NISP and MNI respectively.

Table 3: Age distributions for the KcFs-2 assemblage tallied through NISP.

Taxon	A	SA	I	J	NB/F	UD	NISP
Small seal	425	54	1430	184	2	5104	7199
Harp seal	41	0	24	0	0	36	101
Beluga	7	0	0	1	0	25	33
Walrus	22	0	6	6	0	19	53
Bearded seal	2	0	0	0	0	0	2
Wolf	5	0	0	0	0	0	5
Polar bear	17	2	0	0	0	5	24
Caribou	45	0	4	8	0	63	120
Cervidae	0	0	0	0	0	288	288
Murre	548	0	0	0	0	234	782
Auk	0	0	0	0	0	271	271
Goose	2	0	0	0	0	0	2
Lemming	0	0	0	0	0	1	1
Fox	28	0	1	0	1	17	47
Fish	0	0	0	0	0	1	1
Duck	0	0	0	0	0	4	4
TOTAL	**1142**	**54**	**1467**	**199**	**3**	**6068**	**8933**

Table 4: Age distributions for the KcFs-2 assemblage tallied through MNI.

Taxon	A	SA	I	J	NB/F	UD	MNI
Small seal	1	4	34	2	1	0	42
Harp seal	3	0	2	0	0	1	6
Beluga	1	0	0	1	0	0	2
Walrus	2	0	1	2	0	0	5
Bearded seal	1	0	0	0	0	0	1
Wolf	1	0	0	0	0	0	1
Polar bear	1	1	0	0	0	0	2
Caribou	1	0	1	1	0	0	3
Cervidae	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Murre	37	0	0	0	0	0	37
Auk	0	0	0	0	0	11	11
Goose	1	0	0	0	0	0	1
Lemming	0	0	0	0	0	1	1
Fox	3	0	1	0	1	0	5
Fish	0	0	0	0	0	1	1
Duck	2	0	0	0	0	0	2
TOTAL	**54**	**4**	**40**	**6**	**2**	**14**	**120**

A= adult, **SA**= sub-adult, **I**= immature, **J**= juvenile,
NB/F= newborn or foetal, **UD**= undetermined

5.2.5 Economic Utility

As seen in the previous section, tallies of numbers of bones identified per species and calculations of minimum numbers of individuals can indicate the relative abundance of different species in a faunal assemblage and aid in defining their relative dietary importance. In this section, the results of the economic utility tests for small seal, harp seal, walrus, beluga, caribou and murre are detailed.

Small seal

The small seal remains are by far the most abundant in the KcFs-2 assemblage. Small seals have the highest NISP (7199 specimens, 81% NISP) and represent more than 1/3 of the individuals (35% MNI) in the assemblage. Small seals also represent almost 1/3 of the available meat for the assemblage, second only to walrus. All skeletal elements of small seals are present in the KcFs-2 assemblage; the element distribution for the species, based on %MAU, is seen in Figure 19.

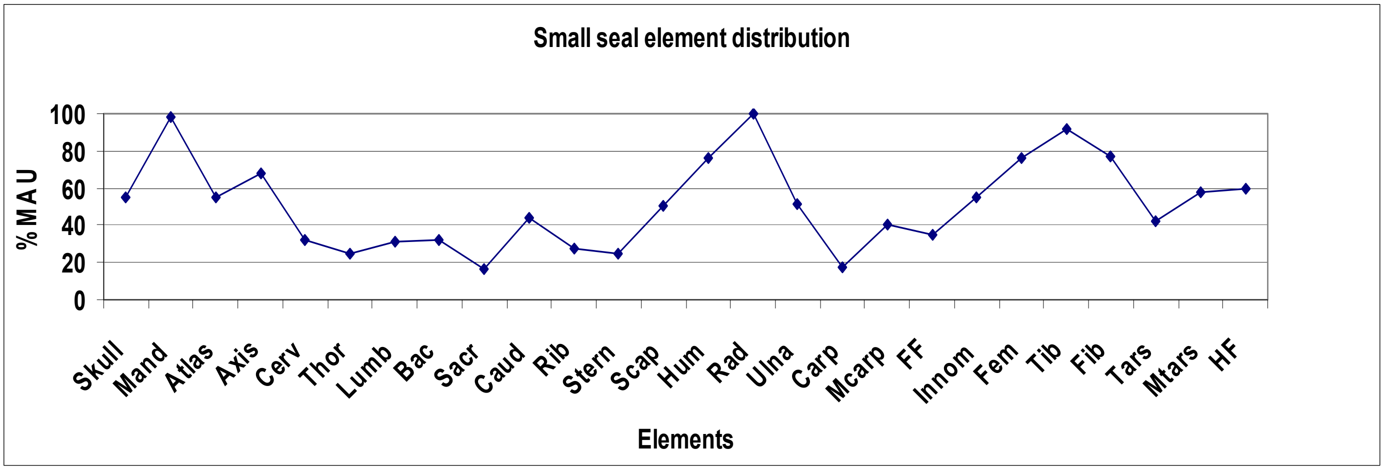


Figure 19: Small seal element distribution (see Appendix I for abbreviations).

It is reasonable, considering both the proximity of the House 3 structure to the procurement area (beach) and the small size of the ringed seal, to propose that small seals were transported back to the residence site as whole carcasses and that preparation of the seals took place in the House 3 area. Application of the ringed seal meat utility index (Diab 1998) to the %MAU calculated for small seal did not reveal a statistical dependence between meat utility and skeletal part frequencies; the test was determined to be insignificant with a negative rank correlation coefficient of $r_s = -.359$ and a probability value of $p = .189$, well above the predetermined acceptable limit of 0.01; the scatter plot can be seen in Figure 20. The small seal element distribution, seen in Figure 19, clearly shows the presence of all skeletal elements of the ringed seal. There is a higher frequency of appendicular long bones (humerus, radius, femur and tibia) which would appear to indicate a slight preference for skeletal parts with a higher meat value. Vertebrae appear to have the lowest frequencies, this could be due to several factors, specifically that sacral vertebrae could well have been classed as vertebrae of another type, and because of the higher rate of fragmentation for vertebrae in general due to relative structural fragility.

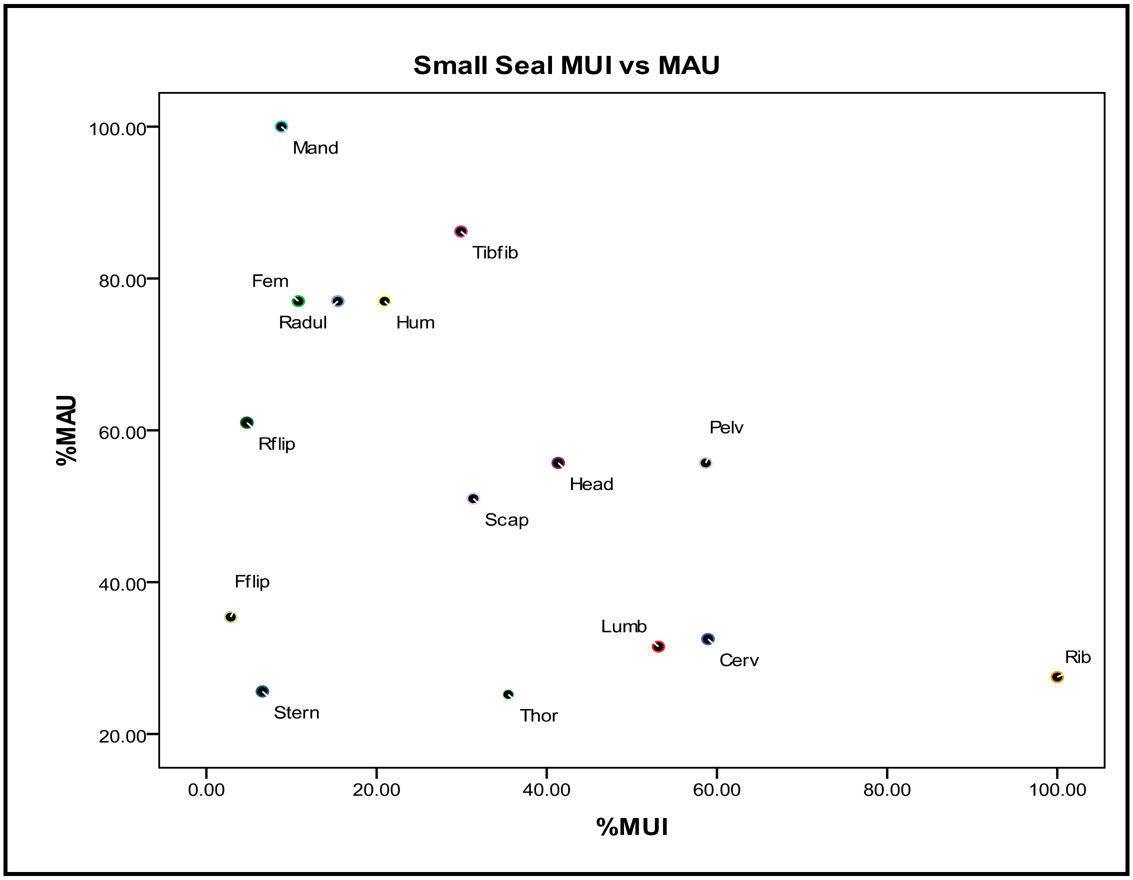


Figure 20: Small seal %MUI vs. %MAU, MUI index taken from Diab 1998 (see Appendix I for abbreviations).

Diab (1998) outlines a set of preference rankings of specific anatomical parts of seals that are defined through an ethnographic study of Inupiat exploitation of ringed seals. In his study, Diab is able to demonstrate that the tibio-fibula, femur, pelvis, radioulna, and humerus are the preferred parts of the ringed seal, respectively (*ibid*.:9). The element distribution for small seal in the KcFs-2 assemblage appears to mirror the preference rankings outlined by Diab, with the exception of the high frequency of mandibles, for which no preferential ranking was given in Diab's study.

Harp seal

The element distribution for harp seal (Figure 21) shows a similar pattern to ringed seal except for a few elements (atlas, axis, sacrum, scapula, and flipper elements). The absence of atlas, axis and flipper elements (phalanges) is likely due to the difficulty in identifying these particular elements to species, and could also be influenced by the low NISP for the taxon and taphonomic factors that increase fragmentation rates for these particular elements.

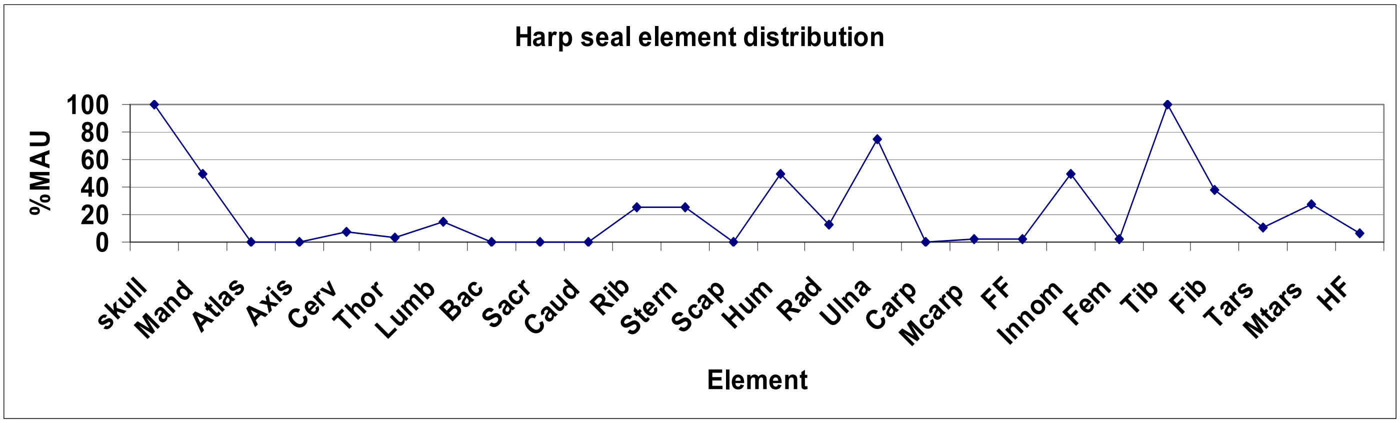


Figure 21: Harp seal element distribution (see Appendix I for abbreviations).

The application of the phocid seal meat utility index, derived by Lyman, Savelle and Whitridge (1992), produced insignificant statistical results, with a slight positive rank correlation coefficient of $r_s = .158$ and a probability threshold of $p = .625$, far greater than the 0.01 predetermined acceptable value (Figure 22). It is therefore not possible to suggest a transport strategy for this taxon.

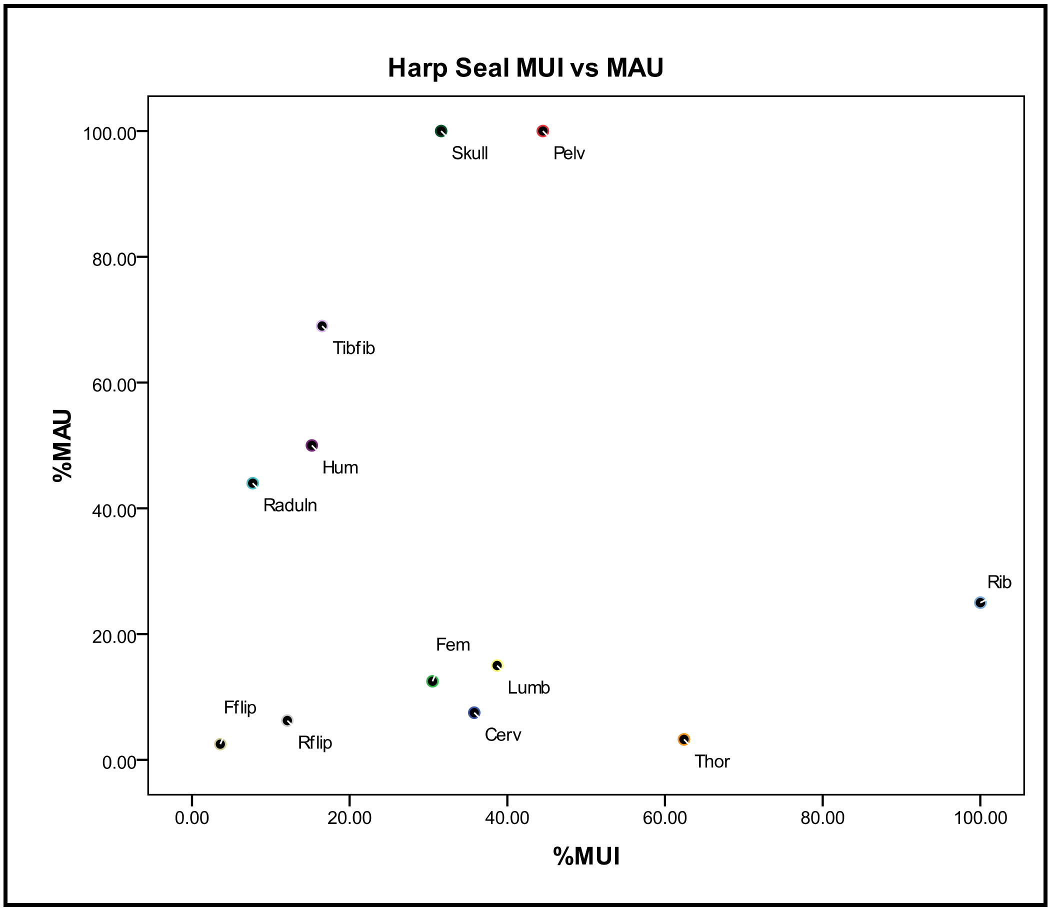


Figure 22: Harp seal %MUI vs. %MAU, MUI values taken from Lyman, Savelle and Whitridge 1992 (see Appendix I for abbreviations).

Walrus

The walrus element distribution (Figure 23) clearly shows a preponderance of appendicular long bones (humerus, radius, tibia, and fibula). There is an obvious dearth of cranial elements, mandibulae, vertebrae and flipper elements. It is reasonable to expect that a large, heavy animal such as a walrus would undergo more intensive butchery before transport. Unfortunately, there were not enough elements present to perform an economic utility test on the walrus remains from the KcFs-2 sample. Franz Boas (1964) in his ethnographic study of the Central Eskimo (originally published in 1888) did, however, note that while butchery of walrus carcasses did generally take place at the kill site, most body parts were rolled up in the skin of the animal and transported to habitation areas (*ibid*. 1964:114). What is obvious from the scant number of walrus specimens present in the KcFs-2 assemblage is that high meat value parts such as limbs were definitely brought to the residential site for processing; it is probable that the skulls were disposed of in another context due to the removal of the tusks, which would have been valuable items for use in the production of tools and for sculpture or other artistic modification.

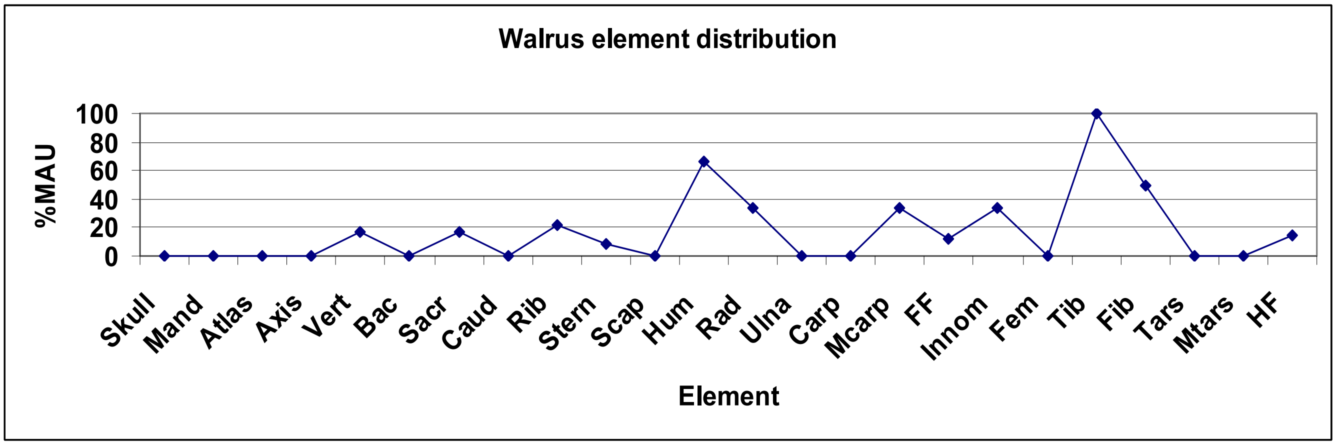


Figure 23: Walrus element distribution (see Appendix I for abbreviations).

Beluga

The few specimens identified for beluga are presented in the element distribution in Figure 24. There is an obvious lack of skull and axial skeletal elements in the beluga assemblage, and a high relative proportion of ribs, long bones (humerus, radius and ulna) and metacarpals. The presence of both ribs and long bones indicates a preference for the bulky region of the carcass that would undoubtedly have yielded the most meat and blubber; the remaining elements could well have been left in the water or at the water’s edge where initial butchery undoubtedly took place. The skeletal elements identified for beluga were unfortunately not numerous enough to allow for further economic utility analyses.

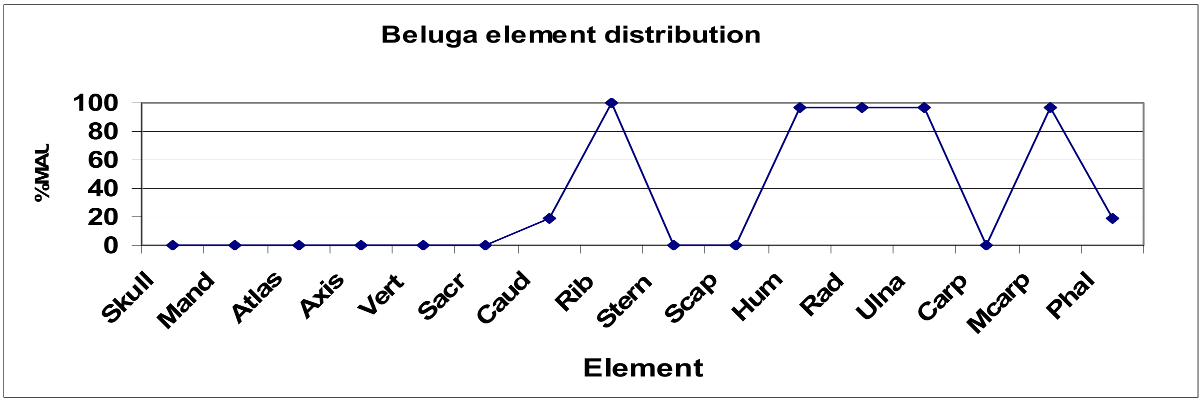


Figure 24: Beluga element distribution (see Appendix I for abbreviations).

Caribou

The element distribution for caribou (Figure 25) shows a high frequency of appendicular elements (ulnae and tibiae) and a lack of specimens representing the vertebral column and sternum. Metapodia and phalanges are present in reasonable numbers, as are scapulae and innominates. The basic trend recognizable in this element distribution is that of a preference for the limbs, the pelvic girdle and the back; these portions of the carcass would have yielded the most meat. The absence of skull bones could indicate differential transport and selection for high utility elements.

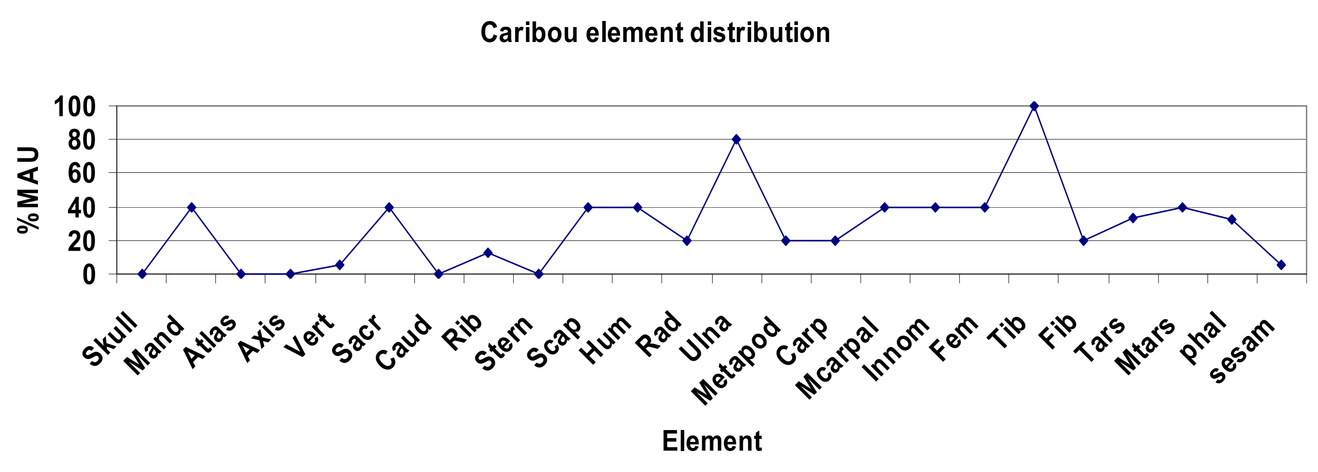


Figure 25: Caribou element distribution (see Appendix I for abbreviations).

The application of the meat utility index for caribou (Binford 1978), unfortunately produced an insignificant statistical test with a weak negative rank correlation coefficient of $r_s = -.286$ and an unacceptably high probability threshold of $p = .344$ (Figure 26); the low NISP for caribou, combined with density-meditated attrition (see below), are most likely responsible for this.

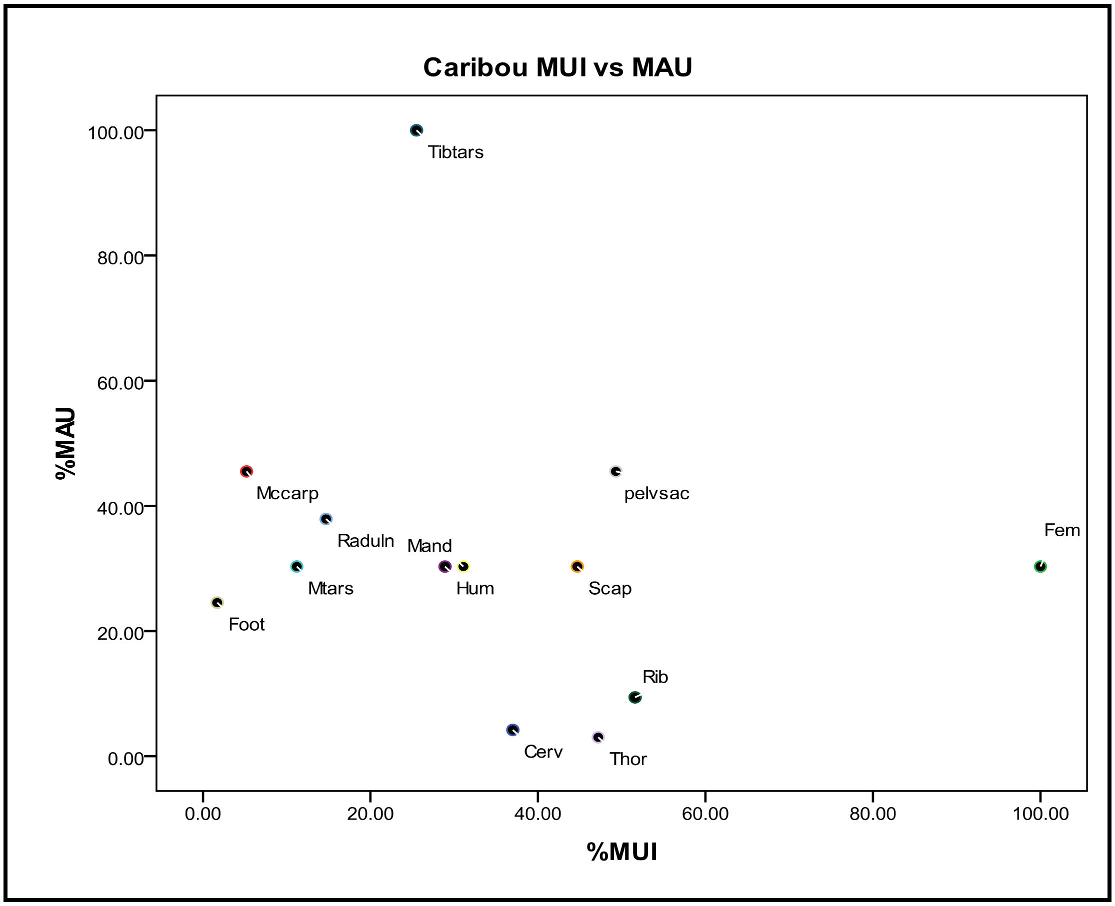


Figure 26: Caribou %MUI vs. %MAU, index taken from Binford 1978 (see Appendix I for abbreviations).

Murre

The element distribution for murre (Figure 27) shows relatively complete skeleton with a notable under representation of vertebrae, ribs and phalanges. The absence of these elements is undoubtedly due to their fragility and extremely small size.

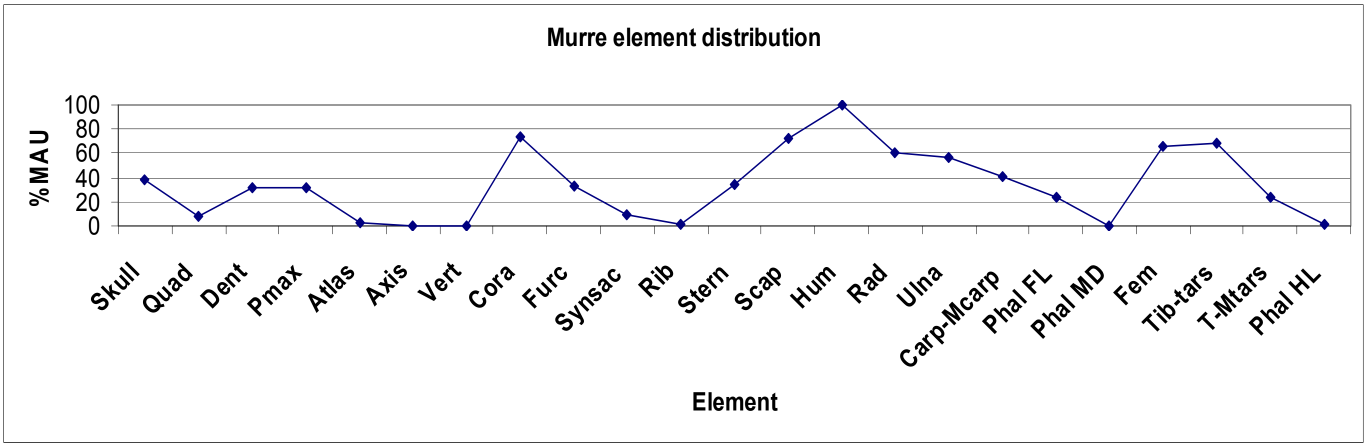


Figure 27: Murre element distribution (see Appendix I for abbreviations).

Economic utility indices are not yet available for murre and no meat utility data was found for any morphologically comparable taxon. The general frequencies in the element distribution for the murre do, however, indicate that whole carcasses were probably brought to the House 3 site for preparation and consumption and some smaller more fragile bones were either passed over during excavation, or have disappeared due to the effects of taphonomic processes. The same pattern of element distribution of murre remains has been noted in assemblages pertaining to Palaeoeskimo sites in Greenland, specifically at the Nipisat I (Saqqaq culture, southeast coast Greenland) where cranial elements, phalanges and vertebrae of murre were either very rare or were absent (Gotfredsen 1997:278).

Element tables for the remaining taxa are presented in Appendix II.

5.3 Bone Density Analyses

In order to assess the level of fragmentation in a given assemblage (and differences in fragmentation rates between species), and interpret the MAU/MUI relationship, it is necessary to analyze the influence of post-depositional bone attrition. Post-depositional destruction of bone is directly linked to the density (bone mineral content) of the bones in the assemblage (see Lyman 1994). Density mediated attrition can be tested for using statistical methods (Spearman's rank correlation) that compare the abundance of skeletal elements (MAU) with the measured density value for the element (bone density index). A positive correlation between normed MAU values (%MAU) and bone density values indicates an influence of taphonomic processes on the bones under study. Inferences on human behaviour are affected by the outcome of bone density tests; in the case of a strong positive correlation, it can be assumed that natural factors have strongly influenced the frequencies of elements in the assemblage. Lyman (1984) first published a standard analytical technique for measuring bone density against differential survivorship, using bone density values for deer. Since that time, density data sets for numerous species have been developed and changes to analytical method have occurred (introduction of photon densiometry and ct bone scans) in an attempt to standardize the approach (Lyman 1994; Stiner 2002).

Bone density tests were undertaken for three species only from the KcFs-2 assemblage due to the fact that several taxa were poorly represented. The three species tested for bone density mediated attrition were small seal, harp seal, and caribou. Of these three, only the test for caribou was significant on the 0.01 level (Figure 28 below). The rank correlation coefficient for caribou was positive at r_s =.506, with a probability threshold of p =.004, showing that density mediated attrition strongly affected the caribou bones in the assemblage (Figure 28.1), which could explain the lack of a correlation between %MAU and %MUI. We suggest that this attrition is related to human activities (processing for marrow) rather than natural taphonomic processes (see below). The test for small seal was excluded with a rank coefficient of r_s =.228 and probability of p =.283 (Figure 28.2). The harp seal test was also deemed insignificant when it produced a rank coefficient of $r_{s\,=}$ .264 and probability threshold of p = .361 (Figure 28.3).

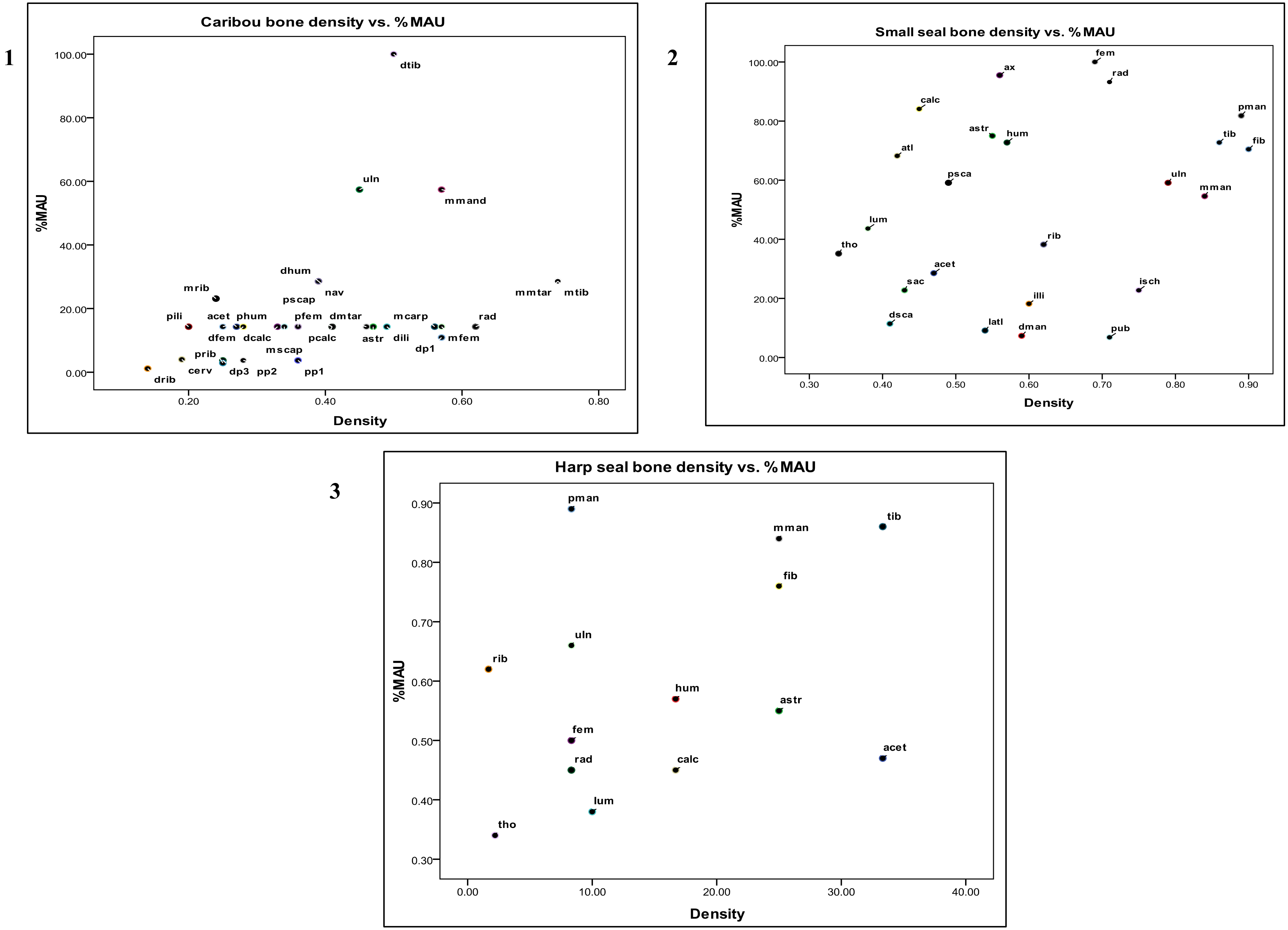


Figure 28: Scatter plots showing the bone density test results for (1) caribou, (2) small seal, and (3) harps seal, all density indices taken from Lyman (1994) (see Appendix I for abbreviations).

The caribou bones appear to have undergone intensive processing in the form of marrow cracking; this technique of selecting and processing the caribou bones produced the fragments in the *Cervidae* category and likely influenced transport decisions regarding the caribou carcasses. The higher frequency of long bone specimens in the element distribution for caribou (see Figure 25 above) could be indicative of a preference for marrow rich elements, a choice of processing method that would not have applied equally to the seal and walrus bones as they do not have the same marrow value. Pinniped bones (seal and walrus) have medulary cavities that are filled with trabeculated bone, which means that they contain far less marrow, and less 'desirable' marrow, than do cervids (Lyman, Savelle and Whitridge 1992). The caribou remains were tested using the marrow index developed by Binford (1978) in order to ascertain whether selection for elements with high marrow content could be demonstrated statistically (Figure 29).

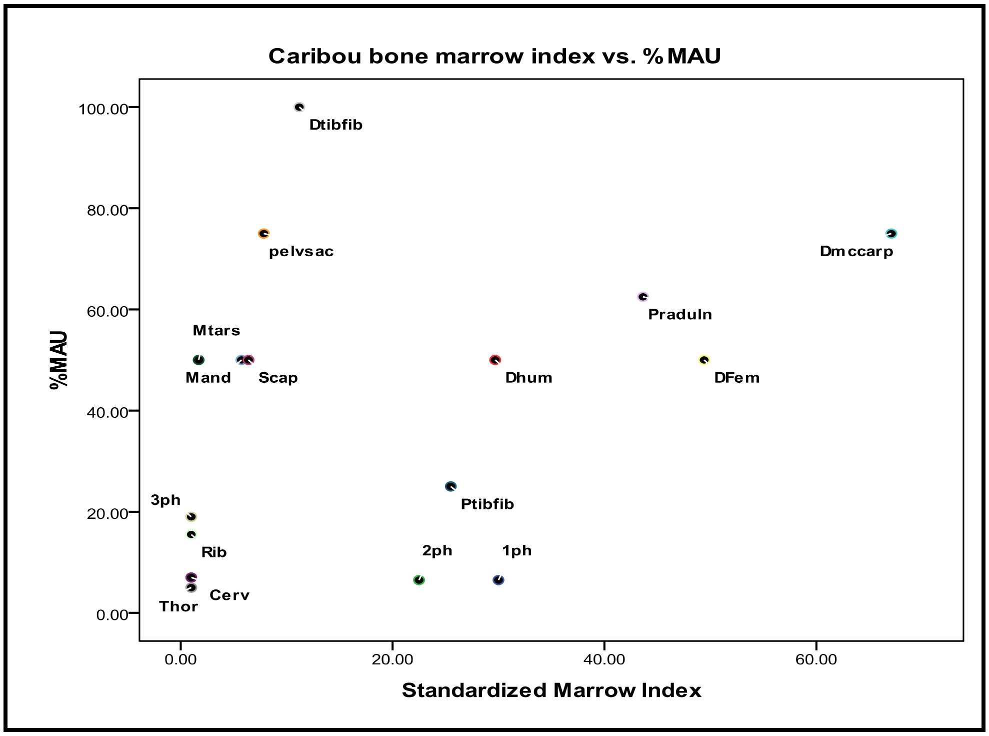


Figure 29: Caribou bone marrow vs. %MAU, index taken from Binford (1978), (see Appendix I for abbreviations).

Unfortunately, because the marrow-cracked *Cervidae* specimens could not be identified to skeletal element, they were excluded from the analysis, and the result was another insignificant test. The caribou marrow rank correlation coefficient was r_s =.429 and the probability threshold was p =.097, significantly above the predetermined acceptable level of 0.01. It remains probable that the lack of significance of the marrow utility test for caribou is due to attrition related to human activities (marrow cracking) rather than site formation processes. If non-anthropic taphonomic processes were responsible for fragmentation in the assemblage then the effects would presumably be evident in the specimens from other taxa, namely those of the murre as they are easily the most fragile specimens in the assemblage but they exhibit very little fragmentation and are well preserved in general.

Bone density values are not yet available for the murre species, the only other taxon with numerous enough MAU values to merit a density test. It would be reasonable, though, to assume that the murre specimens were not heavily affected by density mediated attrition simply because, as mentioned above, they are present in such high numbers and all skeletal elements are accounted for.

5.4 Discussion

In this section, the economic importance of each species is examined through an analysis of their relative importance in the ethnographic accounts for the region under study, as well as their significance in terms of inferences concerning the season of occupation of the KcFs-2 site.

Small Seal

The most economically important species in the KcFs-2 assemblage, specifically in terms of diet, are the small seals. The small seals in the assemblage were most likely of the ringed seal (*Phoca hispida*) genus, by far the most widely distributed and most populous seal species in the Arctic. The harbour seal (*Phoca vitulina*) is of the same relative size as the ringed seal but is rarely identified in archaeological assemblages. It is difficult to differentiate between the two phocid seal species through skeletal analysis (specifically for post-cranial elements) and so the term ‘small seal’ has been employed in order to indicate the possibility that the specimens could pertain to one or the other taxon. Specimens that were securely identified to the harbour seal taxon include 13 auditory bullae and 25 mandibulae; each of these cranial elements exhibits morphological traits that allow for differentiation between the two small seal species. Auditory bullae and mandibulae determined to the ringed seal species total 18 and 72 respectively; this gives ratios of almost 1.5:1 (bullae) and 3:1 (mandibulae) ringed seals to harbour seals. The harbour seals were, however, combined with the ringed seals in the small seal category. Harbour seals are much less visible among archaeological remains, specifically because of the morphological similarities with ringed seals, but also because they have a much smaller sphere of distribution and smaller population size throughout the Arctic and are also more likely to migrate inland to fresh water sources such as rivers, lakes and estuaries (Mansfield 1967). For these reasons, the remainder of the section concerning small seals will focus on ringed seal traits and behaviour.

As previously stated, the ringed seal is the most common seal found in the Arctic territory and the remains of ringed seals are ubiquitous within Arctic faunal assemblages. The ringed seal is circumpolar in its distribution and is present throughout the year. Ringed seals are ice-dependent and are found in all regions of the north where fast-ice forms annually in winter and remains through early spring. Female ringed seals reach sexual maturity between 6 and 7 years of age, males at 7 years (Mansfield 1967). Mating occurs in late April, during the period of lactation, but implantation of the blastocyst does not take place until late August or September. Gestation is approximately 240 days (8 months); females give birth to a single pup in subnivean lairs in the spring, usually between mid-March and early April. Pups are weaned between 38 and 44 days following birth and they achieve approximately 93% of their first year growth during the period of lactation. As a general rule, pups lose fitness during August and September following weaning but quickly regain blubber stores in autumn for the winter months (Diab 1998; Murray 2005; Smith *et al.*1991). During the ice free months all age classes of ringed seals are found along the coastal regions of the Eastern Arctic (on beaches and at the waters edge); melting occurs between early May and mid-August and ice is generally gone between mid-August and mid-October in the Ivujivik region. Age segregation occurs after freeze-up, from mid-October through to early May, during which time sexually mature males and females force immatures and sub-adults to adjacent areas around the stable fast-ice and away from snow covered ice where the adults build subnivean lairs and breed. Immature and sub-adult seals are restricted to maintaining breathing holes in the snow-free offshore fast-ice and usually have little or no snow cover for lair formation (Murray 2005:20; Smith *et al.* 1991; Department of Fisheries and Oceans, 2010: www.ccg-gcc.gc.ca/e0010736).

Ethnographic accounts of Inuit seal hunting give evidence that seals were pursued mainly in the fall using breathing hole sealing methods and in the late winter and spring on the floe-edge and at haul-out points (Vézinet 1982). Sealing in the spring usually requires that the hunters resist taking males until after the mating period as they give off a strong odour during rut (through facial secretions) that also, apparently, can be tasted in the meat (Smith *et al.* 1991). It is possible that seals were taken in the winter at breathing holes with the use of harpoons, but it has been suggested that this practice would have been highly dangerous due to strong winter winds (Mansfield 1967:23; Vézinet 1982:71). Sealing through the summer months from kayaks has also been proposed as a potential hunting method but may not have been common practice before the introduction of firearms (Vézinet 1982:72).

The abundance of immature specimens in the KcFs-2 assemblage, along with the one newborn individual, would appear to indicate a late winter through summer occurrence of seal hunting at the site. The intensive hunting of immature seals has been recently documented in a study by Murray (2005) regarding ringed seal exploitation in the Early Palaeoeskimo period (4000-3500 B.P.) at the Igloolik site in Foxe Basin. Murray's study showed a pattern of deliberate targeting of juvenile and young adult specimens through the fall and winter at the Igloolik site. Late winter and early spring hunting was not ruled out by the study, but the absence of foetal or newborn specimens suggests that hunting during these seasons, if it did occur, did not include breathing holes or pupping dens. The absence of juvenile seals 'of the year' in Murray's study indicated that hunting did not occur there during the summer months (*ibid.* 2005:35), contrary to KcFs-2. Because the immature and sub-adult seals are generally found in areas with little to no snow cover during the winter and spring, it is reasonable to propose that there is an easier access to these individuals than to adults hidden in subnivean lairs. Immature seals certainly appear to have been the easiest prey for the hunters at the KcFs-2 site considering their dominance in the assemblage. The newborn individual in the KcFs-2 assemblage was identified through the presence of juvenile cortex, an extremely small size, a lack of morphological traits, and the complete absence of epiphyseal fusion. The age assigned to the newborn specimen is supported by a [descriptive] comparison with a juvenile of 2-3 months of age that exhibited the same cancellous bone cortex as the newborn specimens in the KcFs-2 assemblage; the newborn was identified in a study by Mark Diab (1998) in which several ringed seals were butchered in order to define a meat utility index for the species. Diab pinpoints the period of capture of the newborn pup to between mid-March and mid-June (*ibid.*:4). When compared with a reference specimen of an approximate age of 6 months, the newborn elements from the KcFs-2 collection (1 scapula and 1 humerus) were far smaller. The lack of fusion of the supraglenoid tubercule of the newborn scapula (estimated at 6 months for ringed seals) (Stora 2000:217) also supports an estimated age of no more than 3 months for the newborn. The identification of a pup, combined with the presence of at least two juveniles and numerous immature individuals, lend considerable support to the proposal of a late winter through summer season of seal hunting at the KcFs-2 site, somewhere between the months of March and June. During this period seals are abundant, specifically because the female ringed seals give birth in the subnivean lairs during this period (pups remain in the lairs from March through May), adult males occupy the remaining stable fjord ice, and all age groups haul out onto the fast-ice, (Smith *et al*. 1991:127-129).

The preceding analysis of the small seal remains from the KcFs-2 assemblage indicate that small seals were the central subsistence focus of the inhabitants of the site, they were hunted in the late winter through until the late spring/early summer at breathing holes and on at least one occasion in their dens (at least one newborn individual was taken), and their carcasses were transported to the residential site whole.

Harp seal

The harp seal (*Pagophilus groenlandicus*) is a migratory, pelagic species of phocid seal and is only available in open water season. Harp seal populations are confined to three isolated groups that breed in three independent regions: (1) the western Atlantic herd that migrates from the Labrador coast and into the Hudson Strait (with another sub-group migrating from Newfoundland down to the St. Lawrence Gulf and

Estuary); (2) the White Sea herd located off northern Europe, and; (3) the West Ice herd that whelps off Jan Mayen Island, north of Iceland (Mansfield 1967). In the region surrounding the KcFs-2 site, harp seals are present first in late spring and early summer (late May and into June) when they follow the retreating sea ice edge, and again in the autumn nearing the end of September and into early October when they move back southward (Banfield 1974:12). Because harp seal pups are born before the migration, from late February to mid-March in the southern regions of the Labrador and Newfoundland coasts, it is expected that no newborn or juvenile individuals would appear in the faunal assemblages in the north. This is the case for the KcFs-2 assemblage, in which three adults, two immature, and one undetermined (for age) harp seals were identified.

Ethnographic accounts for harp seal hunting in the Hudson Strait region indicate that harp seals are only occasionally taken in the spring and fall and are not a central element of subsistence practices in the north. Harp seal remains were only the fifth most abundant in the KcFs-2 assemblage (1.13 %NISP) and only 6 individuals were identified (5 %MNI). This being said, it is interesting to note that harp seals placed third in terms of available meat (14%). Harp seals are larger than ringed or harbour seals, adult males can weigh up to 140 kg, and aside from providing a considerable amount of meat per individual, they are also widely used for their pelts. Renouf and Bell (2008) present an interesting comparison between the use of ringed seal skins and harp seal skins for making clothing and for use in constructing tents; they propose that while ringed seal pelts are often used for making clothing, it would take several more ringed seal pelts to make a set of clothing for an adult than it would harp seal pelts (*ibid.*: 43). The utility of harp seal pelts, in conjunction with a high meat yield, would make the harp seal valuable prey during the season of migration.

The presence of both adult and immature harp seals in the assemblage lends support to the winter through summer occupation sequence previously indicated by the small seal remains. It is plausible that the harp seals in the assemblage were taken during the migration to the north, putting the season of harp seal capture sometime during the month of May.

Walrus

Walrus (*Odobenus rosmarus*) are highly gregarious pinnipeds that tend to congregate in large groups on land during the ice free months, and huddle together on the pack-ice edge or on ice-floes in winter. Banfield (1974) identifies two primary groups of walruses, the Pacific group and the Atlantic group. Pacific walruses have a well-defined migration pattern from the shallows of the Bering Sea in winter to the coast of Siberia in summer. Atlantic walruses are more sedentary and carry only local migrations during the winter months when solid ice forms over narrow coastal shelves. The Atlantic walrus sphere of distribution historically covers the entire coast of Hudson Bay, Hudson Strait, Foxe Basin, Baffin Bay, the Davis Strait, the southern coast of Greenland, and the north-western coast of Iceland, and the Gulf of the St. Lawrence prehistorically. Mating occurs on the ice-floes in April and May, females generally mate every second year, and calves are born from late May to early June.

Walruses are a very important source of both meat and blubber and their large size guarantees a long term source of calories for successful hunters. In addition to their nutritional value, walruses are also valued for their skins and ivory tusks, and because of their aggressive nature walruses can be considered a prestigious prey animal. Ethnographic accounts of Inuit walrus hunting practices in the Hudson Strait region describe intensive capture through the use of kayaks and collective hunting strategies (Vézinet 1982:69). Though no clear evidence for kayak use exists for the Dorset period, it is likely that they had some sort of watercraft for use in travel and hunting. Communal hunting of walrus in the Dorset period is, however, clearly supported in a study by Murray (1999) in which personal ownership of Dorset walrus harpoon heads is detailed through a system of individual markings (see chapter 7). Because walruses are dangerous and aggressive animals, and due to their very large size, communal hunting strategies would have been necessary for their exploitation. The individualization of harpoon heads would have served to prove ownership of prey and to regulate the eventual sharing of the carcass. Communal hunting served to minimize risk to individuals while at the same time maximizing the return in meat, blubber, skin and ivory that the walrus provided. Murray proposes that walrus hunting was a central focus of Middle Dorset subsistence practices in the Foxe Basin region but that there is a noticeable decline in walrus remains for the

Late Dorset period and in conjunction with an increase in ringed seal exploitation at the site studied (Igloolik) (*ibid.* :472-474). This data mirrors the pattern evidenced in the faunal assemblage from the KcFs-2 site.

Walrus is the taxon that contributed the highest percentage of available meat to the KcFs-2 assemblage. The average adult weight for eastern males and females is 665 kg (males 760 kg and females 570 kg), immatures weigh about half that at 330 kg, and newborns some 70 kg (Banfield 1974:363). The meat weight calculation for walrus was based on a conservative estimate of 400 kg average per individual in order to take into consideration the immature specimen and the two juveniles. With a NISP of only 53 and a small MNI of 5 (2 adults, 1 immature, 2 juveniles), it is interesting to note the important contribution of walruses to the dietary framework of the inhabitants of the KcFs-2 site. While walrus was not as readily available as ringed seal and was much more difficult to hunt, it was obviously a very valuable animal to capture when the possibility presented itself.

The presence of two juvenile walruses in the collection adds to the mounting evidence for a late winter to summer season of occupation for the KcFs-2 site; whelping takes place in May and June and it is probable that the juveniles were taken during, or shortly after, this period. The slow maturation process typical of walruses does, however, complicate the use of juvenile specimens for seasonality inferences (Lofthouse 2003:84). Because an exact age for the juvenile specimens is impossible to determine with any real precision (due to a lack of associated dental elements), it is more prudent to consider patterns of seasonality indicators from the assemblage as a whole for defining the season of occupation.

Beluga

The white whale (*Delphinapterus leucas*), or beluga whale, is the largest of the species identified in the KcFs-2 faunal assemblage. Belugas are migratory and follow the same general route as that of the harp seal (up the Labrador coast), they arrive in the Hudson Strait region twice yearly; they first appear in the region between June and early August en route further north, and then again in early September on the route south. Belugas mate in spring and, after a gestation period of approximately 14 months, give birth between March (Greenland) at the earliest and August (Hudson Bay) at the latest, with a peak in the month of June (all areas) (Banfield 1974:250). An average adult weight (males and females) is about 875 kg, immatures can weigh up to half that, and juveniles (1 month) about 90 kg. With a NISP of just 33 bones and fragments of bones, and an MNI of 2 (1 adult and 1 juvenile), beluga are among the least well represented of the species in the KcFs-2 assemblage. Despite their minimal representation in the collection, and assuming access to complete carcasses, belugas were the fourth most important source of available meat of the species present (13%). In addition to meat and blubber, belugas are an important source of skin and large bones, both of which are documented ethnographically as having served in the construction of tents and house structures, and the skin also specifically in the manufacture of clothing. The edible skin of the beluga (muktuk) is also considered a delicacy among modern Inuit groups (Banfield 1974:250). Considering the large size of beluga whales and the amount of blubber, meat, skin and bone that even one of these animals represents, it is reasonable to suppose that they had a very high value from a subsistence perspective. This being said, it is interesting to note that archaeological evidence for intensive or even regular exploitation of the beluga is very rare for prehistoric sites as a general rule (Savelle 1994:116). The paucity of beluga remains at Palaeoeskimo sites can be attributed, according to Savelle, to a lack of appropriate whaling technology for the period. The scarcity of beluga remains at Thule sites has a much less obvious explanation seeing as the Thule possessed sophisticated whaling technology. It is probable that taphonomic factors, special methods of processing, and differential transport are responsible for the shortage of evidence for beluga exploitation in Thule assemblages, and could also effectively influence the recovery of beluga remains at Palaeoeskimo sites as well (*ibid.*). The seasonal presence of the beluga in the region of the KcFs-2 site, and the obvious difficulty involved in hunting them, likely indicate that the capture of the two individuals in the assemblage was both spontaneous and opportune; it is plausible that the whales (possibly a mother and calf) could have been trapped in shallow waters or in an isolated inlet during low tide and thus became easy prey.

The presence of a juvenile beluga in the assemblage, though interesting from a subsistence perspective, cannot be considered a reliable indicator of seasonality due to the migratory nature of the species and to the fact that precise ages could not be determined.

Bearded seal

The marine mammal that contributed the least to the dietary framework of the KcFs-2 inhabitants is the bearded seal (*Erignathus barbatus*). Bearded seals are solitary animals and are most often found on shallow banks of ice-free land in the winter and on fast ice where they haul out, rest and breed in the spring, and at river mouths and sandbars during the ice free months. Bearded seals are present year round in the Arctic. Adult bearded seals are large, robust seals and average 235 kg, with a maximum weight of 397 kg (minimal sexual dimorphism). Mating of bearded seals occurs in mid-May, gestation is 12 months with delayed implantation taking place in August; pups are generally born in April and May. No immature or juvenile individuals were identified for bearded seals in the KcfS-2 faunal sample. Bearded seal has a NISP of just 2 and an MNI of 1, leaving it among the least important species of the assemblage. The bearded seal contributed just 5% of the available meat of the dietary framework represented by the faunal sample. The two elements identified for bearded seal are one 1st metatarsal and one 3rd metatarsal. Though secure identification of metapodial elements to species is not supported in zooarchaeological studies, bearded seal metapodia do stand out from those of other Arctic seals due to their large size and unique morphological traits (Hodgetts 1999:296-297). The two bearded seal metapodia in the KcFs-2 collection fit extremely well with the adult bearded seal reference specimen and were far too robust to be included in the range for the small seal or harp seal. For obvious reasons, no economic utility analyses were undertaken for the bearded seal.

The speculative nature of the identification of the bearded seal specimens and the absence of any juvenile specimens effectively exclude the taxon from influencing inferences concerning seasonality.

Caribou

Caribou (*Rangifer tarandus*) is the largest of the terrestrial species identified in the KcFs-2 assemblage. Caribou are the only species of herbivore, aside from musk ox, with an Arctic distribution that have been a focal resource of Arctic subsistence both historically and prehistorically. Generally, in ethnographic contexts, caribou have been exploited for their hides but they are also a source of meat. Caribou exploitation also differs regionally in intensity (see below). Caribou travel in herds and migrate seasonally through territories that can span to more than 1280 km, ranging between tundra zones in summer to forested regions in winter (Banfield 1974:385). The Ungava-Labrador caribou genus (*Rangifer tarandus caboti*) is found along the coast in the Hudson Strait region from April until November, with some herds departing for the south in September (Vézinet 1980). Caribou give birth in the northern ranges between the months of May and July, with a peak birthing period in mid-June.

Evidence of caribou hunting is ubiquitous at sites dating to the Palaeoeskimo, Neoeskimo and historic periods. Evidence of caribou exploitation in the Dorset period specifically is equally abundant, with some sites having produced faunal assemblages that are dominated by the species (Nunguvik site, Navy Board Inlet and Ekalluk Lake site, Victoria Island) (Maxwell 1985:138). McGhee (1976) also noted evidence of intensive and year-round caribou hunting in some regions of the Central and High Arctic (Victoria Island, Banks Island, Western Barren Grounds) for both pre-Dorset and Dorset period occupations. Ethnographic accounts of caribou hunting reveal two particular methods of procurement, both utilizing lances: (1) by *inuksuk* drive, for which rows of piled rocks resembling people are used to conceal hunters and force stampeding herds into areas where killing them with lances is made easier, and; (2) driving the animals into the water near crossing places where they are killed by hunters waiting in Kayaks (Fitzhugh 1980; Maxwell 1985). Dorset lance heads have been identified at numerous sites (Tayara, Sugluk Island, Igloolik and OdPc-4 on Victoria Island, among others) and attest to caribou hunting practices throughout the period (Maxwell 1985:140).

Three individual caribou were identified in the KcFs-2 assemblage, one adult, one immature, and one juvenile. The juvenile bone specimens all exhibited juvenile cortex and a total absence of epiphyseal fusion. The immature specimens had adult cortex but were unfused and were of a smaller size than the adult specimens from the reference skeleton. As presented in Table 1, the cervid specimens are separated into 'caribou' and '*cervidae*' taxonomic categories, this is due to a large number of fragments of long bones that were attributable to caribou, but were not morphologically identifiable to skeletal element. The *cervidae* bone fragments all exhibit conchoidal fracture patterns typically produced through 'marrow cracking' (see bone density section above). When long bones are cracked open in order to extract marrow, the bone cortex breaks in a specific pattern, this is aptly described by Fisher (1995) in his work on bone surface modification:

> "Conchoidal flake scars and corresponding bone flakes are produced by applying strong force to a bone with a hard object. Ancient humans created conchoidal flake scars and flakes by striking the shaft of a bone with a hammerstone (or other suitable hammer) or by striking a bone on an anvil. The purpose of hitting bones in this fashion was, in many cases, to break the bones open for marrow removal, to fashion an implement from bone, or to obtain a piece of bone as raw material for tool manufacture or other purposes."(*ibid.*:21).

The conchoidal fragments were identified to the *cervidae* family through analysis of the bone cortex, which could not be attributed to any other land mammal of comparable size with a distribution in the area under study (*i.e.* polar bear). Ethnographic and historical evidence for caribou long bone marrow extraction is well documented and, as observed by Binford (1978) in his study of Nunamiut hunting practices, large collections of fragments of marrow cracked bones consistently produce "non-random morphological patterning" and "recurrent morphologies of both fragments and articular ends" (*ibid.*:154). Thus, it is reasonable to assume that the conchoidally fractured long bone fragments belong to the *cervidae* family and are the result of marrow extraction processing. Unfortunately, because the bones could not be identified to skeletal element, they could not be included in either the meat weight calculation or the economic utility test.

The presence of a juvenile caribou in the KcFs-2 faunal sample lends some support to the proposed late winter through summer season of occupation for the site. It is plausible that the juvenile individual was born in the spring (May) and was taken within the two succeeding months, but the age determined for the juvenile cannot be confirmed with any real precision due to a lack of associated dental or cranial elements.

Terrestrial carnivores

The wolf (*Canis lupus*), polar bear (*Ursus maritimus*), and fox (*Vulpes spp.*) specimens place amongst the lowest frequencies of species in the KcFs-2 assemblage. Together, these three genera of terrestrial carnivores total just 0.9% of the total NISP and 7% of the MNI for the assemblage. Both polar bear and fox specimens include either sub-adult (1 adult and 1 sub-adult polar bear) or juvenile (3 adults, 1 immature and 1 newborn fox) elements, the wolf remains are restricted to one adult.

The adult wolf was identified through five canid teeth (1 canine, 1 molar, 1 premolar, and 2 post canines) that matched well with the adult reference specimen. It is difficult to distinguish between wolf and dog exclusively through an analysis of unassociated dental elements; distinctions are usually drawn from measuring the orbital angle of teeth in the mandible (Mech 1974: 36). However, the lack of evidence for dogs at Palaeoeskimo sites (and from Dorset contexts in particular) has been demonstrated through numerous analyses of Arctic faunal remains, and it is commonly agreed that canid remains from this period are more likely associated with the presence of wolves. In a recent study concerning faunal assemblages from across the Eastern Arctic and Greenland, Morey and Aaris-Sørensen (2002) describe the scarcity of evidence for dogs in Palaeoeskimo times as follows:

> "(…) the archaeological record of Palaeoeskimo peoples [preceding Thule] indicates that dogs were sparse at most, and probably locally absent for substantial periods. This pattern is real, not an artifact of taphonomic biases or difficulties in distinguishing dog from wolf remains. Analysis of securely documented dog remains from Palaeoeskimo sites in Greenland and Canada underscores the sporadic presence of only small numbers of dogs, at least some of which were eaten. This pattern should be expected. Dogs did not, and could not, assume a conspicuous role in North American Arctic human ecology outside the context of several key features of technology and subsistence production associated with Thule peoples. (…) current evidence indicates that dogs played no systematic role in Dorset life, and they usually were absent." (*ibid*.: 46-47).

The canid teeth from the KcFs-2 assemblage are most likely those of a wolf, but the lack of any other skeletal element renders any pertinent interpretation of the utility of the animal impossible.

The polar bear remains indicate the presence of at least one adult and one sub-adult individual. The sub-adult specimens (1 metatarsal and 1 distal tibia fragment) exhibited adult bone cortex but were unfused and were slightly smaller than the adult reference elements. Information concerning epiphyseal fusion timing for polar bears was not readily available, but comparable fusion sequences for brown bears (*Ursus arctos*) show fusion of the distal tibia as occurring between 5 and 7 years of age, and the metapodia between 4 and 7 years (Weinstock 2009: 418). Sexual maturity in polar bears is reached between 5 and 6 years of age (DeMaster and Stirling 1981), thus it is therefore reasonable to assume that the unfused specimens in the KcFs-2 assemblage belonged to a sub-adult individual. During the ice-free months, polar bears can be found along the Arctic coastline from Alaska to Greenland. Polar bears are solitary animals and generally inhabit the southern broken edge of the pack ice in spring and fall. Female polar bears hibernate from mid-November until late March, during which time cubs are born, males only enter hibernacula for 50 – 60 of the coldest winter days. Ethnographic accounts describe methods of polar bear hunting as based on the use of sled-dogs, both for pursuit in the open and for 'sniffing out' hibernating animals, and on the extensive use of firearms (Banfield 1974:312). This is unlikely in Dorset contexts, however, where dogs are absent. Though polar bear remains are scarce in archaeological contexts, evidence of polar bear hunting in the late winter and early spring (during which time breathing hole sealing is less productive due to snow cover) has been recovered at several Dorset period sites (Maxwell 1985:130). Two sites in particular in the Nain area, dating to the Middle Dorset period, produced a small number of polar bear remains in the faunal assemblages from areas of the sites with fall-winter-spring occupation sequences (Speiss 1978:49). Polar bears did occupy an important role in the ideology of the Dorset people; this is obvious in the numerous ways that polar bears are represented in Dorset art (miniature sculptures, carvings and zoomorphic figurines). The importance of polar bears in the ideological system of Dorset peoples is likely due to the danger the animal presented. The polar bear is undoubtedly the most dangerous animal living in the Arctic, and the only active carnivorous predator of humans in North America. Though polar bear capture was understandably rare in Dorset times, the successful hunt of a polar bear would have likely bestowed a great deal of prestige upon the hunters. The dangerous nature of polar bear hunting also implies a communal effort, as it is certainly hard to imagine any one human successfully pursuing and killing a polar bear alone. While the meat of the polar bear was undoubtedly consumed (and was important from a caloric standpoint), the preparation of polar bear meat would have been somewhat problematic for Palaeoeskimo people because they harbour the nematode *Trichinella spiralis*, which implies that the consumption of raw meat could lead to problems with the spread of parasitic diseases such as trichinosis (DeMaster and Stirling 1981:3). The most valuable part of the polar bear carcass was likely the hide, due to its large size, insulative properties, and its aesthetic appeal.

The fox remains from the faunal sample, which total 47 specimens (NISP), and allowed for the identification of 5 individuals (3 adults, 1 immature and 1 newborn), were identified as *Vulpes spp.* in order to include both the red fox (*Vulpes vulpes bangsi*) and the arctic fox (*Alopex lagopus ungava*) genera. Both species of fox occur in the northern Ungava Peninsula region, in what is called the 'overlap area' between arctic and red fox habitats. Secure distinctions between the species focus primarily on skeletal-morphological differences, particularly in skull features, dental traits, and greatest length measurements of the humeri and tibiae (Monchot and Gendron 2010:800). The fox bones from the KcFs-2 assemblage were unfortunately too fragmented to merit an in-depth osteometric analysis; the one complete and fused humerus did however fall into the greatest length range for *Alopex lagopus ungava* when measured (Personal communication, Hervé Monchot 2010). The newborn specimen, a very small humerus that could be from a foetal individual, was entirely unfused and exhibited juvenile cortex. The immature individual was determined through analysis of a fused proximal femur fragment that was too small to fit into the adult category. The epiphyses of the red fox fuse rapidly and most are completely closed by 7 months of age, the proximal femur (greater trochanter) closes between 6 and 7 months, which means that determining an exact age is dependant on precise dental analyses (Harris 1978). There are two age categories defined for red fox, juveniles or immatures are individuals that are under one year old, and adults are 1 year and older. Because the immature specimen from the KcFs-2 sample was fully fused, it can be assumed that it was at least 7 months of age, and probably just a bit smaller than full grown. Red fox whelps are born between March and

May, while arctic foxes give birth between May and June. The overlap of the two birthing seasons also complicates the process of determining species for fox remains and site seasonality. While the newborn fox specimen indicates a season of capture falling sometime between March and June, the immature specimen indicates fall or early winter. Due to the difficulty in precisely determining the age of the immature fox specimen, it is necessary to focus on other seasonality indicators.

None of the terrestrial carnivore assemblages were large enough to allow for statistical testing.

Birds

Four different avian taxa were identified in the KcFs-2 assemblage: one species of the *Alcidae* family, the thick-billed murre (*Uria lomvia*) and one undetermined species of auk labelled *Alcidae spp*. (extant auks are numerous and form the subfamily *Alcinae*); two eider ducks (*Somateria mollissima*); and one goose (*Anatidae spp.*). Only the thick billed murre and eider duck remains were determined to species; auk and goose specimens were identified to family only. Together, these avian taxa make up 12% of the total NISP for the assemblage and 42% of the MNI. The most numerous avian remains by far were those of the *Alcidae* family, specifically the thick-billed murre which has the second highest MNI (31%MNI) for the entire assemblage after small seal (35%MNI).

The thick-billed murre remains were identified with the help of zooarchaeologist Claire St-Germain and the use of reference specimens from the *Ostéothèque de Montréal, Inc*., as well as through the use of *A manual for the identification of bird bones from archaeological sites* by Cohen and Serjeanston (1996). Reference elements used for identifying the thick-billed murre were from a specimen of the common murre (*Uria aalge*) species due to the fact that a specimen of the *Uria lomvia* genus was not readily available. The only murre with a distribution in the region of study, however, is the thick-billed murre, and skeletal-morphological differences between the two genera were taken into consideration. Skeletal variation between the *Uria aalge* and *Uria lomvia* genera are restricted to differences in the greatest lengths and widths of certain cranial, sternal and pelvic elements. Though their winter regional distributions often overlap, and they are difficult to differentiate through the analysis of skeletal remains only, there are noticeable differences in behaviour and ecology of the two murre species that have produced adaptive traits that allow for the differentiation of the genera. The thick-billed murre is adapted to diving for bottom invertebrates and bottom fish, whereas the common murre feeds exclusively on pelagic fish (Johnson 1944; Spring 1971). Skeletal modifications correlate with differences in the locomotor performance of the two murres; thick-billed murres have more robust pectoral muscles and longer wing spans useful for diving, while common murre have a more narrow upright stance and are more proficient walkers and swimmers due to their pelagic fishing adaptation. Differences are noted between the *Uria aalge* reference specimens and the *Uria lomvia* remains which coincide with these unique ecological adaptations. A slightly longer and wider sternum and keel were noted in the Uria lomvia remains that indicate more robust musculature in that region, as well as a greater length of the pelvis, slightly longer wing elements, and a wider brain case in the skull. These findings were confirmed by a comparative anatomy study concerning the two *Alcidae* species that outlines their morphological differentiation through an in-depth osteometric comparison, given by Spring (1971). The *Alcidae spp.* remains, though very similar morphologically to the thick-billed murre, were too large to fit into the range of skeletal dimensions outlined for the *Uria lomvia* genera and could not be securely matched with any other available reference specimen.

The relatively high frequency of thick-billed murre in the avian faunal remains is undoubtedly due to the fact that these birds had, then as now, a large nesting colony on the Digges Islands, located at less than 20 km north of the KcFs-2 site. In 1955, the Digges Island colony was estimated at some 2 million individuals (Tuck 1961). The murres migrate to the Digges Islands colony between early April and mid-May and leave again near mid-September. Murres reproduce once a year, with females laying just one egg sometime between mid-June and Mid-August (Birkhead and Nettleship 1981; Gaston 1985). In recent history, thick-billed murres are noted as the most intensively hunted avian species in the Ivujivik region and are taken in great numbers during their stay on the Digges Islands (Roy 1971b). Murres also make up the large majority of avian remains in faunal assemblages from several other pre-Dorset and Dorset sites in the area surrounding Ivujivik (see Nagy 1997). The abundance of murres in the region, and the relatively easy capture of the birds, makes them interesting from both a subsistence perspective as well as in terms of carcass utility outside of consumable material (meat). Bird-skin garment manufacture is well documented ethnographically for Inuit groups inhabiting Alaska, the Canadian Arctic and Greenland, and the use of murres in particular for producing feather parkas is evidenced for both Labrador and Ungava Inuit groups (Oakes 1991). Studies of Inuit skin clothing manufacture show that the use of bird skins is directly related to the availability of caribou (caribou pelts provide the most insulation), and people living areas in which high numbers of caribou are present do not generally use bird-skins. A study by Hatt and Taylor (1969) gives the hierarchy of species selection for skin-clothing as follows: "If one were to mention the sorts of skin used in Arctic clothing in a sequence based on their importance and the geographic distribution of their use, then reindeer skin ought to be mentioned first, followed by bird skins and fish skins, and only then seal skins (…)" (*ibid.* 1969:7) In regions where caribou are less numerous or unavailable, the choice of animal to use for skin clothing depends on the availability of other regional species. The study of Inuit clothing manufacture by Oakes (1991) presents the choice of avian species for clothing production as being a function of both availability and accessibility, and makes specific mention of the use of murres in regions similar to that of the KcFs-2 site:

> "In those regions that depended on bird skins for warm winter clothing, regional differences in bird species preferences were directly related to the available species, hunting conditions, and physical properties of the species. Inuit in regions with high populations of cliff nesting sea- birds, such as dovekies or murres, relied upon these birds for their clothing." (*ibid*. 1991:77)

Considering the ethnographic evidence given above, it is reasonable to propose that the murre remains in the KcFs-2 assemblage are the result of both the consumption of birds at the KcFs-2 site and the use of bird skins for clothing manufacture.

Maxwell (1985) proposes that the most profitable way to hunt birds during the Dorset period would have been through the use of nets on the ends of long poles that would facilitate the capture of birds while they were nesting, or by chasing and grabbing larger species such as geese (*ibid.*:131-132). No evidence of nets was found at the KcFs-2 site, but this is probably due to the fact that the organic material used to manufacture nets (*i.e.* hair) is highly perishable. The high NISP and MNI for the murres is likely a result of their availability in high numbers and their small size which would have facilitated the transportation of whole carcasses to the site for preparation.

Eider duck (*Somateria mollissima*) and goose (*Anatidae spp.*) remains together represent just 0.06% of the total NISP for the whole assemblage, and just 3 individuals were determined from their remains (2 eider ducks, and 1 goose). The two eider duck individuals were determined through the identification of a complete right tibio-tarsus and two left ulnae; all elements compared well with the reference specimen. The goose remains, comprised of one incomplete carpo-metacarpus and one distal femur, were too badly worn for clear species identification but fit well with typical size and morphology for the *Anatidae* family. The low relative frequency of these larger birds is most likely due to the fact that both ducks and geese are migratory and spend less time in the area than do the murres. Eider ducks usually appear in the Ivujivik region in early spring and leave again at the end of the summer season (May – August); nesting occurs between mid-June and late July (Roy 1971a). Geese spend even less time in the region, arriving in the last two weeks of May and the first week of June and leaving again at the end of June; nesting occurs throughout this period (Harvey and Rodrigue 2006; Roy 1971a). Maxwell (1985) indicates that modern Inuit are known to have a preference for eider duck eggs, and it is plausible that Dorset people would have exploited them and perhaps taken small numbers of birds during nesting periods when convenient (*ibid.*:132).

The above mentioned migratory bird species all have closely overlapping migration periods and are all present in the region of the KcFs-2 site between spring and fall; this distribution data matches very well with the arrival in the region, and the birthing period of, several of the mammalian species also present in the assemblage.

Fish

The sole specimen in the KcFs-2 assemblage that pertains to the *Pisces* class is that of an incomplete premaxilla or maxilla of an undetermined marine fish taxon (personal communication, Michelle Courtemanche 2010). No other fish remains were recovered, but a fishing spear was excavated in the E trench (pit SE E5) and clearly indicates that fishing activities were practiced at the KcFs-2 site (Avataq 2010b). The most plausible explanation for the lack of fish remains is that they are much smaller and more fragile than the bones of mammals or birds, and they often decompose quickly and are not highly visible archaeologically (differential preservation). Also, fishing activities were practiced on a much less intensive scale than hunting activities.

5.4.1 Caching

Storage and conservation of food resources played an important role in the adaptive success of prehistoric Arctic groups. In cold-weather environments, short-term scarcity of resources and seasonal fluctuations in resource availability can affect human populations to a greater extent than long periods of harsh conditions (Stopp 2002: 305). Food preparation (drying, smoking, curing) and caching strategies can effectively buffer the effects of unstable environmental conditions and resource fluctuation. Storage and food preparation are directly linked to mobility (nutritional insurance through strategically placed caches across seasonally revisited terrain) and are therefore functionally interdependent with population growth and social complexity. The more settled a community becomes, the more that community depends on a specific set of resources available in a limited space, and the more the growth of that community will depend on the amassing and distribution of diverse surpluses that can counteract the increase in exploitative pressure on local resources. For highly mobile groups, food preparation and caching have an adaptive function that allows for the reduction of risk during periods of spatial or temporal restriction, such as short-term animal migrations, the presence of large numbers of animals in one restricted area, or problems related to the exploitation of periodically abundant resources by a small number of people (Bettinger 1991; Binford 1980; Stopp 2002). Dorset period subsistence practices appear to have been more seasonally variable and more settled (more intensive/continuous occupation) than those of Early Palaeoeskimo groups, and an increase in storage features at Dorset sites has been evidenced in several regions (Murray 1999). Evidence of intensive caching and increases in storage practices can be interpreted both on an adaptive level and in terms of inferences concerning land use, gendered roles, social complexity, and exchange (or resource distribution) within and between groups (Murray 1999; Stopp 2002).

Caching practices specifically affect element distribution in faunal assemblages and thus can also influence inferences concerning seasonality for archaeological sites. As is the case with differential transport and selective butchery practices, so does caching influence the visibility of both species and skeletal elements of species in archaeological contexts. The consuming of stored foods, namely of migratory or seasonally accessible animals outside of their period of availability, can alter the pattern of seasonality evident in the faunal assemblage at a given site. Ethnographic studies outline a seemingly endless number of storage techniques and land use strategies that show the potential benefits of caching in different and distinct environments (see Binford 1978, 1980; Murray 1999; Stopp 2002). While caching and storage activities can be demonstrated as having been important throughout the Dorset period (Murray 1999), there is, as of yet, no evidence of caching associated with the occupation at the KcFs-2 site. The cache features that were identified along the rock-wall edge near to the water at the site do not appear to be temporally associated with the Late Dorset House 3 structure (Avataq 2010a).

The overlapping of the migratory patterns of several of the taxa from the assemblage, in conjunction with the presence of juvenile or newborn individuals 'of-the-year' in the sample, and the lack of evidence for differential transport of skeletal elements for the majority of the species, also support the proposal that the species present in the assemblage were most likely consumed during the season of capture.

A summary of the seasonal presence of the taxa from the KcFs-2 assemblage and their birthing and nesting periods is given in Figure 30 below.

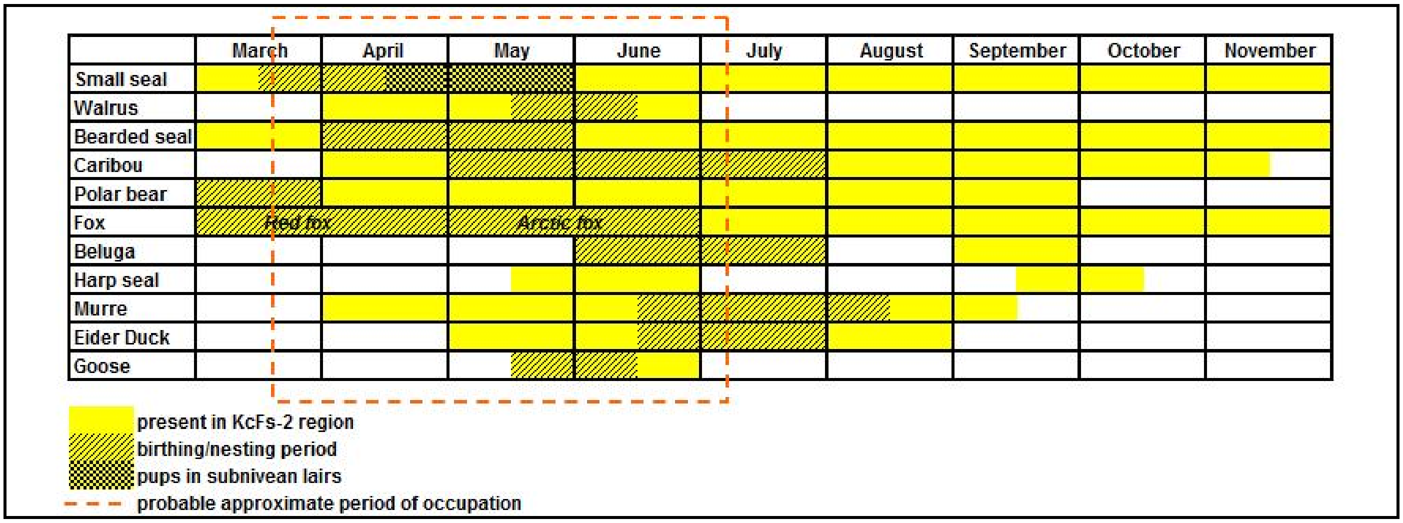


Figure 30: Chart showing seasonal availability and reproductive periods for the KcFs-2 taxa.

5.5 Summary

The analysis of the KcFs-2 faunal assemblage indicates a maritime, marine mammal subsistence strategy which centered primarily on the intensive exploitation of ringed seals, and with a significant focus on capturing murres. The subsistence practices of the inhabitants of the KcFs-2 site, though strongly centered on seals, also include the capture and consumption of diverse marine animals and a small number of terrestrial taxa and can therefore be considered to be generalized. The presence of a majority of immature ringed seals, juveniles from the small seal, beluga, walrus and caribou taxa, and newborn specimens from small seal and fox species, all indicate a late winter to summer season of occupation for the KcFs-2 site. This seasonality inference is also supported by the presence of migratory species (harp seal, walrus, beluga, caribou, murre, eider duck, and goose) that only occur in the region during the spring and summer (continuing until early fall) seasons. The semi-subterranean house structure also lends credence to the proposed seasonality for the site due to the prevalence of this type of habitation structure at winter and spring occupation sites across the region of study (Maxwell 1985).

A late winter through summer occupation sequence, combined with a generalist subsistence strategy focussed on the exploitation of ringed seals, fits well with the seasonality and subsistence patterns described for Late Dorset people across the Eastern Arctic. The absence of cache structures associated to the House 3 feature implies that the animals present in the assemblage were consumed during the season of capture, and also supports the proposal that the season of occupation did not continue into the fall and early winter at KcFs-2 as stored food would most likely have been necessary for sustaining inhabitants at the site once the migratory species had left the area. The trends that have been outlined through the present analysis can be considered representative of the subsistence activities at the site but do, however, require further support through continuing excavations at the site and ongoing analyses of the undetermined faunal material in order to confirm their validity.

Chapter 6: Taphonomy and Site Formation

Archaeological sites from Arctic contexts generally yield well preserved organic collections in comparison with those from sites located in warmer climes. Due to the continuously cold climate, and to the permafrost layer which discourages tree growth, arctic assemblages generally provide a level of organic preservation rarely found elsewhere. This being said, there remains a wide array of forms of disturbance and modification that can potentially affect material from Arctic sites and the physical integrity of the sites themselves. The following section includes a discussion of the level of preservation of the KcFs-2 assemblage with relation to natural taphonomic processes, carcass preparation, and the effects of scavenger activity.

6.1 Taphonomy Results

Table 5 below gives the number of taphonomically altered bones per taxon for the KcFs-2 assemblage. Detailed analyses of each taphonomic process and resulting evidence in the KcFs-2 assemblage are outlined in the following sections.

Table 5: Taphonomy results for each taxa of the KcFs-2 assemblage

Taxon	Cut	Burn	Gnaw
Alcidae spp.	0	0	0
Anatidae spp.	0	0	0
Cervidae	2	0	0
Wolf	0	0	0
Beluga	0	0	0
Bearded seal	0	0	0
Fish	0	0	0
Lemming	0	0	0
Walrus	1	0	0
Harp seal	1	0	1
Small seal	14	0	80
Caribou	2	0	1
Eider duck	0	0	0
Polar bear	1	0	0
Fox	2	0	2
Murre	0	0	1
TOTAL	**23**	**0**	**85**

Butchery

Evidence of butchery and cut marks on bones were recorded when apparent but no in-depth cut-mark analysis involving strong magnification was undertaken due to time constraints and to the size of the assemblage. Each bone was systematically scrutinized for cortex texture, porosity and rigidity (juvenile vs. adult cortex), exfoliation of the cortex, colour, general state of preservation, epiphyseal fusion, and for evidence of percussion, cut marks, gnawing, and burning that were visible to the naked eye or using a simple magnifying glass (30X-21mm). Only 23 specimens exhibiting cut-marks were recorded for the whole of the assemblage (Table 6). Preservation of the KcFs-2 sample was generally very good, with very little exfoliation of bone cortex and minimal fragmentation of elements overall. The lack of cut-marks, specifically on the small seal specimens, is most likely due to efficient butchering techniques that involved the use of extremely sharp microblades for disarticulating the limbs through the cartilage at the joints; cut-marked bones from Dorset sites are generally few in number and most often occur on the pelvic-femoral joint (see Maxwell 1985: 142).

Table 6: Summary of cut-marked bones from the KcFs-2 assemblage.

Taxon	**Element**	**Cut Mark Location**
Small seal	costal rib (X2)	mid-shaft, dorsal
	fibula (X2: 1 left, 1 right)	distal diaphysis, dorsal surface
	femur (X2: 1 left, 1 right)	mid-diaphysis, lateral, external
	1st metatarsal	medial, palmar surface
	5th metatarsal	medial, palmar surface
	mandible	mid-body, buccal surface
	manubrium	medial, dorsal surface
	scapula	proximal, ventral surface
	scapholunar (X3: 2 left, 1 right)	distal, palmar surface
Harp seal	innominate	ilium, lateral, exterior
Caribou	proximal phalanx (anterior)	medial, palmar surface, on width
	sacrum	proximal, dorsal surface, near acetabulum
Cervidae	long bone fragment (helical) (X2)	across medial shaft, tips ‘sharpened’
Walrus	rib	mid-shaft, ventral surface
Polar bear	humerus	distal extremity, diaphysis, bi-lateral
Fox	fibula	distal, above epiphysis, dorsal surface
	radius	proximal, above epiphysis, dorsal surface

As seen in Table 6, cut marks were identified on femora, fibulae, one sternum element (manubrium), a rib, two metapodia, one tarsal, and a scapula of small seal. These marks are undoubtedly the result of butchery of the animals. Lyman (1992) noted that butchery marks on pinniped bones can be divided into three categories: (1) those made by dismemberment; (2) those resulting from skinning; and (3) those marks produced by filleting or meat removal. Lyman's study shows that dismemberment specifically involved the skull, mandible, long bones of the anterior limb (humerus, radius and ulna), carpals/tarsals, innominate and sometimes the femur (*ibid.*: 255). Bones affected by the filleting process also include the innominate and anterior long bones, as well as the femur, tibia and fibula. Skinning of the pinniped carcass, according to Lyman, affected the skull, mandible, metapodia and phalanges (*ibid*.: 256). These results correspond well with the summary of cut-marked seal bones above.

Binford (1981) and Lyman (1987), both show evidence of cut-marks on bones from artiodactyls (caribou) that include the sacrum and phalanges (produced during disarticulation) and long bones, which also corresponds well with the cut-marked caribou and *cervidae* bones shown in Table 6 above. The cut-marked long bone fragment appears to have been sharpened for use as a tool. The marrow-cracking of the *cervidae* long bones is most likely responsible for the general lack of cut-marked long bones.

The cut-marked bones of the polar bear and fox (all elements are from the limbs) are most likely due to the removal of the pelt from the appendicular portion of the carcass, or for meat removal from limbs.

The one cut-marked walrus rib could also be the result of butchery, or could simply be a sign of use of the bone for some other domestic task. Walrus ribs are long, thin objects that could have a number of imaginable uses outside of meat procurement (Maxwell 1985).

Not a single cut-mark was identified on any avian specimen, nor was there any evidence of tool marks on the beluga or bearded seal remains. The wolf remains were limited to 5 teeth and cut-marks were absent.

Cooking

Not a single calcined or burned bone was recovered in the KcFs-2 sample. The scarcity of wood in the treeless tundra regions forced prehistoric groups in these regions to burn fat and grease in soapstone bowls (lamps) as a source of heat and light as well as for cooking. Hearth structures have been identified at numerous Dorset sites, both above and below the tree line, and driftwood is assumed to have provided occasional fuel for these larger cooking features (Maxwell 1985). While cooking with oil lamps and occasionally in hearth structures has been well demonstrated, it is also reasonable to assume that due to the lack of regular sources of combustible energy, Dorset people ate a good portion of their meat raw, dried or cured in fat as these methods of preparation would have demanded less energy (combustion), and drying and curing would have provided food that could be kept for longer periods of time.

Scavenger activity

Evidence of tooth marks and gnawing on bones by scavenger animals can also affect the identification of skeletal elements and fragmentation rates in faunal assemblages. The KcFs-2 assemblage showed extremely low frequencies of gnawing on bones, only 85 specimens exhibited obvious gnawing on the extremities and 80 of those were small seal elements (figure 31), one element pertained to harp seal, one to caribou, one was murre, and two were fox.

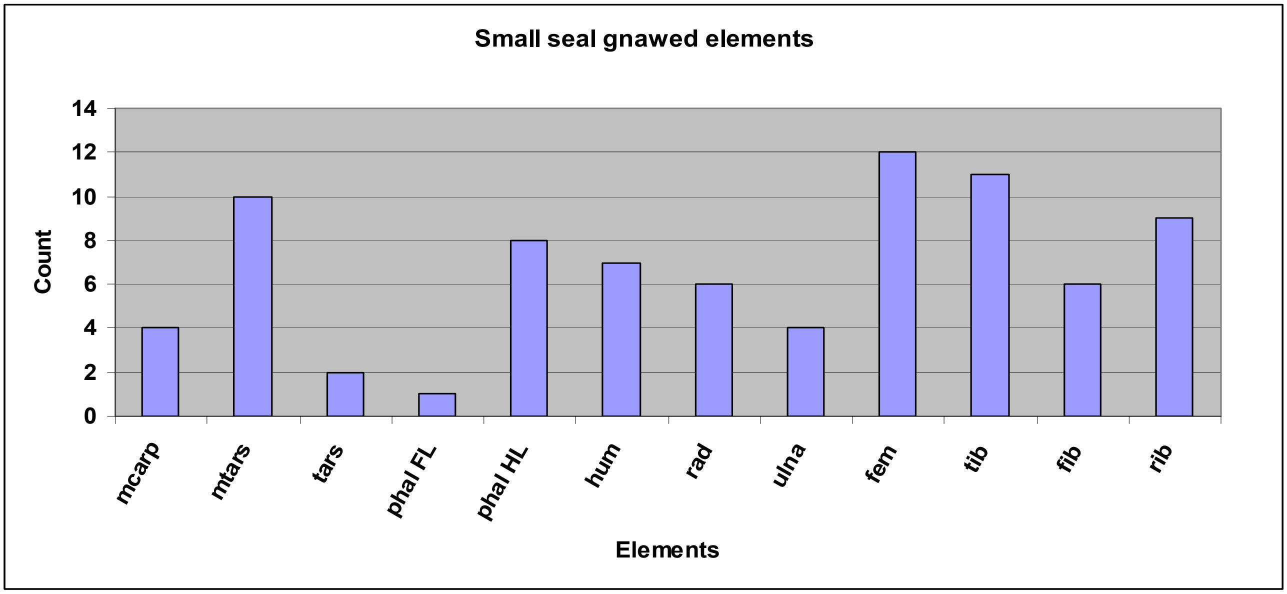


Figure 31: Graph showing the small seal skeletal elements exhibiting evidence of gnawing (see Appendix I for abbreviations).

The most common small seal elements that exhibited gnawing were those of the femur, tibia, rib and metatarsal bones, which indicate a preference for the meaty region of the chest (ribs) and the hindlimbs (femur, tibia, fibula), with gnawing of the elements from the extremities of those limbs (tarsals, metatarsals and phalanges). While it is possible to show a pattern of selection by scavengers for specific skeletal elements such as the hindlimbs, the low relative frequency of gnawed specimens (only 1% of small seal bones) indicate that scavenging activity did not have any appreciable effect on the faunal sample.

6.2 Interpretation

In the previous chapter, the discussion concerning relative species abundances and skeletal element frequencies in the faunal assemblage focussed on transport decisions and selective behaviour processes that affect the composition of zooarchaeological collections. The present chapter concerns the study of the taphonomic processes that govern the burial and ensuing modification of organic remains, or the 'laws of embedding' as termed by Ivan Efremov in his pioneering publication on the science of taphonomy in 1940. Agglomerations or collections of animal remains can be divided into [at least] two categories: those that are 'culturally deposited' (as a result of human behaviour), and those that are naturally deposited (Binford 1981; Lyman 1994). The 'taphonomic history' of a zooarchaeological assemblage includes a number of stages or phases of transformation on both cultural and natural levels. The taphonomic history of a zooarchaeological assemblage is aptly represented in a model developed by Hesse and Wapnish (1985) seen in Figure 32 below. The natural factors (N) in Hesse and Wapnish's model, remove increasing amounts of cultural information (C) with the progression along the taphonomic process; at the end of the process, natural information is more visible in the assemblage than cultural information. The initial stage of the taphonomic process, the biotic/cultural phase, concerns the environment in which the animals were exploited, their availability (abundance) and seasonal movements, and their utility for prehistoric groups (*ibid.*:20).

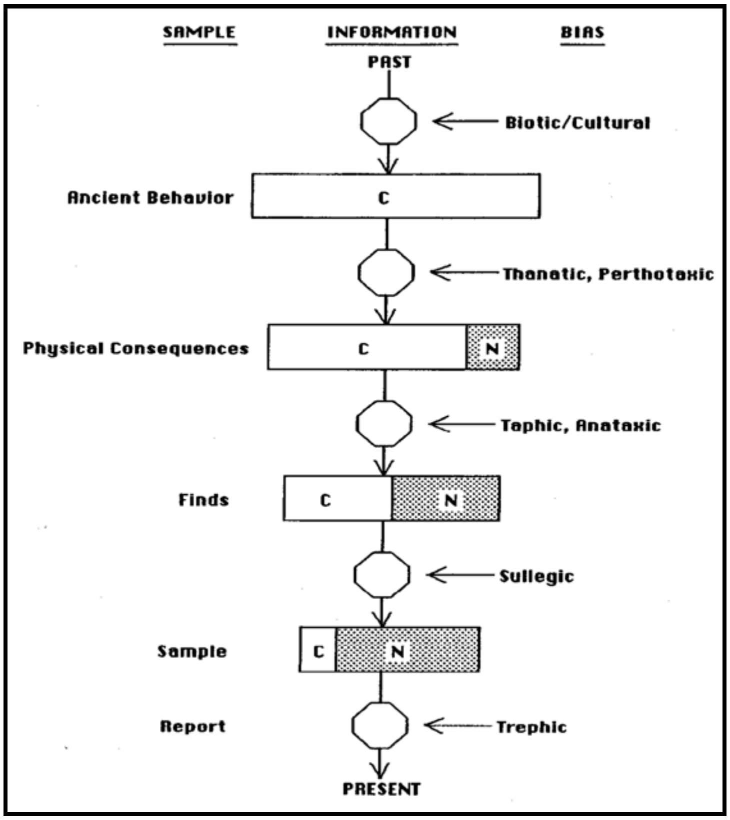


Figure 32: Hesse and Wapnish's (1985) model of a taphonomic history of a zooarchaeological assemblage of faunal remains.

In the case of the KcFs-2 assemblage, the biotic phase of the taphonomic history encompasses the migratory species exposed in the faunal analysis that have allowed for the inference of a late winter to summer site occupation sequence. The availability of large numbers of small seals and murres, in combination with the presence of other seasonally available species such as harp seals, walrus, beluga and caribou and their young, have contributed to their presence in the faunal assemblage and allowed for the interpretation of cultural factors that also influence the assemblage composition.

The ‘ancient behaviour’ process refers to the exploitation, or killing, of the species under study, and the thanatic factors are those surrounding the death and deposition of the animal remains. Thanatic factors concern everything from the killing of the animals (hunting techniques) to the types of tools or equipment used to exploit targeted species (use of boats or transportation devices and weapons), as well as butchering techniques and selective transport decisions (caching and storage). Perthotaxic processes take place during the thanatic phase and basically concern the climatic conditions prevalent, and the treatment and exposure of the remains, before deposition (fluvial processes, weathering, carcass treatment and disposal conditions). Among the factors included in the Perthotaxic process is that of the disposal method of the remains. The faunal assemblage from the KcFs-2 assemblage was excavated from a midden found outside of the habitation structure, this method of disposal of waste implies a higher level of exposure of the remains during the initial burial process and puts the assemblage at greater risk of the effects of taphic processes like pedoturbation (namely cryoturbation and faunalturbation in the Arctic context). Taphic processes such as cryoturbation are common factors affecting Arctic assemblages; extreme seasonal temperature fluctuations and the freeze-thaw action they bring about can greatly affect shallowly deposited midden assemblages. The northern Ungava Peninsula, situated in the southern-most boundary of the Arctic zone, has a lower permafrost layer than regions further to the north and thus archaeological assemblages from this region experience more cryoturbational disturbance as a general rule (Lofthouse 2003:105). The taphic stage also includes modification due to chemical and physical deterioration. Soil acidity and alkaline levels can be a concern during this phase of the taphonomic history of an assemblage, and these effects are often worsened by accompanying freeze-thaw processes. The KcFs-2 assemblage does not appear to have been greatly affected by these processes in that bone cracking and cortex exfoliation was minimal and dental preservation was generally very good (minimal desiccation).

The anataxic processes that can affect assemblages at the Taphic stage of taphonomy mainly concern erosion and animal or human interference. The KcFs-2 assemblage does not appear to have been greatly affected by either soil erosion or by animal activity. A small number of bones had been gnawed by scavengers and it is reasonable to assume that a certain amount of trampling took place on the surface of the midden, but due to the fact that the midden did not exhibit a stratigraphy it is impossible to interpret the post-depositional movements of the bones within the midden with any precision. The test-pitting around the House 3 structure does, however, show human activity on the site, and the House 3 structure appears also to have had some disturbance on this level.

The sullegic and trephic processes concern the selective recovery (or non-recovery) of bones from sites and information loss due to selective excavation, sorting, sampling, recording, storage, and publication respectively. Sullegic processes have certainly had an effect on the faunal sample from the KcFs-2 site. The House 3 midden was only partially excavated and the zooarchaeological analyses undertaken here concern only a sample of the material that was recovered; the sample has also been divided into 'identified' and 'unidentified' assemblages, which has in turn affected the results of the analyses. The trephic processes that can be identified for the KcFs-2 assemblage concern any problems with recording information throughout the excavation process and the issue of the loss of provenience information due to the deterioration of the bags in which the bones were stored, and the presence of mould on a portion of the specimens after transportation. The loss of provenience information from the E trench directly affected the sampling procedure undertaken to isolate the assemblage for analysis.

Overall, it appears that the KcFs-2 faunal assemblage was most heavily altered by biotic, cultural, sullegic and trephic taphonomic processes, *i.e.* the processes at either end of the taphonomic spectrum. The caribou and *cervidae* bones were the most affected by density mediated attrition and butchery. Differential transport appears to have had a very minimal impact on the assemblage and was possibly a factor affecting only the largest species; that of beluga, walrus, and (to a lesser extent) caribou. It does not appear that taphic and anataxic processes had any measurable effect on the assemblage.

Chapter 7: Worked Ivory and Organic Artefacts

As mentioned in chapter 4, there are numerous organic artefacts made of ivory or worked antler in the assemblage. A miniature ivory maskette, typical of Dorset period art (Figure 33.1) was found *in situ* in the midden (SE C4), measurements and elevations were taken using the theodolite at the time of discovery. Several pieces of worked antler were also found *in situ* and elevations were recorded for these pieces as well; these specimens are very small and have no discernable symmetry but are either sharpened or exhibited cut marks at the extremities. The miniature ivory carving of a walrus (Figure 33.2) was found during the initial sorting process in a bag of bones pertaining to the C trench in the midden (SE C2 pit); it is so small that it is not surprising that it was not identified *in situ*.

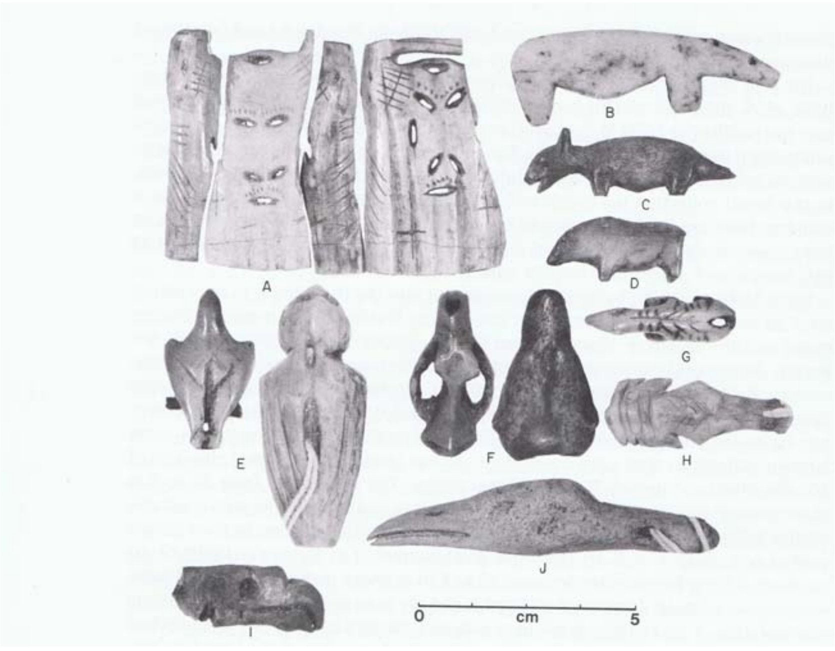
Figure 33: (1) Ivory maskette with x-ray motif from pit SE C4 (SE) and (2) miniature ivory walrus sculpture from pit SE C4 (SE) (Avataq 2010b).

These artefacts are not only important for the relative dating of the site, but also for interpretations of subsistence practices and links to the ritual or shamanic belief systems of the Dorset people, and the diffusion of these systems both temporally and spatially. In his 1996 work concerning the ancient Arctic cultures, McGhee describes the static nature of Dorset art as follows:

> "This exceptional uniformity of [artistic] style may indicate further the importance that a shared system of beliefs and magico-religious ideas held in

> Dorset life. Given the evidence that non-functional concepts may have been important in shaping Dorset technology and that mystical qualities may have been ascribed to exotic materials used in that technology, we should perhaps expect the uniformity of Dorset artefacts to reflect a uniformity of beliefs." (*ibid*.1996:148).

Further analysis of assemblages from different Dorset sites supports the hypothesis of a diffused, uniform system of beliefs; strong similarities in art manufacture and symbolism are evident in collections from across the Dorset sphere of influence in the Eastern Arctic. A particularly interesting comparison can be made between the objects from KcFs-2 in Figure 33 above and objects from the Brooman Point site on Bathhurst Island (some 1800km to the North West) in figure 34 below.



A. Ivory shaman's tube (with human faces and walruses with interlocking tusks)
B. polar bear
C. fox cub
D. musk-ox calf
E. two falcons
F. polar bear skull
G. polar bear with skeletal engravings
H. sculpin
I. raptorial bird head
J. head of raven or gull

Figure 34: Magico-religious artistic carvings from the Brooman Point Site, photos courtesy of Robert McGhee (Maxwell 1985:230).

Incised masks, very much like the one recovered at the KcFs-2 site, have been found at numerous Dorset sites and are remarkably similar in size, style and anatomical traits (shapes of eyes, mouths, ears and incising). Several researchers propose that the x-ray incisions on the facial features of the maskettes are representative of tattooing; this is also supported by ethnographic accounts given by modern Inuit and would appear to indicate ritual behaviour common in shamanic belief systems (Maxwell 1985; McGhee 1996).

Miniature animal statuettes are also common in Dorset assemblages and are of strikingly similar proportion and anatomical detail. The miniature walrus seen in Figure 33 is just over 2cm in length and yet the detail in the physical traits such as the eyes, tusk sockets, snout and flippers is surprisingly precise. The sculptor made obvious efforts at giving the animal a realistic representation through precision in morphology, right down to the anatomical positioning of the caudal flippers in a ‘walking’ pose.

The artistic representation of animals can be interpreted in a number of ways. Certain animals are portrayed in realistic form and others in a more abstract fashion; researchers believe that this stylistic difference is related to the role of the particular animal, *i.e.* whether the animal was more important from a subsistence perspective or from an ideological one. The level of stylization of the object would appear to indicate the symbolic importance of the animal in question within the belief system of the Dorset people. Dangerous predators such as polar bears and falcons are often represented in a more stylized fashion in Dorset art; this is most probably due to their role within the belief system and the fact that when the Dorset crossed paths with these particular animals they presented a real danger and an element of competition for survival. The wolf, another dangerous Arctic predator, is very rarely represented in Dorset art because it is more closely associated with the caribou herds of the interior which were of far less economical importance to the coastally adapted Dorset. The spectrum of non-predatory animals portrayed in Dorset art, such as seals and walrus (the most common) are represented in a more limited stylistic manner (or purely naturalistic) which is perhaps due to their role as prey. Stylistic representations of walrus do exist in Dorset art and their abstract form is most likely due to their importance in the subsistence strategies of the Dorset. Large animals that provided more sustenance and important materials like ivory (walrus tusks) and blubber would probably have occupied a special place in the belief system of the Dorset and were perhaps associated with shamanic practices or subsistence 'rituals' (McGhee 1996).

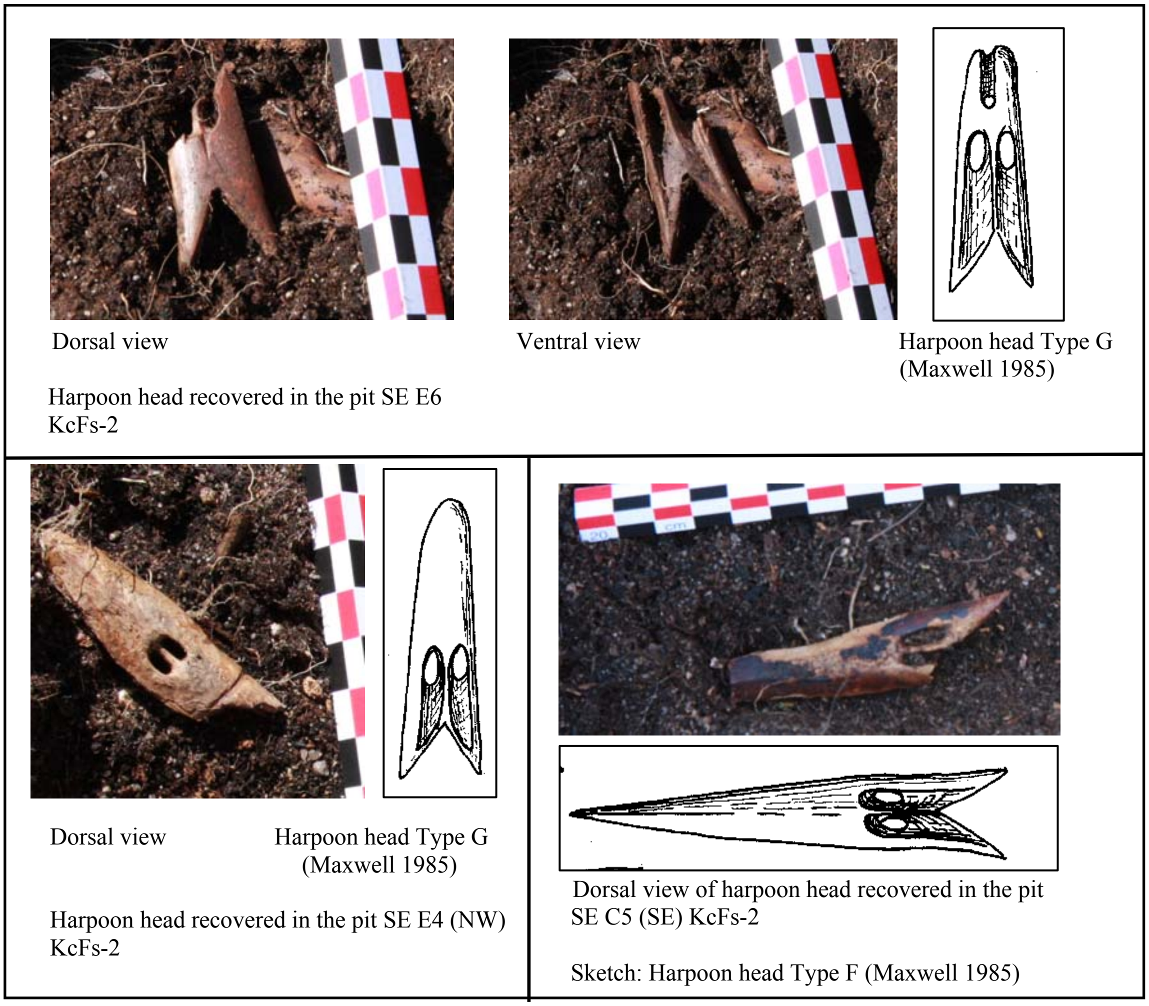
In McGhee's 1996 interpretation of Dorset life ways, he describes the veritable dearth of terrestrial mammal imagery in Dorset art and the implications for interpretations of subsistence practices:

> "The animals of the land are much more poorly represented in the repertoire than are the sea mammals, among which polar bears are classed. Although Dorset hunters did take caribou and muskoxen, these animals may have been perceived as less mysterious or less dangerous than the creatures of the sea and perhaps not as potent in magical qualities. (…) No known carving portrays an entire caribou, but the animal is occasionally represented by part of its anatomy, usually the hoof and lower leg." (*ibid*.1996:168).

While interpretations of shamanic belief systems and ritual behaviour remain highly subjective, it would seem reasonable to assume that Dorset people would have elaborated their art style after a belief system that focussed on both their primary resources (marine mammals) and their well defined economic practices that played a central role in their hunter-gatherer or band level organization (*i.e.* providing food and usable materials through the hunting of marine species).

Harpoon heads

Along with the maskette and the miniature walrus, 11 of the ivory harpoon heads in the KcFs-2 assemblage were found in the midden area, two of which were miniatures. Secure typological identification of all the harpoon heads was not possible due to fragmentation, but certain specimens were large enough to allow for determination: two were identified as Type F Late Dorset; one was determined as Type G Late Dorset; and one labelled as a Southampton Island Type (examples photographed *in situ* in Figure 35 below).



Dorsal view

Ventral view

Harpoon head Type G (Maxwell 1985)

Harpoon head recovered in the pit SE E6 KcFs-2

Dorsal view

Harpoon head Type G (Maxwell 1985)

Harpoon head recovered in the pit SE E4 (NW) KcFs-2

Dorsal view of harpoon head recovered in the pit SE C5 (SE) KcFs-2

Sketch: Harpoon head Type F (Maxwell 1985)

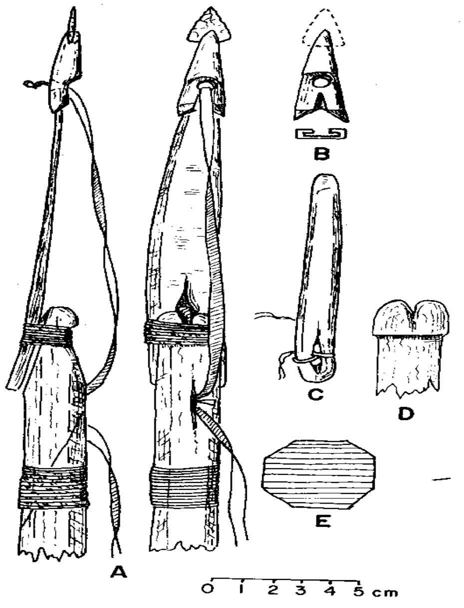
Figure 35: Photos of Late Dorset harpoon heads recovered at the KcFs-2 site (Avataq 2010b) shown with sketches of corresponding Late Dorset harpoon head types taken from Maxwell (1985:219).

One harpoon head was recovered in the House 3 structure that was determined to be Type F Late Dorset along with one worked antler specimen. The Type F and Type G harpoon heads excavated in the midden are typologically very similar to those recovered at the KcFs-2 site by Leechman (1943), seen in Figure 12 (page 53). Harpoon heads are important to the description of subsistence systems in several ways. Not only do they provide information useful for dating sites but also about the procurement and uses of organic materials such as ivory; their typological traits inform researchers concerning the species of animals that were targeted, the hunting strategies that were used, and shifts in hunting strategies and focal prey species over time. Dorset peoples used one specific type of harpoon head that varied in form both temporally and spatially.

As described by Maxwell (1985) the Dorset harpoon head differs from the later Thule model:

> "The Dorset harpoon does not have the toggling flexibility that the Thule on does. The foreshaft of a Dorset harpoon, a long, flat piece cut from caribou leg bone, is tied to the scarfed distal end of the wooden shaft. The foreshaft is bent by steaming so that the harpoon head is brought into the thrusting axis of the shaft. The harpoon line is then pulled tightly against the distal end of the shaft and wedged into a small split in the shaft" (*ibid.* 1985:132-133).

An example of an assembled Early Dorset harpoon can be seen in Figure 36 below.



Replica of an Early Dorset harpoon made with stone burin, burin-like tools, and side and end scrapers (based on artefacts recovered at the Tanfield site, Lake Harbour)

A. Assembled harpoon
B. Harpoon head with sliced socket
C. Caribou tibia foreshaft
D. Knobbed end of foreshaft
E. Octagonal cross section of foreshaft

Figure 36: Replica of an assembled Early Dorset harpoon (Maxwell 1985:133).

The Dorset harpoon head was designed for marine mammal exploitation such as breathing hole and floe ice hunting, like those pertaining to the KcFs-2 site. These harpoon heads could also have been used for open-water hunting for both seals and walruses, but they appear less functional for this type of strategy (Maxwell 1985). Zooarchaeological studies of subsistence practices during the Palaeoeskimo periods have shown a direct link between changes in subsistence practices and changes in the technological material (see Maxwell 1985; McGhee 1996; Murray 1996, 1999; Nagy

1997). One particular study, undertaken by Murray in 1999, concerns the assemblage pertaining to the Igloolik site (Igloolik Island, Nunavut) in which the appearance of new form of harpoon head (specifically the larger Dorset Parallel Sliced Type) at around 2450 B.P. coincides with an intensification of walrus exploitation. Previous to 2450 B.P., the late Pre-Dorset type of harpoon head, with an open-socket, single line hole and self-bladed or barbed tip, was predominant but is replaced in the Dorset period with closed-socket types of harpoon heads exhibiting double line holes and stone tips (examples in Figure 35). These Dorset type harpoon heads are designed to carry a larger line and withstand greater weight and stress than all other types. Due to the change in manufacture and style of the harpoon head, Murray proposes that the Dorset Parallel Sliced style harpoon heads are the best candidates for the type used for walrus hunting. Furthermore, Murray goes on to propose that special markings on the harpoon heads indicated ownership of the tool and therefore show that walrus hunting was a communal activity for the Dorset:

> "The walrus hunting harpoon head is the most commonly decorated. (…) Decorative motifs include incised faces, skeletal patterns, diagonal slashes and short sequences of straight lines, dashes, and dots. (…) the sequences of lines, dashes and dots appear only in the Dorset period, and only on walrus hunting harpoon heads. In contrast to other motifs, no two are alike and they do not co-occur with other motifs or with each other on individual harpoon heads. In co-operative hunting there is a need for some form of leadership, and the relationships between hunters must be clear in order for the hunt to function smoothly and for game to be shared out properly. The distinction of hunting equipment is one way of indicating ownership of game." (Murray 1999: 474-475).

Because walrus hunting presented more of a danger to the hunters than sealing or fishing would, it is reasonable to imagine that it was done in groups and that the catch was then shared between families or small bands. In this way, the manufacturing of new types of hunting weapons such as harpoon heads, and the individualisation of the tools through marking, would be a reasonable end result of changes in subsistence practices that began in the Early Dorset period. While the proposition that walrus hunting became a central focus for some Dorset groups in the Foxe Basin is in need of further support, it remains an interesting and pertinent example of interpretations of technological material such as harpoon heads and the link to understanding and describing subsistence practices.

Dorset style harpoon heads are useful not only for interpretations of focal prey species and subsistence practices, but also for dating sites and for distinguishing between phases within the Dorset period. Variation in harpoon head styles can be traced throughout the Dorset period, with stylistic changes occurring simultaneously at sites across the territory. Changes over time in the manufacturing of harpoon heads include: the shift from open to closed socket styles, changes in the shape of the dorsal groove, increasing sharpness of the basal spurs, and the transition from producing single line holes to double line holes. The shape of the socket changed from an open-socket style to a closed socket in the Early Dorset (2450 B.P.) and then shifts towards an essentially closed socket with a 'slice' near 2250 B.P.; the open socket style then reappears around 1900 B.P. for certain types but in conjunction with other closed socket types (see Maxwell 1985). The Dorset Parallel Sliced harpoon head appears in the Early Dorset, it is always slotted for an end blade and is larger and more robust than the Dorset harpoon heads used for sealing. Much like the Dorset Parallel type of the Middle and Late Dorset periods, the Dorset Parallel Sliced type is believed to have been used primarily for walrus hunting, as suggested by Murray (1999). The other Dorset harpoon head types of a less robust form but with similar double-line holes and stone tips were commonly used for sealing. The elaboration of a variety of forms of one type of harpoon head, and the production of a specific type for walrus hunting, indicates a narrowly focussed subsistence strategy with specific prey species (marine mammals).

As exposed in the previous sections, archaeological data indicate that the Dorset people focussed on marine mammal exploitation, perhaps as a result of environmental influences including climatic cooling trends and the possibility of diminishing terrestrial mammal herds. Settlement patterns focus on locations near areas of fast ice and polynyas, and material culture assemblages from the Dorset period manifest the appearance of cold weather tools such as ice-creepers, sled shoes, ice chisels, and snow knives (Maxwell 1985; McGhee 1996). Artistic representations (sculptures and maskettes) and organic artefact manufacturing (*i.e.* harpoon heads) also indicate a narrow focus on a more specialized maritime subsistence strategy. A prevalence of marine mammal representations in Dorset art, and the evolution of complex forms and styles of harpoon heads during the Dorset period, when viewed in tandem with the faunal evidence given above, lends strong support to the proposal that marine animals dominated the economic framework of the Dorset people. The widespread and uniform styles of Dorset symbolic representations indicate that marine mammals also formed the basis of their ideology. While the most dangerous and symbolically prestigious animals (bears, falcons, wolfs) appear more stylized and are relatively rare in Dorset art, most other animals (seals and walrus in particular) are portrayed in naturalized form and are by far the most commonly represented. As proposed by McGhee (1996), Dorset art is most likely evidence of a complex belief system in which:

> "(…) most of the carvings [found in the remains of Dorset villages] can be associated with magical or religious means of dealing with a shamanic universe"; this virtual universe can been interpreted as stemming from the realities of living in an inherently rigorous environment and the need to communicate in some fashion with the [spirits of the] animals that were primordial to their survival (*ibid*.: 171-172)".

In other words, artistic representations of marine animals in Dorset art are most likely representative of the basis of the Dorset people's 'way of life' and are imbued with symbolic importance because they exemplify the daily struggle for survival in the Arctic environment.

CONCLUSION

The zooarchaeological analyses of the KcFs-2 faunal assemblage revealed several lines of evidence that support the proposal of both a Late Dorset cultural affiliation and an economic strategy based on a subsistence system that focussed primarily on marine mammal exploitation, and specifically on seals. Murres also appear to have been intensively hunted by the KcFs-2 inhabitants; their ease of capture and the use of their skins for garment manufacture are the most likely explanations for their high numbers in the faunal assemblage.

An analysis of the environmental and climatic conditions in the Arctic, both across the different regions and through time, indicates that fluctuations in physical and climatic circumstances brought about culture change on both regional and global levels. The transition from highly mobile and broadly generalist Early Palaeoeskimo subsistence practices to the more narrowly selective marine focus of Dorset ways of life is evidenced in the KcFs-2 faunal assemblage. The faunal data from the KcFs-2 assemblage clearly shows selection for, and intensive exploitation of, marine mammals. The location of the KcFs-2 site also corresponds well with the maritime-oriented settlement pattern defined for Dorset groups. The focal species of the KcFs-2 assemblage is the ringed seal; the remains of the ringed seal species are ubiquitous, and very often dominant, in faunal assemblages across the Arctic territory throughout the Pre-Dorset and Dorset periods (Maxwell 1985; Murray 1999).

The predominance of immature ringed seals that is evident in the KcFs-2 assemblage underlines that seals were both numerous in the region and highly accessible in terms of predation (ease of exploitation), and also suggests a late winter through summer season of occupation for the site. Juvenile and immature individuals were identified for six of the taxa in the assemblage (small seal, harp seal, walrus, caribou, beluga, and fox) two of which also provided newborn/foetal specimens (small seal and fox); the presence of these immature and juvenile individuals confirms the proposed seasonality for the site (most likely between March and July) and also attests to an abundance of marine resources in the area of the KcFs-2 site, a lack of subsistence pressure for the given season of occupation, and the sometimes opportunistic nature of the subsistence strategy employed by the inhabiting group. A similar conclusion regarding seasonality may be drawn from the presence of several migratory species in the KcFs-2 assemblage (harp seal, walrus, beluga, bearded seal, caribou, murre, and eider duck) whose seasonal presence in the region of the KcFs-2 site either occurs simultaneously or overlaps during the period between the months of March and July. The House 3 structure also supports the proposal of late winter to summer seasonality as it is of similar form and design to that of numerous habitations elsewhere in the region that are typically associated with cold season or multi-season occupations (Nagy 1997; Maxwell 1985; Murray 1999).

The Late Dorset cultural affiliation that was inferred for the KcFs-2 site is substantiated by the presence of diagnostic organic artefacts in the form of distinctive harpoon heads (Late Dorset Types F and G) that were identified in the assemblage under study here, as well as several distinctive specimens in the samples recovered at the site through previous investigations by Leechman (1943). The House 3 structure also lends support to the Late Dorset association in that it corresponds well with similar structures identified at various other sites from the period (Maxwell 1985:153-158; Murray 1996, 1999) and also conforms with interpretations of structures that are thought to have housed multi-family groups (Nagy 1997). The distinctive art objects recovered at the KcFs-2 site, which include a sculpted walrus and an incised ivory maskette, also serve to solidify the Dorset cultural affiliation and emphasize the importance of marine animal symbolism in the shamanic belief system of the Dorset people. The presence of artistic representations of marine animals in Dorset archaeological assemblages can be seen as a confirmation of the primordial role of these animals in the lives of the Dorset people and the links between daily survival and ideology that underscore economic and social organization.

The zooarchaeological analysis of the KcFs-2 site has revealed much pertinent and verifiable information concerning the economic organization of the inhabitants of the site. The KcFs-2 site appears to conform well to both the regional and global definitions of Late Dorset life ways, specifically on the level of settlement patterns and subsistence pursuits. Further analyses of the remaining faunal material and lithic assemblage would be both worthwhile for solidifying the present inferences, and beneficial to future studies concerning inter-site and inter-regional comparisons of Palaeoeskimo economies and culture change.

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APPENDIX I

Abbreviations

Element distributions (Chapter 5)

Small seal, Harp seal, Walrus, Beluga, Caribou:

Skull – skull
Mand – mandible
Atlas – Atlas
Axis – axis
Vert – vertebrae
Cerv – cervical vertebrae
Thor – thoracic vertebrae
Lumb – lumbar vertebrae
Bac – baculum
Sacr – sacrum
Caud – caudal vertebrae
Rib – ribs
Stern – sternum
Scap – scapula
Hum – humerus
Rad – radius
Ulna – ulna
Carp – carpal
Mcarp – metacarpal
FF – front flipper
Phal – phalanx
Innom – innominate
Fem – femur
Tib – tibia
Fib – fibula
Tars – tarsal
Metapod - metapodia
Mtars – metatarsal
HF – hind flipper
Sesam – sesamoid

Murre:

Skull - skull
Quad - quadrate
Dent - dentary
Pmax - premaxilla
Atlas - atlas
Axis - axis
Vert - vertebrae
Cora - coracoid
Furc - furcula
Synsac - synsacrum
Rib - ribs
Stern - sternum (keel)
Hum - humerus
Rad - radius
Ulna - ulna
Carp-mcarp - carpometacarpus
Phal FL - phalanx forelimb
Phal MD - phalanx of major digit
Fem - femur
Tib-tars - tibiotarsus
T-Mtars - tarsometatarsus
Phal HL – phalanx hindlimb

Abbreviations cont'd

Economic utility indices (Chapter 5)

Small seal and Harp seal:
Head – head
Radul – radius and ulna
Fflip – front flipper
Tibfib – tibia and fibula
Rflip – rear flipper

Caribou (marrow):
pelvsac – pelvis and sacrum
dhum – distal humerus
praduln – proximal radius/ulna
dmccarp – distal metacarpal/carpal
dfem – distal femur
Ptibfib – proximal tibia/fibula
Dtibfib – distal tibia/fibula
Mtars – medial tarsal
1ph – 1st phalanx
2ph – 2nd phalanx
3ph – 3rd phalanx

Bone density indices (Chapter 5)

Small seal and Harp seal:
pman – proximal mandible
mman – medial mandible
dman – distal mandible
atl – atlas
latl – lateral atlas
ax – axis
tho – thoracic
lum – lumbar
sac – sacrum
rib – rib
psca – proximal scapula
dsca – distal scapula
hum – humerus
rad – radius
uln – ulna
acet – acetabulum
ili – ilium
isch – ischium
pub – pubis
fem – femur
tib – tibia
fib – fibula
calc – calcaneus
astr – astragalus

Caribou:
mmand – medial mandible
cerv – cervical
prib – proximal rib
drib – distal rib
pscap – proximal scapula
mscap – medial scapula
phum – proximal humerus
dhum – distal humerus
rad – radius
uln - ulna
mcarp – metacarpal
acet - acetabulum
pili – proximal ilium
dili – distal ilium
pfem – proximal femur
mtib – medial tibia
dtib – distal tibia
astr - astragalus
pcalc – proximal calcaneus
dcalc – distal calcaneus
nav - navicular
mmtar – medial metatarsal
dmtar – distal metatarsal
pp1 – proximal 1st phalanx
dp1 – distal 1st phalanx
pp2 – proximal 2nd phalanx
dp3 – distal 3rd phalanx

APPENDIX II

Faunal Data

Small seal MAU and bone density

Element	Scan Site (Lyman 1994)	MNE	Elements per complete skeleton	MAU	%MAU	Bone Density (Lyman 1994)
Skull	N/A	9	1	9	41	N/A
Mandible						
prox	DN6	36	2	18	81.81	0.89
comp	DN2	24	2	12	54.55	0.84
dist	DN1	1	2	0.5	7.32	0.59
Atlas						
comp	AT1	15	1	15	68.2	0.42
lat	AT2	2	1	2	9.1	0.54
Axis	AX1	21	1	21	95.5	0.56
Cervical	N/A	69	7	9.9	45	N/A
Thoracic	TH1	116	15	7.73	35.13	0.34
Lumbar	LU1	48	5	9.6	43.63	0.38
Baculum	N/A	10	1	10	45.5	N/A
Sacrum	SC1	15	3 sacral verts	5	22.72	0.43
Caudal	N/A	123	9	13.67	62.13	N/A
Rib	RI3	252	30 (w 1st rib)	8.4	38.2	0.62
Sternebra	N/A	70	9 (w manub.)	70	35.35	25.08
Scapula						
prox	SP1	26	2	13	59.1	0.49
dist	SP5	5	2	2.5	11.4	0.41
Humerus	HU3	32	2	16	72.73	0.57
Radius	RA3	41	2	20.5	93.2	0.71
Ulna	UL4	26	2	13	59.1	0.79
Carpal	N/A	75	14	5.36	24.36	N/A
Metacarpal	N/A	126	10	12.6	57.27	N/A
FF	N/A	302	28	10.79	49.05	N/A
Innominate						
acetabulum	AC1	13	2	6.5	29.54	0.47
ilium	IL1	8	2	4	18.18	0.6
ischium	IS2	10	2	5	22.72	0.75
pubis	PU2	3	2	1.5	6.81	0.71
Femur	FE4	44	2	22	100	0.69
Tibia	TI3	32	2	16	72.73	0.86
Fibula	FI3	31	2	15.5	70.45	0.9
Calcaneus	CA2	37	2	18.5	84.1	0.45
Astragalus	AS2	33	2	16.5	75	0.55
Tarsal	N/A	112	10	11.2	51	N/A
Metatarsal	N/A	180	10	18	81.82	N/A
HF	N/A	517	28	18.5	84.1	N/A

* Due to the abundance of unfused bones in the small seal assemblage, the bone density MNEs were calculated using the tally of the mid-shaft portions of the long bone elements.

Harp Seal MAU and bone density

Element		Scan Site (Lyman 1994)	MNE	Elements per complete skeleton	MAU	%MAU	Bone Density (Lyman 1994)
Skull		N/A	6	1	6	100	N/A
Mandible							
	prox	DN6	1	2	0.5	8.33	0.89
	comp	DN2	3	2	1.5	25	0.84
	dist	DN1	0	2	0	0	0.59
Atlas							
	comp	AT1	0	1	0	0	0.42
	lat	AT2	0	1	0	0	0.54
Axis		AX1	0	1	0	0	0.56
Cervical		N/A	2	7	0.28	4.67	N/A
Thoracic		TH1	2	15	0.13	2.2	0.34
Lumbar		LU1	3	5	0.6	10	0.38
Baculum		N/A	0	1	0	0	N/A
Sacrum		SC1	0	3 sacral verts	0	0	0.43
Caudal		N/A	0	9	0	0	N/A
Rib		RI3	2	30 (w 1st rib)	0.1	1.67	0.62
Sternebra		N/A	9	9 (w manub.)	1	16.7	N/A
Scapula							
	prox	SP1	0	2	0	0	0.49
	dist	SP5	0	2	0	0	0.41
Humerus		HU3	2	2	1	16.7	0.57
Radius		RA5	1	2	0.5	8.33	0.45
Ulna		UL2	1	2	0.5	8.33	0.66
Carpal		N/A	0	14	0	0	N/A
Metacarpal		N/A	1	10	0.1	1.67	N/A
FF		N/A	1	28	0.04	0.67	N/A
Innominate							
	acetabulum	AC1	4	2	2	33.33	0.47
	ilium	IL1	0	2	0	0	0.6
	ischium	IS2	0	2	0	0	0.75
	pubis	PU2	0	2	0	0	0.71
Femur		FE1	1	2	0.5	8.33	0.5
Tibia		TI3	4	2	2	33.33	0.86
Fibula		FI5	3	2	1.5	25	0.76
Calcaneus		CA2	2	2	1	16.7	0.45
Astragalus		AS2	3	2	1.5	25	0.55
Tarsal		N/A	1	10	0.1	1.67	N/A
Metatarsal		N/A	11	10	1.1	18.33	N/A
HF		N/A	7	28	0.25	4.2	N/A

* The bone density MNEs for harp seal were calculated using the tally of the mid-shaft portions of the long bone elements.

Caribou MAU and bone density

Element		Scan Site (Lyman 1994)	MNE	Elements per complete skeleton	MAU	%MAU	Bone Density (Lyman 1994)
Skull		N/A	0	1	0	0	N/A
Mandible							
	inter	DN4	2	1	2	57.41	0.57
Atlas		N/A	0	1	0	0	N/A
Axis		N/A	0	1	0	0	N/A
Cervical		CE1	1	7	0.14	4	0.19
Thoracic		N/A	0	13	0	0	N/A
Rib		N/A					
	prox	R12	2	26	0.1	2.9	0.25
	inter	R14	21	26	0.81	23.14	0.24
	dist	R15	1	26	0.04	1.14	0.14
Lumbar		N/A	0	6	0	0	N/A
Sacrum		N/A		1			
Caudal		N/A	0	11	0	0	N/A
Sternebra		N/A	0	0	0	0	N/A
	prox	SP1	1	2	0.5	14.29	0.36
	inter	SP4	1	2	0.5	14.29	0.34
Humerus							
	prox	HU2	1	2	0.5	14.29	0.25
	dist	HU5	2	2	1	28.57	0.39
Radius		RA2	1	2	0.5	14.29	0.62
Ulna		UL2	4	2	2	57.41	0.45
Carpal		N/A	1	2 (hamate)	0.5	14.29	N/A
Metacarpal		MC1	1	2	0.5	14.29	0.56
Innominate							
	acetabulum	AC1	1	2	0.5	14.29	0.27
	ilium	IL1	1	2	0.5	14.29	0.2
	Ilium	IL2	1	2	0.5	14.29	0.49
Femur							
	prox	FE1	1	2	0.5	14.29	0.41
	inter	FE4	1	2	0.5	14.29	0.57
	dist	FE6	1	2	0.5	14.29	0.28
Tibia							
	inter	TI3	2	2	1	28.57	0.74
	dist	TI5	7	2	3.5	100	0.5
Fibula		N/A	1	2	0.5	14.29	N/A
Tarsal							
	Astragalus	AS1	1	2	0.5	14.29	0.47
	calcaneus prox	CA1	1	2	0.5	14.29	0.41
	calcaneus dist	CA4	1	2	0.5	14.29	0.33
	navicular	NC1	2	2	1	28.57	0.39
Metatarsal							
	inter	MR3	2	2	1	28.57	0.74
	dist	MR5	1	2	0.5	14.29	0.46
Phalanges							
	prox 1	PI1	1	8	0.13	3.71	0.36
	dist 1	PI3	3	8	0.38	10.9	0.57
	prox 2	P21	1	8	0.13	3.71	0.28
	dist 3	P31	1	8	0.13	3.71	0.25

MNE and MNI

Small seal

Element	MNE	MNI
Skull	9	9
Mandible	28 left, 33 right	33
Atlas	17	17
Axis	21	21
Cervical	69	9
Thoracic	116	7
Lumbar	48	9
Sacrum	15	5
Caudal	123	13
Rib	252	8
Baculum	10	10
Scapula	16 left, 15 right	16
Humerus	26 left, 20 right	26
Radius	42 left, 22 right	42
Ulna	15 left, 17 right	17
Capitate	1 left	1
Cuboid	12 left, 14 right	14
Hamate	3 left, 4 right	4
Scapholunar	12 left, 5 right	12
Trapezium	6 left, 10 right	10
Trapezoid	4 left, 5 right	5
Triquetral	1 left, 1 right	1
Metacarpals	66 left, 60 right	12
FF phalanges	302 total	10
Innominate	13 left, 21 right	17
Femur	23 left, 24 right	24
Tibia	27 left, 30 right	30
Fibula	29 left, 19 right	29
Calcaneus	18 left, 19 right	19
Astragalus	15 left, 18 right	18
Navicular	25 left, 13 right	25
Cuboid	12 left, 14 right	14
Internal cuneiform	15 left, 10 right	15
External cuneiform	9 left, 12 right	12
Middle cuneiform	2 left, 1 right	2
Metatarsals	102 left, 78 right	10
HF phalanges	517 total	18

* MNEs calculated using the tally of the most abundant proximal or distal epiphysis for the long bone elements.

Harp seal

Element	MNE	MNI
Skull	6	6
Mandible	4 right	4
Cervical	2	1
Thoracic	2	1
Lumbar	3	1
Rib	2	1
Humerus	2 left, 1 right	2
Radius	1 left	1
Ulna	5 left, 1 right	5
Metacarpals	1 left	1
FF phalanges	1	1
Innominate	1 left, 3 right	3
Femur	1 right	1
Tibia	2 left, 6 right	6
Fibula	1 left, 2 right	2
Calcaneus	2 right	2
Astragalus	3 left	3
Cuboid	1 right	1
Metatarsals	5 left, 5 right	1
HF phalanges	7 total	1

* MNEs calculated using the tally of the mid-shaft portions of the long bone elements.

Caribou

Element	MNE	MNI
Mandible	2 right	1
Cervical	1	1
Rib	24	1
Scapula	2 right, 2 left	2
Humerus	2 left, 1 right	2
Radius	1 left	1
Ulna	2 left, 2 right	2
Carpal	1	1
Metacarpals	1	1
Phalanges FL/HL	6	1
Innominate	3 left	3
Femur	1 right, 2 n/a	1
Tibia	3 left, 2 right	3
Fibula	1 left	1
Calcaneus	2 left	2
Astragalus	1 left	1
Navicular	2 right	2
Metatarsals	1 left, 2 n/a	1

* MNEs calculated using the tally of the most abundant proximal or distal epiphysis for the long bone elements.

Murre

Element	MNE	MNI
Skull	13	13
Quadrate	5	3
Dentary	5 left, 5 right	5
Premaxilla	12	12
Atlas	1	1
Coracoid	29 left, 22 right	29
Scapula	25 left, 26 right	26
Vertebra	1	1
Sternal keel	6	6
Sternum	6	6
Rib	7	1
Humerus	32 left, 37 right	37
Radius	19 left, 23 right	23
Ulna	22 left, 17 right	22
Carpo-metacarpus	12 left, 14 right	14
Phalanges FL	6 left, 11 right	11
Synsacrum	3	3
Femur	19 left, 26 right	26
Tibio-tarsus	21 left, 26 right	26
Tarso-metatarsus	6 left, 10 right	10
Phalanges HL	6	1

* MNEs calculated using the tally of the most abundant proximal or distal epiphysis for the long bone elements.

Walrus

Element	MNE	MNI
Cervical	2	1
Lumbar	1	1
Rib	9	1
Sternebra	1	1
Humerus	1 left, 1 right	1
Radius	1 left	1
Metacarpals	1 right (1st)	1
FF phalanges	5 total	3
Innominate	1 left	1
Sacrum	1	1
Tibia	2 right (Juvenile)	2
Fibula	3 (1 J, 1 I, 1UD)	2
HF phalanges	6 total	1

* MNEs calculated using the tally of the most abundant proximal or distal epiphysis for the long bone elements.

Beluga

Element	MNE	MNI
Caudal	2	1
Rib	3	1
Humerus	1 (Adult, unsided)	1
Metacarpal	1	1
Metapodia	1	1
Phalanx	5	1
Radius	1	1
Ulna	1 left (Juvenile)	1

* MNEs calculated using the tally of the most abundant proximal or distal epiphysis for the long bone elements.

Auks

Element	MNE	MNI
Skull	1	1
Quadrate	2 n/a	2
Dentary	7 left, 11 right, 1 n/a	11
Maxilla	5 n/a	5
Coracoid	2 left	2
Scapula	1 left, 2 right	2
Vertebra	4 n/a	1
Sternum	1	1
Rib	7 left, 3 right, 30 n/a	2
Humerus	1 left, 3 right, 1n/a	3
Ulna	2 n/a	1
Phalanges	1 left, 1 n/a	1
Synsacrum	2 n/a	2
Femur	1 left	1
Tibio-tarsus	1 left, 1n/a	1

* MNEs calculated using the tally of the most abundant side of the dentary.

Polar Bear

Element	MNE	MNI
Thoracic	1	1
Tibia	1 right	1
Humerus	1 right	1
Femur	1 n/a	1
Metacarpals	1 n/a	1
Phalanges HL/FL	1 right, 1n/a	1
Tibia	2 left (1A, 1SA)	2
Fibula	1 right	1
Metatarsals	2 right, 1n/a	1

* MNEs calculated using the tally of the most abundant proximal or distal epiphysis for the long bone elements.

Fox

Element	MNE	MNI
Mandible	1 right hemisphere	1
Maxilla	1	1
Cervical	1	1
Caudal	1	1
Scapula	4 n/a	2
Humerus	3 left, 3 right (1 NB/F)	4
Radius	1 left, 2 right	2
Ulna	3 left, 1 right	3
Innominate	1 right	1
Femur	2 left, 3 right (4A, 1I)	4
Tibia	2 left, 1 right, 1n/a	2
Fibula	2 left	2
Autopodia	1	1

* MNEs calculated using the tally of the most abundant proximal or distal epiphysis for the long bone elements.

Goose

Element	MNE	MNI
Carpo-metacarpus	1 left	1
Femur	1 right	1

Eider Duck

Element	MNE	MNI
Carpo-metacarpus	1 right	1
Tibio-tarsus	1 right	1
Ulna	2 right	2

Wolf

Element	MNE	MNI
Canine	1	1
Molar	1	1
Post-canine	2	1
premolar	1	1

Bearded seal

Element	MNE	MNI
3rd Metatarsal	1 left	1
Distal epiphysis 1st Metatarsal	1 right	1