CULTURE CONTACT, ETHNICITY AND FOOD PRACTICES OF COASTAL FINNMARK, NORWAY (1200 TO 1600 A.D.)

by

Colin P. Amundsen

A dissertation submitted to the Graduate Faculty in Anthropology in partial fulfillment of
the requirements for the degree of Doctor of Philosophy, The City University of New
York

2008

This manuscript has been read and accepted for the Graduate Faculty in Anthropology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

Thomas H. McGovern

___________ ___________________________
Date Chair of Examining Committee

Louise D. Lennihan

___________ ___________________________
Date Executive Officer

Sophia Perdikaris______________________________

Orri Vésteinsson______________________________

Bjørnar Olsen_________________________________

Supervisory Committee

THE CITY UNIVERSITY OF NEW YORK

Abstract

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Adviser: Professor Thomas H. McGovern

One of the consequences of early commercial fishing, with regard to Norway, was the partial influence upon the Norwegian state to expand its regional borders and influence further north. Although this was out of economic necessity it was not the only reason for the establishment of permanent settlements, in the form of fishing villages, along the coast of Finnmark. One of the outcomes of this movement was a more visible Norwegian presence in the Far North which brought with it more direct contact with the local indigenous population, the Saami, as well as more inflammatory contacts with tribal peoples (Karelian) from present day Northwest Russia who were in the region to trade and to collect tribute on the behalf of the Principality of Novgorod. This period of Finnmark's historical past is characterized as a high point of stately hegemonic desires, both from the west and the east, which at times was considerably hostile. However, there were periods of economic cooperation in the form of trade between Norwegian, Saami and Russian/Karelian. It is during this period that unique structures appear along the coast, known as multi-room houses, which have remained enigmatic monuments within north Norwegian archaeology. It is from these sites, and under the above historical context, that the material presented in this dissertation originated. Special attention will focus upon the ichthyological remains with an in-depth discussion devoted to the multiple butchery styles observed which are believed to be ethnically prescribed practices outside of what has been observed thus far in Northern Norway or the North Atlantic.

ACKNOWLEDGEMENTS

This dissertation could not have been completed solely by me; it took numerous individuals throughout the various stages of its progress to help me along. I can confidently state that without the assistance of these people the dissertation process would have been a less than positive experience and this dissertation would be a far different piece of work. I greatly appreciate them all for their selflessness in assisting me during this long journey.

Financial support was provided to me by various entities. The Norwegian Science Council held by Bjørnar Olsen which funded the "Multi-room house project." Funding from both the Leverhulme Trust Fund and National Science Foundation held by Thomas H. McGovern; and, the City Hall Park Analysis Project Grant held by Sophia Perdikaris and Thomas H. McGovern all provided the means for me to develop my skills in zooarchaeology. The King Olav V Norwegian-American Heritage Fund Scholarship from the Sons of Norway Foundation and the Norwegian Marshall Fund from the Norway-American Association funded my stay in Norway in 2002. From the Graduate Center I received CUNY Dissertation Travel Fund, CUNY University Fellowship, CUNY Student Travel and Research Fund/Alumni Association Dissertation Support Fund which assisted me with trips to the zoological museum in Bergen and travels to various conferences over the years. I also received a Graduate Teaching Fellowship which provided me with the opportunity to teach.

The "Multi-room house Project" consisted of numerous individuals over the four years of fieldwork. I wish to thank you all for sharing with me the good times, the hard work and the bad weather. Those were special days. A special thanks is owed to Przemylaw Urbańczyk, Derek Skrzyńska, and Kasha Misiewicz, for the memorable moments at Skonsvika, Warsaw and Krakow. I wish to thank Jørn Henriksen for his friendship, calm demeanor, clear thinking and his unflinching selflessness. Thank you Elin Myrvol for keeping things organized. To Bjørnar Olsen, the project leader, thank you for your leadership, sense of humor and cooking prowess. Finally, I wish to thank the Neptune and the townspeople of Berlevåg for their generosity and hospitality over the years.

I wish to extend my sincere gratitude to the members of the my dissertation committee, Thomas H. McGovern, Bjørnar Olsen, Sophia Perdikaris and Orri Vésteinsson, for their advice and encouragement during the dissertation process. Tom presented me with a great opportunity to work in his laboratory in 1998. From that day forward I've learned a great deal about research, grant writing and the integration of multiple strands of data. His generosity brought me into the North. I'm extremely grateful to him for connecting me with numerous researchers throughout the world, especially to Bjørnar Olsen. Bjørnar generously took me on to work on his great project, I will always remember my very first night in Tromsø and my indoctrination into northern Norwegian culture. Bjørnar's support, both professionally and personally, and friendship over these many years has been immeasurable. Without Sophia I most likely would not be in archaeology today. She encouraged me to pursue the Ph.D. and persuaded me to study fish osteology. It is Sophia's research which has provided the base to which this research is supported. Orri exhaustively pressed me to clarify my dissertation. His tenacious editorial comments encouraged me to go beyond what I thought was capable of myself to produce something to be proud of.

There are others who worked closely with me, especially during these months of writing, who were not officially part of my committee, but who nonetheless generously provided me all of their time. Most notably is Brain Hood. Brain selflessly read and commented on the early drafts of this dissertation. He also instructed me on how to organize the dissertation. Susan Kaplan provided me with sound and practical advice during the final stretch of the dissertation process.

I owe a great deal of gratitude to Brita Solvang and to the faculty at the Institute for Archaeology at the University of Tromsø for the work and laboratory space. In addition, thanks to Karl Frafjord, Wim Vader, Stefan Hügel and Per Helge Nylund for the loan of specimens and assistance. Without their support this work would not have been possible. A special thanks to Reidar Bertelsen, Ingerid Sommerseth and Marianne Skandfer who provided me work during difficult times. And a special thanks to Morten Ramstad who in 2004 provided me with a great job on the Melkøya project. I'm appreciative to Anne Karin Hufthammer for access to the zoological collections and a job at the Bergen Zoological Museum.

I wish to thank Wendy Castor, Raymond Petit, Sevitha Patel for the assistance with the osteo-metrics.

To the folks at the Hunter College and Brooklyn College zooarchaeological laboratories who over the many years provided enjoyable distractions. I would like to especially thank Marianne Betti, Seth Brewington, Matt Brown, George Hambrecht, Ramona Harrison, Yekaterina (Kate) Krivogorskaya, Ray Pettit and Konrad Smiarowski. Thank you all.

There are few special people I must set aside and thank for their support over the years. To my long time friend and room-mate Jonas Wesley who was always there for a good conversations. In addition, a special thank you to David and Helen Wesley who gave me a second-home and to Ragnar Edvardsson and our early days in the North-west of Iceland. Ruth Maher, who over the years has been a great friend. Jeromiah Scholl, thanks for the great advice in finishing-up. I would also like to thank Mary Fanning, Ellen Sirkka Nora and Line Nilsen Eliassen, each of whom helped me along the different legs of my journey in their own unique way. And to all my friends in the USA and Norway, thank you.

Thank you to Gerald Bigelow who has made the last months of writing survivable.

To my trainers Svenna Terje Gunge, Terje Wickstrøm, Cathrine Olsen and all the members of the Tromsø Kickboxing Club thank you for the hard training and pushing me beyond my limits. To Andrew Lesmerises, thank you for teaching me the ground game.

At the Graduate Center Ellen DeRiso, whose patience and attention to detail is above any of us. Ellen always answered my questions and made sure I was on the right track. Without her help many of us would be lost. Thank you to Louise Lennihan for her leadership and kindness.

Finally, to my parents, Erik and Dodie Amundsen, who stuck by me and encouraged me over these many years. Thank you both for your love and unwavering support. I could not have made it without you!

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Chapter 1. Introduction

This dissertation examines the subject of ethnicity as it relates to the practices of subsistence and specialized animal processing in northern Norway during a time of increased inter-ethnic interaction. This area witnessed several different ethnic groups traveling, trading and living in the period from 1200 to 1600 A.D., which is the focus of this research (Amundsen et al. 2003). The ethnic groups in question were the Saami, Norwegians and Russians/Karelians. Indications of their presence on this landscape are seen in the various structures from Norwegian fishing villages to Saami single room circular houses to the more enigmatic and ethnically unaffiliated structures known as "multi-room houses."

This dissertation will present field and laboratory work on multi-room houses which began in the summer of 2001 and concluded in the winter of 2006. The majority of the data introduced in this dissertation originates from three sites: Kongshavn, Skonsvika and Nordmannsett, located in the Berlevåg Municipality Finnmark County Norway, see Figure 1. Based on the analysis of the faunal material from these sites their economic function will be examined and their ethnic affiliation discussed. In addition, this analysis will place these sites in to the context of the Late Medieval regional and super-regional economy and the political and cultural systems of North Norway, as well as the North Atlantic as a whole, see Figure 2.

This chapter will introduce the aims and goals of this research. The first section will discuss the "Multi-room house Project" of which this research formed a part. The second and third sections will briefly outline the cultural history and natural resources of Finnmark. The fourth section will present the questions and problems associated with the data of the region and super-region. This will be followed by a short excavation history of the sites used in this dissertation. The sixth section will outline very briefly the archaeological research history of North Norway. This is followed by another more specific historiography of zoo-archaeological research history in North Norway. Finally, a brief account will be given of the archaeology of fisheries research in the North Atlantic which this research has been built upon.

1.1. The Multi-room house Project

"The Multi-room house Project," also known as "Cultural Landscapes from the Iron Age and the Older Historic period in Coastal Finnmark Project,"was a multi-disciplinary research project that provided the data used to write this dissertation. From 2001 to 2004, under the direction of Prof. Bjørnar Olsen of Tromsø University, this project focused almost exclusively upon the multi-room houses of coastal Finnmark (Figure 1). Prior to this investigation, there had been little research into these structures. Over the past 80 years there have been sporadic and limited investigations into the multi-room houses. In the late 1920's the Finnish scholar Väinö Tanner conducted the first investigation into these structures. He investigated a single multi-room house located in Soim east of the Petchenga Fjord in northwest Russia (Tanner 1923). Tanner interpreted the structure as part of the eastern Skolt Saami housing tradition based on the local oral history of the Petchenga Saami. Later excavations in Finnmark were conducted by Povl Simonsen (1981), who investigated an aggregation of 20 structures on the island of Vadsøya, Vadsø Municipality, in the late 1970's (Simonsen 1981). His conclusion, based on documentary sources, pointed to a Norwegian occupation associated with the medieval expansion and late medieval fishing stations. In a more recent investigation at

Forsøl, Hammerfest Municipality Finnmark Håvard Bratrein (1996) came to the similar conclusion that these sites were Norwegian associated with the northwards expansion and establishment of fishing villages. Bratrein's conclusion was based both on archaeological and documentary interpretation (further references Niemi 1997; Myvoll 2002; Amundsen et al. 2003). Despite these investigations the presence of these structures on the coastal landscape of north Norway was still an enigma for Norwegian archaeologists and a blank spot in North Norwegian cultural history. One possible reason why the multi-room houses were still open to speculation was because the archaeological findings were so sparse. Regardless, a popular theory filling in this blank, based on Simonsen's and Bratrein's conclusions, held that these structures were fishing settlements, which implicitly meant Norwegian occupants had connections to the commercial trade in dried fish. With little or no archaeological or historical information the Mutli-room house Project set out to fill in the void of the later historic period of North Norwegian cultural history by asking some elementary questions: why were these structures built, who built and used them and for what purpose?

The first phase of the project set out to gather *in situ* organic material for radio-carbon dating as well as acquire an understanding of the sites' formation. Test pitting was done in 2001 at 12 of the 19 known multi-room house sites (Figure 1) (see Henricksen 2002). The dates provided by the 37 radio-carbon assays established that the sites were occupied during a period ranging from approximately the beginning of the 13th century to the early/late 17th century with no site being continuously occupied during this time period (Figure 3) (Amundsen et al. 2003). Rather, it is believed through interpretation of the stratigraphy that most sites were seasonal occupations only lasting a few hundred years, although there are indications of re-occupation at some of the sites, e.g. Kongshavn (Amundsen et al. 2003). The structures are made up of thick turf and stone foundations with the interior having in some cases wood planking for the walls and large pieces of whale bone for support structures. The floors are typically stone slabs with planks of wood lying above, but this is not always so. House types come in two forms, symmetrical and cluster, with varying number of rooms. For example, Nordmannsett is a symmetrical form and Skonsvika is a cluster form (Figures 31 and 26).

The second phase of the project concentrated on larger scale excavations. A single trench (approx. 2 x 30-40 m) was excavated at two very large (approx. 25 x 40 m) multi-room house structures, the Skonsvika and Kongshavn sites (Figures 26 and 28). Both sites were chosen for further excavation because of the excellent organic preservation observed during the first phase. From 2002 to 2004 these two sites were the main focus of the project. In 2004 another multi-room house site at Nordmannsett was investigated with a small trench excavation (approx. 2 x 5 m). The Nordmannsett site was excavated because questionable radio-carbon samples collected in 2001 made it necessary to acquire other samples of organic material to re-date the site.

The results from the archaeological and environmental analysis of data from Skonsvika and Kongshavn reveal two sites that are distinguishable both in their functions and cultural connections; however, there are certain qualities within the data which connect these sites. It is believed that these structures are probably connected with the Norse or Russian expansion into the region beginning in the 13th century (Amundsen et al. 2003, Henricksen et al. 2004, and Henricksen forth-coming). The material culture at Skonsvika has been described as more eastern in style, with a few of the artifacts possibly originating in Russia/Karelia. The soil science data points to a short but intense use of Skonsvika based on the analysis of the numerous ovens and pits possibly for smoking and processing of meats. The geophysical data uncovered the presence of more ovens, which when coupled with the soil science data, indicated large scale industrial activity on site. In addition, the faunal material indicated that fur processing took place at the site. Although not exclusively connected with the Norse much of the material culture at Kongshavn was more connected to Norse elements. The soil science evidence revealed farming activity taking place on site. Evidence from occupational surfaces and middens indicated the presence of livestock and fishing activity. These conclusions were also supported by the faunal data which indicated the presence of domesticates but an association with a specialized cod fishery. As mentioned above there are certain qualities within the data which appear to link these sites even though much of the data points to dissimilar functions. Several unique forms of butchery practices were observed in the osteological remains of cod (*Gadus morhua L.*), haddock (*Melanogrammus aeglefinus*), and Atlantic halibut (*Hippoglossus hippoglossus*) at all three sites. The uniqueness of these practices could be the common denominator that links not only these sites but possibly others.

1.2. Brief outline of local setting and resources exploited

A more in-depth discussion of the environment follows later in this dissertation (Chapter 3). However, the following will briefly describe the local setting and the animal resources available. North Norway proper encompasses the counties of Nordland, Troms and Finnmark. North Norway and the entire country of Norway are a part of Fennoscandia which includes modern day Norway, Sweden, Finland and Northwest

Russia. Finnmark County is characterized by its three ecosystems (sub-arctic, alpine, arctic), deep fjords (Altafjord, Tanafjord, Porsangerfjord, Laksefjord and Varangerfjord), rivers (the Tana River, the Alta River and the Pasvik River), mountains and a plateau (Finnmarkvidda), but it is the relative warmth of the Atlantic Water in the Barents Sea and the productivity of the sea which influences the distribution of the flora and fauna communities (Figure 6) (e.g. Johansen 1947, Ahti et al. 1968, Sollid et al. 1973, Dahl 1975, Vorren et al. 1984, Dahl et al. 1986, Moen 1987, Townsend 1987, Loeng 1991, Ådlandsvik and Loeng 1991, Sigmund 1992, Chapin and Körner (Eds.) 1994, Oksanen and Virtanen 1995, Fremstad 1997, Påhlsson 1998, Moen 1999, CAVM Team 2003, Kanestrøm et al. 2003). Because of the extreme locality many of the animal and plant species available are seasonal and thus, are only available in the warmer months of the year.

1.3. Brief outline of the cultural history

From 1200 to 1500 A.D. Finnmark County of northern Norway was the main area of concern between the Norwegian state and the principality of Novgorod for trade, taxation/tribute and settlement expansion (Amundsen et al. 2003, Hansen and Olsen 2004). The cultural landscape was an interface of western (Norwegian) and eastern (Russian) cultures, both of which were connected economically and politically to the local indigenous population, the Saami. Throughout the Iron Age and the Early Medieval Period the Norse settlements in the northern parts of Norway had remained geographically stable, with their northern most border being the Lyngenfjord in north Troms county (Figure 1 and 4) (NgL III: 151-152, DN VIII nr. 80: 101-102). This fjord was a physical border between the Norse and the Saami. In the 9th century the Norse chieftain Othere (Ottar) reported to King Alfred the Great of Wessex that there was extensive trade and contact with the Saami beyond this fjord (Lund 1983). Based upon this historical account there was already an established relationship between the Norse and the Saami; whereby the Saami provided the elite class of Norse society with the necessities for maintaining their status in exchange for European goods.

In the 13th century the Norwegian state moved beyond this border (Niemi 1983, Nielsen 1985, 1986); partly out of political (and ecclesiastical) ambition and partly in response to its connection to the Hanseatic trade network which presented new markets for North Norwegian goods which led to increased fishing and fishing settlements (Figure 4) (Helle 1982, 1985, Nedkvitne 1983, 1988, and Nielsen 1993). Prior to 1520 A.D. the historical evidence is sparse but small scale archaeological investigations do point to the establishment of a few Norse settlements in Finnmark around 1200 – 1300 A.D. (Bratrein 1990). The motivation for the fishery colonization by the Norwegian State and its Roman Catholic Church was to oppose the religious, economic, and political power of the city of Novgorod, the most important center for trade in the East at this time (Hansen 2003).

Also in the 13th century the principality of Novgorod made its political and economic authority increasingly more felt in the north. This expansion was a response to a variety of economic and political circumstances in the region. First, there was the increasing economic competition with the principality of Rostov-Suzdal', who were vying for control over Novgorod's trade network in the east (Bulgar). Incidentally, by the early 1300s the Mongolian expansion will disrupt trade with Bulgar for both Novgorod and Rostov-Suzdal' (Hansen 2001:53). Second, since the 10th century

Novgorod had a well established fur trade with Scandinavia and the rest of western Europe, which, although by the 13th century this demand in furs was in flux it was still profitable and more stable than the eastern trade network (Martin 1986). Third, was the connection with the well organized German Hansa, who replaced the Scandinavians as trading partners with Novgorod, and its extensive Baltic trade network. By the 12th century the German Hansa set up a trade court within the city of Novgorod to oversee its operations (Grandberg 1996:99). The Hansa would mediate and funnel Novgorodian furs into the western and central European markets and import European goods back to Novgorod (Hansen 2001:53). To strengthen its expanding trade network Novgorod established administrative centers in newly acquired areas (Martin 1986). These centers had two functions which were to exercise Novgordian authority over the newly dominated areas and to organize the paying of tribute in furs from the local indigenous populations (Hansen 2001:53).

One of these indigenous populations subjugated by Novgorod was the Karelians. The Karelians were a Baltic-Finnic tribe related to the Finns who spoke a Finno-Ugric language. Their settlement area was near Lake Ladoga and Lake Onego (Figure 5). Karelian economy was a mixture of agricultural, fishing, hunting/trapping and trading.

Possibly commencing in the 12th century, the Karelians began to expand their territory northwards (Figure 4) (KLNM VIII: 279). The impetus behind this migration was the attraction of the hunting, fishing, and bog iron in these northern lands (Zachrisson 1988). Prior to their move, the Karelians had extensive contacts with the Saami (forest Saami) of the interior of the Gulf of Bothnia who they traded with and extracted tribute from (Storå 1977:78-80, Zachrisson 1988). This push north would bring them into contact with other Saami populations, specifically the Kola Saami whom they would trade and collect tribute from by 1300 A.D. (Zachrisson 1988, Hansen 1995). Another motivation behind this progression north was the possibility of expanding their trade relations with other Saami populations. As a result of their expansion the Karelians came to reside in one of the administrative districts of Novgorod, and thus were under the administrative control of the principality (Hansen 1996:55-56).

Under Novgorodian administrative control the Karelians retained a semi-autonomous rule. They were permitted to continue trading and exacting tribute from the Saami but they were now obliged to pay taxes on this income to Novgorod. Both the Karelians and Novgorod were in advantageous positions. Novgorod had a reliable supply of furs coming in from its hinterland, while the Karelians could continue their exploits in trading and tribute collection unhindered to a certain degree (Luukko 1969, Yrwing 1969, Storå 1971, Hansen 1996). The written sources document the presence of Karelians in Finnmark and North Troms by the middle of the 13th century, most likely entering Finnmark from their settlements in the White Sea region (O.A. Johnsen 1923:78-102). By the 15th century the west coast of White Sea heavily populated by Karelians (Hansen 1996:56, Hansen and Olsen 2004). As a move to counter this foreign presence, Norway established a fortress and church in 1307 at Vardø, the eastern most point of Finnmark, to clearly demonstrate its political, economic and religious ambitions (Storm 1888, Munch 1849, Bugge 1909, O.A. Johnsen 1923:78-102).

During this period numerous treaties and border agreements were signed that shaped the borders of the region and the trade relations and networks well into the Early Modern Period (Hansen In Press). Norway made peace treaties with Novgorod in the early 14th century. On June 3rd 1326 a peace treaty between Norway and Novgorod confirmed reciprocal rights to collect tribute and trade freely with the Saami in the north, but it did not lessen or do away with the open hostility and occasional armed conflict between the two trade networks (Hansen 1996, Bratrein 1998, Hansen and Olsen 2004). Another agreement was a border delimitation from ca. 1330 A.D. which defined fixed border markers and established a mutually recognized "commons" between the two stately powers from Lyngenfjord, north Troms in the west to the eastern tip of the Kola Peninsula (Bratrein 2004, Pape 2004:162, Hansen In Press). In addition it granted safe passage to the traders (Karelians) travelling in and out of the region (Hansen In Press). The Karelians are mentioned frequently in trade agreements that Novgorod made with the Norway, indicating the Karelians prominent position in Novgorod's trade network (KLNM VIII: 279). For the Saami, these agreements meant being pulled into a larger world economic system as participants. However, the degree to which this happened and the level of participation by the Saami did vary from western to eastern Finnmark (Hansen In Press).

This level of participation by the Saami is particularly true by the Early Modern Period when there is a clear difference of economic involvement in the various trade networks across Finnmark, i.e. western and eastern trade networks. The involvement of local Saami populations in either a western or eastern based economic network varied according to where in Finnmark they resided. Lars Ivar Hansen (In Press) points out that the Saami located in Porsangerfjord, Laksefjord, Tanafjord and Varangerfjord had more "stable and institutionalized" contacts with traders from the east, while the populations of western Finnmark and north Troms did not. Hansen based this claim on tax registers and other documents of the Swedish state ca. late 16th century. It was during this time that the Swedish state was trading and collecting taxes from the Saami of coastal Finnmark (Hansen 1990: 204-212). Incidentally, for the coastal Saami this was an advantageous time period because of the fierce commercial competition between Norwegian, Swedish and Russian traders. This will be the case well into the Early Modern period (Hansen 2006:72).

By the 16th century the Saami were participating in the commercial fish trade. Based on royal accounts the coastal Saami were using stockfish to pay their taxes (Nielssen 1990:37). By the 1600s the Saami were active participants in the Lofoten fishery (Nielssen 2005). It was in the Early Modern Period that the economic organization of the coastal Saami would be transformed from a mixed economy of fishing, hunting and trapping (reindeer) to an economy dominated by fishing, both commercial and subsistence, supplemented by animal husbandry and agriculture (where possible) (Hansen 2006:69). By the 18th century the coastal Saami were trading with the Pomor, who were Russian traders from the White Sea region. The Pomor sailed and traded along the coast of Finnmark trading primarily with the Saami for summer fish like saithe. The Norwegians, although well-established in Finnmark by this time, did not take part in the Pomor trade because their main focus was the winter fisheries and production of stockfish.

By the beginning of the Early Modern Period Novgorod was out competed by the principality of Moscow and lost its control of the northern fur trade. Why this occurred is partially based on the fact that Novgorod could not meet European demand in furs, which by the late 14th/early 15th century Europe demand shifted to more luxurious furs, like otter and fox (Martin 1986: 84). By 1494 the Hanseatic compound in Novgorod closed and the city shifted to exporting commodities like flax, cable yarn, wax, train oil and leather (Martin 1986: 84). The demise of Novgorod did not mean the end of Russian presence in the north, see Hansen (In Press), or an end to the contention over the Finnmark border between Norway and Russia.

It is during this time, well before the finalized border agreement of 1826, that Norway and Russia had established a cooperative agreement on Finnmark. The historical evidence details a mutually over-lapping tax system between Russia and Norway (Pape 2004, Hansen In Press). According to Hansen (In Press) from the first half of the 16th century there existed a definitive border between Russian and Norway. The former had authority over the Kola peninsula, and the latter had authority over the territories west of Varanger fjord. This was documented in the Peace of Teusina (1595) which established that Russia could not collect taxes west of the Varanger fjord (Niemi 1994). The other document was the Treaty of Knäred, signed after the Kalmar War (1611-1613), which gave Denmark-Norway unilateral sovereignty over the coastal Saami of Finnmark from 1613 onwards (Hansen In Press).

1.4. Research questions

The main research questions have been developed in the context of current research issues of Finnmark and the North Atlantic. Beginning with the local region, where understanding the cultural development from the Iron Age through the Middle Ages has been paramount. Traditionally there have been two main themes in North Norwegian archaeology, which have tended to be geographically focused on different counties. The Stone Age has been the primary focus of research in Finnmark County, while Norse Iron Age and Medieval archaeology dominates research in Troms and Nordland Counties. This lack of interest in later periods in Finnmark may be in part due to the focus of the research on the earlier Saami Iron Age material and the ambiguity of the data, such as how to define a non-Norwegian site (see Kleppe 1977, Reymert 1980, Olsen 1984, Odner 1992, Henriksen 1996, Urbańczyk 1996, Schanche 2000). This issue is discussed by Bjørnar Olsen (see Amundsen et al. 2003 and Henriksen et al. 2005) who explains that formerly there was an ethnocentric attitude, which focused exclusively on Norse/Norwegian sites. Since the 1970's this attitude has changed and because of this change questions have progressively evolved to attempt to examine this cultural complexity of Finnmark's multi-ethnic cultural history. The multi-room house sites fit neatly within this research framework because they have often been viewed as a demonstration of the complexity of cultural development of Finnmark because of the ambiguity surrounding their function, purpose and occupants (Olsen 2000 and Amundsen et al. 2003).

With regard to the North Atlantic as a whole there are a few specific questions that this dissertation will address. In the post-Viking period North Atlantic one of the more pressing questions within zoo-archaeology has been the intensification of fishing which means investigating the early development and expansion of commercialized fisheries (Perdikaris and McGovern 2004). Part of the discussion has centered upon the culturally specific examination of discard and processing behavior. Throughout much of the North Atlantic region there has been a long tradition of processing fish, specifically cod, for long term storage in the form of klipfisk or tørrfisk (salt and air-dried fish respectively). This “way-of-doing” has been associated with Norse/Norwegian commercial/industrial fishery sites in Norway and throughout the islands of the North Atlantic, like Iceland. These sites are economically specific via their connection to the German Hansa and the fish trade to Continental Europe. It is within this context that a specific way of processing cod, or butchery, was performed, which leaves tell-tale signs in the form of cut-marks and a distinct pattern of skeletal elements. What these findings could reveal was that the North Atlantic was not exclusively Western European.

The main research questions reflect current research issues of Northern Norway and the North Atlantic.

1) What are the functions of the multi-room house sites: Kongshavn, Skonsvika and Nordmennsett?
    i. Are the sites commercial/industrial in nature, with signs of specialized production, or trade in specialized commodities like dried fish or furs?
    ii. Or, are they primarily subsistence sites based hunting/fishing activities?
    iii. Or, some mix of the two?
2) If possible, can the ethnicity of the people inhabiting these sites be determined?
    i. Do the faunal deposits reflect “Norwegian” economic practices such as commercialized fishing?
    ii. Or, do the faunal deposits reflect “Eastern” economic practices such as trapping/trading furs?

        iii. Are the butchery practices observed connected to any known ethnic group?

3) Are there economic differences along the coast of Finnmark during the Late Medieval and Early Modern periods?
4) What do the findings mean with regard to the cultural history of the North Atlantic region?

Finally, this dissertation sets out to add more knowledge and information about a region of northern-Europe that has lacked archaeological data regarding its more recent past. Through the analysis of faunal remains this dissertation will examine the function and ethnicity of these sites. As mentioned before, the incorporation of this data-set into the wider region will hopefully aid in understanding the cultural complexity of the far north. It is within this cultural complexity that the ability to distinguish ethnicity will be a crucial device to illustrate key moments within the culture history of Finnmark and to better understand the historical processes that created this cultural history.

1.5. Brief outline of the data

The following will present a very brief overview of the data that forms the core of this research project. As mentioned at the beginning of this chapter the bulk of the data for this project originated in Finnmark County, Norway with the main deposits of this dissertation coming from sites in the Berlevåg Municipality: Skonsvika, Kongshavn and Nordmannsett (Figure 1). Table 1 outlines the history of all of these deposits starting with the earliest test pitting in the summer of 2001 through the full scale excavations of 2002, 2003 and the completion of the excavation portion of the project in 2004.

1.6. Research history of North Norway

Archaeological interest in the past did not begin in Finnmark until the middle of the 1850s. Credit is given to A.G. Nordvi (Nordvi 1855 and Olsen 1994) as the first archaeologist in the Varangerfjord area, as well as a pioneer of early North Norwegian archaeology (Olsen 1994:11). Another pioneering researcher was Ole Solberg who in 1909 published his work on the Kjelmøy culture, also in the Varangerfjord area (Olsen 1994, see also Gjessing 1932, 1935 and Solberg 1909). But the beginning of systematic archaeological work in Finnmark is Anders Nummedal who, in 1925, discovered the early Stone Age (Mesolithic) "Komsa Culture" near Alta, Finnmark (Bøe and Nummedal 1936).

Since the early 1980s Finnmark's social and economic development during the Stone Age has been primarily explained through internal influences (e.g. Olsen 1994), so much so that the any external forces that might have played a role in its development have not been considered. In Troms and Nordland counties, where interest lies with the Iron Age and Medieval periods, the two main research themes revolve around the origins and maintenance of cultural complexity. First, it was held that most of this complexity came from the South through colonization by Germanic/Nordic peoples who had subjugated the indigenous Arctic populations. Second, that the acculturation , or Europeanization, of the north into the greater southern sphere of influence was through cultural and economic contact with southern populations (Bertelsen 1979). The purpose of this dissertation is not to refute or support these ideas; it is, however, important to be aware of how these ideas have influenced the current debate. Keeping this in mind, the following will only present North Norwegian archaeological research of the medieval period because it is most relevant to this project. In the Chapter 9, there will be a short discussion of how the present research contributes to North Norwegian and North Atlantic archaeology.

When discussing the history of medieval research in the North one could begin with the work of Povl Simonsen. In North Troms Povl Simonsen in 1951 to 1954, and then in 1961, excavated several Saami 'gamme' type houses (Holm-Olsen 1986). These were the sites in Mjølvik, Værneset, Fagerfjord and Elvefjord (see Simonsen 1980 for further detail). These sites would be part of a much later publication (Simonsen 1980) of his cumulative works where he explores the regional phenomena of farmer-fishers of the late Medieval and early Modern period in North Troms County. The earlier work of Simonsen set the tone (Bertelsen 1979) for later research projects, specifically in North Nordland and North Troms counties. Most of the research on medieval Norse and Saami settlements has been carried out in Nordland and Troms (see Urbańczyk 1992:16 for details), whereas Finnmark county, where there are numerous sites from this time period has lacked intensive research (see Odner 1992 and 2001).

Within the archaeological study of Norse settlements, farm mounds have been a signature cultural monument in the North Norwegian landscape, one that was a primary focus for a considerable amount of research and debate (see Urbańczyk 1992:Chapter 5). The main question has been: What processes created the accumulations that led to the farm mounds? Stamsø-Munch argued in favor of the "stockfish-model,"whereby inclusion into the economic system of the Hanseatic traders and the demand for stockfish in Europe led to a decrease in farming. So much so that an abandonment of fertilizing techniques led to the accumulation of house remains, middens etc, which resulted in the build-up of farm mounds. The second model argued for by Bertelsen (1979) was in favor of a "normal" outcome of permanent farms where the stability of location over hundreds of years naturally led to a buildup of settlement mounds with the latest farm on top (Bertelsen and Urbańczyk 1988). These monuments are very enigmatic and numerous proposals have been made for their origin and creation as well as their ethnic association (Urbańczyk 1992). Tangible information began to surface with the first systematic survey by Gerd Stamsø-Munch in 1966, but foremost acknowledgement has been given to Harald Egenes Lund (1957) and Povl Simonsen (1954) for their initial description of these monuments (Bertelsen 1979 and 1993, see also Stamsø-Munch 1966). In his 1993 publication Bertelsen also points to the early accounts of historian Arthur Brox who explained that what was occurring was a transition from a mixed subsistence economy to a commercial fishery. It is now believed that the mounds are an accumulation of debris from settlements; more specifically, though, the archaeological data from numerous sites points to an association with the later Medieval two-fold economy: a subsistence economy supported by fish and animal husbandry and a market economy with participation in the fish trade (Bertelsen 1993, Holm-Olsen 1981, Perdikaris 1998 and Urbańczyk 1992). Historian Håvard Dahl Bratrein in the 1970's and 80's did extensive documentary research and archaeogical research on farm mounds as well, most notably on Helgøy and Karlsøy, North Troms (Bratrein 1981). But it has been Reider Bertelsen and Inger Marie Holm-Olsen who for the past 30 years have devoted themselves to researching farm mounds with excavations in Storvågan, Nordland, Helgøy, North Troms and Måsøy, Finnmark (Bertelsen 1979, Holm-Olsen 1985 and Urbańczyk 1992: Chapter 5).

Out of this research on farm mounds came several larger projects. The Helgøy Project from 1975 to 1978, aimed to use a multi-disciplinary approach to study "eco-ethno" processes in the Helgøy region, North Troms from the year 0 A.D. to the present (Holm-Olsen 1981 and Mathiesen et al. 1981). More accurately the project tried to answer the question of how to unravel and make distinctions between ethnic groups, like Norwegian versus Saami settlements, in an ethnically mixed setting. In some sense this project reflected the changing mood within archaeology and Norwegian society. Keller (1978) points out that the present day ideologies form our thoughts and ideas of the past, which had influenced Norwegian archaeological research to be very ethnocentric. The "eco-ethno" portion of the project concentrated on the time period of 1300 to 1700 A.D., which was believed to be when immigration into the far north by Norwegians took place. Although no final conclusions were ever reached the investigation did reveal the difficulties and problems of making ethnic distinctions based upon material culture (Håvard Bratrein personal communication). The research in Nordland and Troms county is very extensive so given the limited space and time the above should be viewed as just a brief exposé of the research relevant to this dissertation (see Urbańczyk 1992:17 for details of last thirty years).

Regardless, of a heavy research focus on early sites there is a substantial historical chronology to later period research in Finnmark. Povl Simonsen who documented some of the earliest research into the Medieval and later periods, investigated, amongst others, the site of Vadsøya; which is believed to be a Norwegian fishing village (*fiskevær*) representing Norwegian expansion into the North (Simonsen 1981). Bratrein in the 1980's conducted a survey and dating of several *fiskevær* in the North Cape area of Finnmark (Håvard Bratrein personal communication, see also Bratrein 1990). From this survey work came the discovery of possibly the earliest Norwegian site in Finnmark, which is believed to be a seasonal trading site dated to around 700 A.D. (Håvard Bratrein personal communication). Another farm mound, and *fiskevær*, (ca. 1500 A.D.) excavated by Holm-Olsen on the island of Måsoy, was part of an earlier research effort focusing on farm mounds and the extent of the Norwegian expansion into Finnmark (Holm-Olsen 1981).

The earliest research into the later Saami culture was influenced by two main research objectives: one viewing the Saami as dependent on, and the other as independent of the Norse political and economic system. Some of the earliest work into later period Saami sites was carried out by the ethnographer Vorren (see Vorren 1958), who was interested in the reindeer economy of the Saami (see Vorren 1998 and 1993). Inger Storli was influenced by this enquiry when investigating the possible time of domestication of reindeer. Although Storli's research begins in the Viking Period it extends into the early Medieval. She set out to test the popular theory that the Saami stallo sites were not hunting localities linked to the Scandinavian fur trade but were part of a reindeer herding system (Storli 1993:1 and 1994). Knut Odner's (2001) research focused on the integration and reaction of the fisher-hunter-gatherer society of the Saami to the complex economic and social construction of the late medieval and early modern period (see also Hambleton and Rowley-Conwy 1997). In a recent publication Odner (2001) points out some of the limitations, or lack of data, of the research of this period. There has been some research on the hunting systems, graves and sacrificial places but investigations of houses have been lacking (Odner 2001). It should be noted that with the recent project Home, Hearth and Household headed by among others Bjørnar Olsen investigation into various house forms from this period is underway. Odner's research spans several decades and focuses primarily on the later Varangerfjord area (Odner 2001). Odner's results contradict the once popular view of the Sami being "harassed and exploited by the more developed and better organized Scandinavians" (Storli 1993:1). Rather he finds that the relationship was one of mutual co-operation and reciprocity, as substantiated by the work of Lars Ivar Hansen (Odner 1985, Hansen 1990 and Storli 1993).

1.7. In focus: zoo-archaeological research in North Norway

The following will briefly outline zoo-archaeological research in North Norway. The primary focus of archaeological research in the North has been on Stone Age studies with much of the faunal analysis concentrating on the Varanger sites, and to a great extent on the middens of Gressbakken houses. In terms of zoo-archaeological research the most widely cited piece of osteological work is Haakon Olsen's (1967) analysis of the Younger Stone Age material from the Varanger Fjord sites, for example Gropbakkeengen, Barsnes, Gressbakken, Advik, Nyelv, Bugøyfjord and Høybukt. Olsen presented a detailed description of the archaeo-fauna, emphasizing subsistence economic practices and seasonality, as well as discussing specialty topics like the taphonomic factors influencing bone survival. Olsen lumped the material together which caused interpretative problems and he never fully published all of the data, e.g. the mammals.

Decades later Priscilla Renouf (1989) re-examined much of the material from Varanger analyzed by Olsen. She was particularly concerned with re-evaluating some of the conclusions reached by Olsen by taking a closer look at occupation seasonality and the intensity and stability of occupation and economic activity. Renouf used new excavations at Nyelv to provide a more nuanced approach. She separated out a series of different middens associated with ephemeral dwellings rather than intensely used houses and analyzed the contexts of each midden component separately, which permitted the establishment of a more complex picture, specifically of occupation intensity, seasonality and economic activities (Renouf 1989). Renouf's conclusions were later to be substantiated by another analysis of a midden deposit at Iversfjord (Helskog 1983), which also supported Engelstad's idea that settlement pattern and resource utilization was more variable in the Younger Stone Age than previously thought (Engelstad 1984:19).

Lisa Hodgetts (1997, 1999, and 2000) focused on economic and social life by examining the cultural complexity of the Gressbakken Phase of the Younger Stone Age (ca. 2200 to 1700 BC), with respect to egalitarian or non-egalitarian relations. Based on her examination of body-part representation, Hodgetts concluded that all of the house sites had equal access to seals and reindeer, which suggests to her the presence of a non-hierarchical society. Her re-examination of the age-structure of the seal bones from Gressbakken Nedre Vest House 3,4 and 5 introduced interesting speculations about possible social organization in terms of co-operative harp seal hunts from boats and seasonal targeting of ringed seal pups. With regard to zoo-archaeological methodologies Hodgett's also employed metric-data and more detailed identification criteria to speciate seals as well as investigate the dental annuli on seal teeth.

Schanche's (1994) excavation of Gressbakken houses produced a considerable amount of bone material but this was merely identified and quantified by NISP without further analysis within her dissertation. This same material is reported by Anne Karin Hufthammer (1992) who differentiates the midden deposits and quantifies the faunal material by different cultural layers resulting in a more detailed analysis and a suggestion of seasonal differences within the midden.

Other stone-age studies include Olaf Sverre Berntsen's (1997) examination of the midden at Iversfjord in east Finnmark, in which he considers bone taphonomy and the use of bone in the production utilitarian items.

In contrast to Stone-Age zoo-archaeological research in North Norway, the later period research is geographically broader and covers a greater variety of issues. A study by Winge (in Solberg 1909), one of the earliest faunal studies in the North. provided an account of the economic activity at the sites of Mestersanden and Makkholla on Kjelmøy in Bøkfjorden during the Early Metal Period (first millennium BC). Later, in the 1950s, 1960s and 1980s, further excavations were conducted and more up-to-date quantitative approaches were applied to the osteological material by Håkon Olsen and Pirjo Lahtipëra both of whom demonstrated a summer occupation based on the dominant presence of coalfish (Olsen 1967:27-29, Olsen 1984:148). A later project by Roger Jørgensen investigated the problem of what is economically important to a farm mound economy, animal husbandry or fishing (Jørgensen 1984). In his investigation of the farm mound at Bleik at Andøya in the northern Nordland county Jørgensen concluded that during the Iron Age animal husbandry was more important to this dual economy (Jørgensen 1984).

Turning to the Medieval period, one site of prominence is the settlement mound at Helgøy in Troms county, with occupation ranging from ca. 1300 AD to the turn of the last century (Holm-Olsen 1981, 1983). Analysis of the osteological material demonstrated a mixed economy characteristic of this time period, i.e. fishing, farming, stock raising and hunting and gathering (Bertelsen 1979). One of the goals of this research was to determine ethnic markers in the archaeological data which also included the zoo-archaeological data. In addition major research efforts have been devoted to the large scale production and trade of procured fish, such as air dried fish. Sophia Perdikaris (1998) examined the transition from a subsistence economy to a commercial economy in the Lofoten archipelago of Nordland county from the late Iron Age to the early Middle Ages. The result of her research, which included the largest synthesis of zoo-archaeological datasets in Norway to date, observed a substantial increase in fishing during this period of rising commercialization.

Other zoo-archaeological researchers have focused on Saami sites in Finnmark. Ellen Hambleton and Peter Rowley-Conwy (1997) investigated Odner's (2001) Saami site at Gæccevaj'jar'ga in the inner Varanger Fjord. Their analysis concluded that the Saami were intensely utilizing wild reindeer based upon evidence of marrow and bone grease extraction and because of this intense use the settlement could represent a winter occupation. This economy was not exclusive to reindeer and was supplemented by other taxa e.g. fish, birds and seals. The presence of sheep probably suggests milking and wool production rather than meat production. They warn that these conclusions are tentative because the material analyzed came from the interior of the house and not from the midden where a better representation of the economy would be present (Hambleton and Rowley-Conwy 1997:69).

Because of the lack of research in the later historic period there is not much faunal material to draw from in Finnmark. The Måsøy site is a large late medieval to early modern deposit located on an outer island of the Kobbfjord in the Måsøy Municipality Finnmark. The Måsøy site is a historically known Norwegian fishing village (*fiskevaer*). This collection had been analyzed by Pirjo Lahtipëra (Zoological Museum of the University of Bergen). Besides the large number of fish identified, mostly cod, there was a large number of birds, the majority of which were puffin. The site's location near a major breeding colony for a variety of seabirds on Hjelmsøy could explain the high abundance of puffin, but it is also probable that the presence of puffin is due to specialized processing for the local economy, or export to Bergen, which by the late 18th century was the center for receiving puffin feathers for export (Rikardsen 1984:46).

1.8. Outline of fisheries zoo-archaeology of North Atlantic

In the following a brief overview of zoo-archaeological research in the North Atlantic will be presented with an emphasis on research on the early commercialization of the fisheries in the region (e.g. Amorosi et al. 1996, Barrett et al. 1997, 1999, Bigelow 1984, 1985, Cérron-Carrasco 1994, Church et al. 2005, Dockrill et al. 2001, Edvardsson et al. 2004, Enghoff 2003, Jones 1991, Nicholson 1998, Ogilvie 1996, Perdikaris 1996, 1998; Perdikaris and McGovern 2004; Rackham 1996, Simpson et al. 2000). One of the main research problems in the post-Viking period North Atlantic is understanding what factors caused this shift from local subsistence economies to regional commercialized/industrialized economies (see Perdikaris 1996, 1998a, 1998b, Peridikaris and McGovern 2004, Barrett et al. 2004). It is generally accepted (but not exclusively) that sometime around or after AD 1100 gift-exchange in the North Atlantic was being augmented by market trade, particularly evident in the expansion of trade in low-value bulk goods like procured fish, i.e. dried and salted cod (Perdikaris 1996, 1998a, Barrett et al. 2004: 618, Perdikaris and McGovern In Press). In the past three decades research has relied on zoo-archaeological data, in particular the analysis of large fish middens throughout much of the North Atlantic, to document the growing importance of market economies based on staple goods at the expense of prestige economies.

Some of earliest investigations into this research problem began in the British Isles. As mentioned in Barrett et al. (2005) it has long been appreciated by archaeologists that in the middle ages there was an increase in marine fishing in the North Atlantic (Jones 1981, 1988; Locker 1988, Barrett et al. 2005:619). Colley (1983) was one of the first zoo-archaeologists to investigate this noticeable development. At the medieval site of Quoygrew on the island of Westray in Orkney Colley (1983) identified a possible processing site based upon the large size of the cod and other Gadidae, which she interpreted as the debris from a commercialized fishery, seeing the fish remains as evidence of surplus production for exchange. The other half of this argument was based on her observations that these large Gadidae represented an offshore fishery again based on the reconstructed total length of the fish recovered. At the medieval site of Unst in Shetland Gerald Bigelow (1984, 1985, and 1989) made some key observations of the archaeofauna. Specifically, he noted a marked over-representation of cranial versus tail elements (Bigelow 1984). This he interpreted as evidence of procuring behavior with the intent of exchange (Bigelow 1984, 1985, 1989). Later, James Barrett (1995) closely examined the socio-economic trends in northern Scotland. He noted that pre-Viking period (Pictish) fishing was modest and contained within the littoral zone. This trend changed in the 9th and 10th centuries (see Barrett et al. 1999) when more Gadidae (cod, ling and saithe) begin to be caught but by the 11th and 12th centuries fishing had increased dramatically, and as Colley noted in the Orcadian material based on size reconstruction of total length there was more offshore fishing.

As the regional perspective grew and the number of analyzed sites increased zoo-archaeologists started to note characteristics that differentiated sites, specifically what differentiates a processing site versus a habitation site and vice versa. Cérron-Carrasco's (1994) analysis of a fish midden deposit from a farm mound at St Boniface, Papa Westray (11th to 13th century) found that it represented a commercial deposit based on the lack of cleithra, which she interpreted as evidence of export based on the modern analogy of dried cod having the cleithrum remaining. Andrew Jones (1991) analyzed material from Freswick Links, Caithness (11th to 13th century) interpreting the site as a processing site for market exchange based on the over-representation of cranial remains.

Outside the British Isles other researchers were taking notice. For Iceland, Amorosi (1991) had mentioned the importance of discerning between the ratios of head versus tail parts as a way to determine if processing had taken place. Other studies focused upon the taxa present, particularly the presence of non-local taxa (see Heinrich 1983, Van Neer and Ervynck 1994). Size of fish has also been debated as an indicator of curing (Heinrich 1987), specifically if certain size fish cure better than others given a variety of other variables involved. Cut-marks have also been discussed as an indicator of processing (see Brinkhuizen 1983). Much of this work lead to a large body of work that examined the processing and discard behavior involved in the dry fish trade and its origins (see McGovern and Perdikaris 2002, 2003, Perdikaris et al. 2002, Edvarsson et al. 2003, McGovern et al. 2003, Brewington et al. 2004, Amundsen et al. 2004, Harrison et al. 2004, McGovern et al. 2004a, McGovern et al. 2004b, Krivogorskaya 2005).

Thus, investigations turned to the dried fish in North Norway and Sophia Perdikaris' investigation into the identification of early commercial fishery sites. Her work assembled and fine-tuned the many valuable methodological techniques and applied them to several sites through the counties of Nordland and Troms of North Norway. Perdikaris' specific research questions addressed social change in Arctic Norway from the Iron Age to medieval times. Specifically she examined, the role commercialized fishing played in connecting this once peripheral economy with the larger continental market, transforming it from a prestige-based economy to a market economy (1998). Her analysis of the archaeo-faunal material from Storvågan, Nordland county (11th and 13th century) and Helgøy, Troms county (14th century) resulted in a detailed picture of the fish trade of North Norway. Storvågan was a commercial entrepot beginning in the medieval period in connection with the Lofoten fisheries (Perdikaris 1998:93). The large and well studied faunal collection makes this an anchoring site which all other archaeo-fauna collections from this period of early commercialization and beyond have to be compared to.

The research of NABO (North Atlantic Bio-cultural Organization), which is a co-operative research organization, has effectively aided in this investigation of commercialization of fisheries begun by Perdikaris with investigations into numerous North Atlantic island sites. Most prominent has been the work in Iceland, and more recently in the Faroe Islands, where investigators have examined coastal sites and interior sites in connection with the processing of marine fish for long-term storage (McGovern and Perdikaris 2002, 2003, Perdikaris et al. 2002, Edvarsson et al. 2003, McGovern et al. 2003, Brewington et al. 2004, Amundsen et al. 2004, Harrison et al. 2004, McGovern et al. 2004a, McGovern et al. 2004b, Krivogorskaya 2005). Together all of this research into fisheries archaeology has assisted tremendously in putting together the analysis presented in this dissertation.

Chapter 2. Theoretical Framework of the Research

2.1. Introduction

In the previous section there was a brief description of the history of the northern borders of Europe with an emphasis on Finnmark, Norway. In the subsequent section an attempt will be made to provide possible explanations for the social and cultural changes occurring in Finnmark during the Late Medieval to Early Modern Period. This ambitious task will require a discussion of issues of modes of production, commodities, interregional interaction, trade diasporas, communities, and daily activities all of which had a profound impact on all the cultural groups in the region. All of these elements are interconnected and depend upon one another to answer the questions established at the outset of this thesis.

2.2. Mode of Production

There are misconceptions held by many that societies are separate systems that are tightly "integrated" and static (Wolf 1982). The reality is that both the archaeological and historical data can show the exact opposite. Cultures, nations and other large organizations are made up of heterogeneous parts whose borders melt and intermingle, almost in a fluid nature, with other permeable borders (Wolf 1982, Durrenberger and Pálsson 1985). With this in mind, Eric Wolf (1982) attempts to understand and explain the social processes involved in the economic transition of a generalized feudal Medieval Europe into a modern-capitalistic Europe. Much the same, but on a smaller scale, I will attempt to use Wolf's theoretical idea about economic transitions to examine this pre-modern-economic system setting to explain what was occurring in Finnmark. This was a landscape of tension; firstly, between two competing economic systems: a system of tribute extraction which came to be rivaled, and later replaced, by a market orientated system. Secondly, there was the conflict-ridden relation between two powers contesting their sovereignity over the region and their indigenous clients. As derived from the arcaheological record the end result of this tension brought about changes in social relations, as observed by the noticeable and distinct marks on the landscape.

There is a point of view that these processes and their effects are historical, but they are also material processes, and they linked people who may not have been kinsmen let alone countrymen brought together by some outside power (Wolf 1982). It is through this perspective that we can better understand the long-term development of "material conditions". This pragmatic approach allows for a more holistic view of the consequences brought about by the afore mentioned tensions, and allows for a more judicious way to evaluate their impact on the political and economic development of a system (Mintz 1985 and Wolf 1998). Thus, the creation of expansive political and military systems, long-distance trade network and bounded heterogeneous system controlled by a singular religious or political ideology can be understood in their temporal dimension (Wolf 1982). This is the most practical way at revealing the causal pressures and their cumulative consequences (Mintz 1985 and Wolf 1998:508).

A relevant example is in Finnmark where such pressures resulted in changing social relations and modes of production for the Saami from the Varanger sii'das, a residential district, and the western Finnmark sii'das between AD 1300 and 1700. As discussed by B. Olsen (1987) this period witnessed an increased volume of western and eastern European commercial traffic in the area, which for some of the local Saami meant increased interaction with non-Saami peoples and increased participation in larger regional and world markets. Olsen (1987) points out that increased economic interaction resulted in the emergence of economic specialization such as the development of reindeer pastorialism, specialized fishing and agriculture (Gjessing 1954, 1975: Vorren 1968, 1977, 1980; Vorren and Manker 1957; Tønnesen 1977 from Olsen 1987). As the economy became more specialized and access to resources declined within the spectrum of private and/or limited access the tradtional egalitarian band structure dissolved (Gurevich 1977, Gjessing 1954, 1975: Vorren 1968, 1977, 1980; Vorren and Manker 1957; Tønnesen 1977 from Olsen 1987). In this new social relation of production reciprocal distribution came to an end and was replaced by resource accumulation by individual households (Paine 1971, Ingold 1980, 1988).

To understand the social processes in Finnmark one needs to put the issues in perspective by using the Marxist idea of production modes as an analytical tool. There are two central concepts at the core of this theory; one is that humans are a part of nature, this does not mean that they are passive in their position on the contrary, they are quite active in changing nature via culture (Steward 1955, Wolf 1982, and Ingold 1987). Second, as social beings humans are organized. This is critical because it is this organization, technological, socio-economic and ideological, which dictates how humans, and their culture, change nature (Steward 1955, Wolf 1982).

When it comes to discussing and describing this relationship between man and nature Marx uses the term labor. Labor describes the social processes that humans place on nature that eventually transforms it into a commodity, while work “represents the activities of individuals, alone and in groups, expending energy to produce energy” (Wolf 1982:74). Both labor and labor processes are “social phenomena” which are described by social bonds within a specific society. Although there are different kinds of labor all of which are qualitatively different it is only when money (as wages) is added do the qualitiative differences equalize. This latter concept is part of the understanding of a manufacturers cost of production, the importance of which will become apparent below.

Generally it is through the modes of production and the idea of labor that we are able to understand how labor organization helps people transform nature. The capalistic mode of production is a concentration of laborers simultaneously employed working on the same commodity. A generalized example would be a modern-day industrialized fishery where non-kin and non-friends worked side by side (Breton 1977, Pálsson 1991). This same concentration of labor has been obsereved within the archaeological record at sites like Storvagån Norway which was associated with the Lofoten cod fisheries. The concept allows for an understanding of labor organization and how this organization permits energy to be retrieved from nature in a more proficient and prolific fashion (Wolf 1982, Marx 1990:63); however, it is worth mentioning that there are also criticisms within Marxist theory about the validity of modes of production (Graeber 2006). With that said, there are various ″types″ of modes of production ranging from Chayanov‘s (1966) peasant mode and domestic mode (Sahlins 1977) to the focus of this dissertation the tributary and capalistic mode.

In the tributary mode of production the producers, be they fishermen or reindeer herders, have direct access to their means of production. Although, tribute will be taken from these individuals through agents of some external political or military power individuals still have control over decisions on how to appropriate nature (Wolf 1982:80). This authoritative control can either originate from a local elite ruler, like a chieftain, who has local and easy coercive influence, or a non-residing elite authority, like a state or principality. As an illustrative example in the North both the Norwegian state and the Principality of Novgorod fit the latter type, exacting tribute from local groups like the Saami and the Kareilians.

In Europe, coexisting with the tributary mode, was the activity of the merchant class (Holden 1993). Like any profit interested individual a merchant working in a tributary mode will possibly, and probably, try to re-direct items into a commodity exchange market. This is an important moment of transformation as the changing of an article's use-value can and does seriously influence the overall stability of the tributary mode (Wolf 1982:89). Because the goods, which the tributary mode relies on for its existence are being undermined, as is the control of the producers, this causes a shift in the mode of production relationship towards increasing the overall importance of the producer's labor. Immanuel Wallerstein (1974) views the preceding scenario as the antecedents to capitalism beginning with mercantile merchants (see also Braudel 1973 and Duchesne 2001). John Holden (1993) also views this mode of production as influential in the development of south-east Europe and Anatolia. This argument has traditionally been used to explain the economic situation in the counties of Nordland and Troms where the early tributary processes simply expanded. As in the rest of Europe in around the time of the Christianization most of northern Europe witnessed a trend of political consolidation. This trend began through various avenues but one of these was the extraction of tribute, commerce and the direct control of labor by centralized powers involved in trade.

The capitalist mode of production is, in a chronological perspective, a later social phenomenon in Europe. Here the producer and the means of production are totally separated, gone is the ability of the producer to independently control any decision making. The possession of wealth allows some individuals the ability to control the means of production of others. The possessor of wealth can oppress those who lack wealth. Theoretically, what non-wealth holders have is labor power, which is a negotiable commodity. Once access is granted these individuals will be given wages to pay for life necessities, and in essence this makes them perpetual consumers. Those who control the means of production can also control those commodities produced.

The main goal of this mode of production is to produce a profit. The holders of wealth hire laborers who produce more than the cost for hiring them, a surplus, which belongs to the holder of wealth. Here the capitalist is concerned with abstract exchange values and not with concrete goods or use values (Pálsson 2000:3). Gísli Pálsson uses the example of industrialized fishery as one form of a capitalistic mode of production where, as typical with this mode of production, non-kin and non-friend work side by side (Breton 1977, Pálsson 1991). Pálsson points out that in this mode of production the capitalist can and does respond quickly to changes in fishing and processing profitability, thus capital can be easily transferable to a more profitable enterprise.

2.3. Commodities

The preceding discussion took an economic perspective to the situation in Finnmark. Embedded within the discussion is the implied role of material culture as a commodity. As with all systems of exchange commodities are the center piece (see Appadurai 1986). These have the power to grab and fix the attention and involvement of non-related parties whose sole priority in any type of transaction is to guarantee an equal exchange (Kopytoff 1986). But there is also a perspective of commodities that takes into account their own personal "qualities" as well as items that have the ability of social reproduction (see Appaduarai 1986 and Preucel and Hodder 1996). Igor Kopytoff (1986), in reference to commodities, points out that they need to be something that has a wide-ranging value. What this means is that they are easily exchangeable, based on value, with a multitude of dissimilar items. In his writings he traces the transition of objects to commodities, i.e. their "cultural biography", and what is an interesting aspect, and one that maybe playing out in the north, is that their values are not always transferable over cultural borders. Therefore, what we might be seeing in the north is how different cultures commodify similar items. Here reference is being made to the different kind of butchery patterns observed. But before we tackle these ideas and their relevance to Finnmark we need to understand how an object obtains value through an economic perspective.

In the starkest and in the most compact terms a commodity is something that has value. As mentioned previously this has to do with labor investment and production, but it also has something to do with the usefulness of an object, known as its use-value (Marx 1990). How an object is transformed and becomes a commodity is connected to this concept of use-value. The value of an object makes reference to the amount of time and labor that it takes to make the object, known as the production time (Marx 1990). Because of this process the object will be embedded with an exchangeable value; meaning that an object can be exchanged with other commodities of equal, lesser or greater value (Marx 1990). This idea is contingent upon the usefulness of the object. In other words, how useful an object is to an individual, or a culture, is embedded within the object and constrains physically what it can and cannot be used for.

The above eventually leads to the concept of exchange value. Exchange value simply means when two or more commodities, based upon their values, are exchangeable (Marx 1990). This relationship between two commodities is not static, rather these exchange values do change. When discussing exchange we are not talking about the transfer of use-values from two different kinds of commodities, rather what we are talking about is their value. So in terms of equal exchange both commodities must be exchangeable based upon the amount of labor instilled in each object.

How this process relates to Finnmark is difficult to say because we are confronted with a problem: we are dealing with multiple cultures where the idea of what a specific commodity is in one culture does not necessarily translate into exactly the same meaning and value in another, so there must be a slight detour from this line of rational thinking and into the politics of value (Preucel and Hodder 1996). As Kopytoff (1986) points out the process of commodification should have a cultural perspective, because not only are we dealing with specific things that have become commodified but these are "culturally marked" items (Kopytoff 1986:66). These specific things are akin to that society. Now, as we examine the situation in Finnmark we see this world of culture contact where it can be assumed objects are moving back and forth between different cultural spheres. As Kopytoff presents the biography of an object one critical piece of information is that ideas, and therefore commodities, can be adopted. But he states that it is not so much the fact that something foreign has been adopted but in truth it is "the way they are culturally redefined and put to use" (Kopytoff 1986:67).

In archaeological terms this would require the examination of the cultural patterns expressed through artifacts, ecofacts and structural remains in order to distinguish similar behavioral patterns. Although this will be a revisited theme it is worth illustrating here, because this leads into Pierre Bourdieu's idea of habitus which represents the psychological collective nature of a culture that is expressed through the mundane practices of production. Based on this understanding any alteration to the social structure in which the habitus is operating under will not only alter it but in turn this will result in changing the practices of production (Bourdieu 1977:533). As Bourdieu states, "in short, the habitus, the product of history, produces individual and collective practices, and hence history, in accordance with the schemes engendered by history" (Bourdieu 1977:537). So in reference to Finnmark proper, much of what we are seeing on this cultural landscape is a by-product of its history. In regard to the material culture, and commodities specifically, there are subtle differences but differences nonetheless. These differences are a by-product of the surroundings as well. This applies specifically in situations of culture contact where new ideas might be adopted, or integraded, whereas in a post-contact world old practices may still persist but in a less "standardized" form.

So in this contact and post-contact milieu the historical setting demonstrates individual cultures connected to one another via a tributary and or a capital mode of production. So it is within this setting that we can begin to define the roles of each individual culture and there relations to one another. From the historical perspective one or more of these individual cultures are in some degree in service to a larger organizational structure or culture via these different modes of production. Therefore, it could be argued that they might be trying to meet the demand of a hegemonic power and would attempt to pander to the specific requirements of the dominant group to the highest standard. One example of this is DeBoar's paper on South American potters (DeBoar and Lathrap 1979). In this article DeBoar examined how non-local pottery makers who married into local families would stringently adhere to the cultural codes of the local pottery tradition, while locals followed the rules of production less stringently. So with this example it would probably better be argued that an individual outside of a culture group might be more willing to adhere to a much stricter code of compliance than an actor from that culture, if the latter was working in that specific system (DeBoar and Lathrap 1979). But also what we might be seeing is exactly what Kopytoff (1986) is discussing which is how individual cultures redefine things. Therefore in this case the differences in butchery patterns might be a positive example of this.

2.4. Interregional interaction

Probably the most important issue, and one that has had a profound, but maybe an immeasurable, impact on the social processes in the north, was the contact between the various cultural groups. Given the historical back drop of the previous sections, it would appear that the cultural interactions in Finnmark were totally dictated by the behavior of emerging capitalistic markets and/or competing hegemonic powers. This view although correct only appreciates a portion of what was occuring. The other portions of equal weight and sway were the day to day interactions with, or avoidance of, one another. As outlined earlier, Finnmark had a triadic confluence of cultural groups. Some of these relations were well established prior to 1200 AD but soon changed, while others were newly established post-1200 AD. The typical and predictable unidirectional approach of world-system and acculturation models do to their credit neatly lay out the evolution at the moment of contact. But, at the same time these approaches disregard the cultural complexity of the area. Therefore, a fuller consideration of the pluralistic context of Finnmark must be given and the possible development of a trade diaspora.

Culture contact studies have long been a part of anthropological research, or since the early days of the last century (see Redfield, Linton and Herskovites 1936 and Wells 1980). Traditional studies of culture contact have often presented the interaction from a one sided perspective that typically followed a standardized and predictable pattern whereby a weaker culture was subjugated by a more dominant culture (see Lightfoot 1995 and Stein 2002). Typically the end result of this relationship was described as the less dominant culture being transformed into a mirror image, or "mini-culture", of the more dominate one. Or, better yet, as Kent Lightfoot (1995) points out, past studies have often merged cultures into monolithic identities rather than seeing their plurality, as was the case of the interaction between colonial European and Native American cultures. In doing this archaeologists easily transform the relationship into something overly simplistic. Traditional understanding of culture contact, and its potential to bring about change, has focused on two very popular models: the world-system model and the acculturation model.

A world-system model is made up of three interconnected parts each with independent functions that together translate into a social system (see Wallerstein 1974 and Frank 1966). As a larger social system expands it incorporates an area and the peoples within that area (Hall 2000). Some authors believe that the world-system model extends well back into prehistory, well past the early modern context in which Wallerstein had originally based his model upon, but this is debatable (see Hall 2000). For purposes of illustration, as a periphery Finnmark was a source of natural resources like fish and animal furs that were appropriated and then funneled back to a centralized market, or core area, in Bergen, Novgorod and/or Continental Europe. It will have been in these core areas where the governing bodies of political and economic control existed. Between these two extremes are the semi-peripheral societies, which act as "buffers" and link the two extremes together (see Hall 2000b for an in depth discussion). The difference between the core and the periphery lies in the inequality of production processes, which favors the core area (Wallerstein 1982:92, see Peregrine 2000 for detailed discussion on various approaches to world-system theory). As Hopkins points out this difference is continually manufactured, like social reproduction, thereby the division of labor between the core and periphery is maintained and perpetuated, regardless of locality or time (Hopkins 1982:48).

The inequality mentioned lies in the fact that the core area flourishes because there is an uneven exchange in use-value and labor in the goods being brought into the core area from the periphery. This disparity is maintained by the fact that the labor in the periphery is of a lesser value. Both areas accrue capital but it's the uneven distribution of this towards the core that defines the core-periphery relationship (Wallerstein 93:1982).

The acculturation concept was first presented in the seminal piece ″Memorandum for the Study of Acculturation″ by Redfield, Linton and Herskovites 1936. The purpose behind this piece of work was to qualitatively measure the effects of European cultural dominance over indigenous populations, in this case in the Americas, but this idea has since been applied to many parts of the European colonial world, and the non-European world for that matter (Stein 2002). The premise behind the acculturation concept was similar in concept to the world-system models', i.e., a dominant culture's subjugation of a weaker culture. The acculturation model diverged from the world-systems model when the discussion turned to the gradual absorption of the weaker culture by the dominant culture. This process of borrowing and/ or imitation, sometimes by free-will, sometimes by force, or some times by something in between is never considered by the world-systems model (Stein 2002).

The above models are still applicable to the archaeological record but there needs to be some revision in how to perceive the data, and as mentioned before, with an understanding of the social context. Recently there has been a shift, or a reexamination of how archaeologists should view culture contact, or interregional interaction situations (Canuto and Yaeger 2000, Cusick 1998, Schortman and Urban 2000). An article by Gil Stein (2002) neatly lays out some of the critical aspects of interregional interaction. The most profound aspect is the recognition that complex societies, and I would add complex landscapes as well, are not the by-product of uni-modal cultures, but on the contrary they are the creation of a heterogeneous culture (Stein 2000). Using the complex landscape analogy, it is here where different ways of doing things, different goals and different attitudes come together, whereby the result of these disparate differences often is conflict

(Stein 2000). Maybe out of this conflict, or just a result of the whole heterogeneous context, these interregional interactions provide the right setting for the creation of new kind of identification through ethnogenesis. And finally, a key-point is that unlike world-systems models human agency is believed to be deeply involved in these interactions. In the end the archaeologist is left with trying not to view the residues of settlement patterns, bone collections or structures as a static reminders of one culture but rather of multiple cultures or at least single cultures in constant connection with multiple influences; therefore the borders are down, permeable both to change and influence.

When it comes to these interregional interactions there needs to be an understanding of what defines and characterizes these relations. One critical characterization dispels the myth that societies are completely isolated and self-sustaining. Rather, the exact opposite seems to be true whereby some would argue that at every level within a society there is some kind of contact with an outside society or societies (Schortman and Urban 2000:3). This contact typically takes the form of trade or exchange relations. What limits these kinds of studies is trade. They see trade as the limits of the study, whereby they need to identify the material correlates of contact via trade and exchange items. This exchange will not affect everyone in society. As Philip Curtin (1984) points out it is really the elites and their agents who are involved in this kind of relationship, while the rest of society is quite removed from it. Furthermore, these interactions are not always stable, and they have a tendency to wax and wane (Curtin 1982).

To understand all of this it must be agreed that all trade relations have some antecedents. These early antecedents, and their eventual growth, cross cultural trade relations are often carried out through special institutional arrangements. These act as buffers to insure and guarantee mutual security of all parties involved. In some cases where a trade diaspora has developed the merchants involved might begin as a single settlement which will later develop into a whole series of trade settlements. This will eventually result in an interrelated net of commercial communities that form a trade network. The definition of what constitutes a "trade diaspora" is borrowed from Ina Baghdiantz McCabe's conference paper where she quotes Abner Cohen (1971) and his definition of what a trade diaspora is: *A diaspora of this kind is distinct as a type of social grouping in its culture and structure. Its members are culturally distinct from both society of origin and from the society among which they live. Its organization combines stability of structure but allows a high degree of mobility of personnel. It has an informal political organization of its own…it tends to be autonomous in its judicial organization …its members form a moral community* (Cohen 1971). This definition, however, cannot be seen as too stringent in its archetypical arrangement. For example, the Franco-Huron trade relationship resulted in the co-habitation of either side in the others' settlement areas rather than exclusive settlements. This was a political move as a sign of good faith of both parties. In summary, if one examines the writings of Marcel Mauss (1925) and his discussion on gift giving in which all forms of exchange are inherent with risk, therefore it is up to the parties involved to somehow minimize the risk. Therefore, the establishment of trading centers is intended to minimize the risk inherent to exchange relations.

Therefore, a trade diaspora, and their physical counterpart the trading center, is initialized because cultural differences create a need for its existence. Mediation between two or more parties is the purpose of a trading center; one could say that they act as “cross-cultural brokers” who assist to encourage trade between the host society and the traders (Curtin 1982). As Philip Curtin (1982) points out members of a trade diaspora belong to a plural society, where two or more cultures exist side by side. In most instances this close proximity was a source of stress and tension between traders and the host nation/community. In his book Curtin discusses three possible trade diaspora scenarios. One is between the traders, or the trade community and the host community (Curtin 1982). The second relationship might exist between the various traders, whereby the same cultural connections or trade diasporas are established as political entities, with each node, or outpost, under a central control.

Over time however the cultural differences would be expected to disappear. Basically, trade diasporas eventually work themselves out of existence. Theoretically, over centuries or decades cross-cultural differences will work themselves out and hence the need for cross-cultural brokers will end. What physically happens to the traders is variable. Some withdrew to their home country to allow the host country to carry on in their formal role, or a minority community is left behind in the host country, as a legacy, even though they may not be trading anymore.

In the end what is central to the milieu of a trade diaspora is the community. The community can and does encompass a variety of groups, classes and ethnicities. In a general sense these are specific people at a specific place during specific times that make up a community. Under such circumstances institutions of all types develop based on interactions over a specific and not so specific period of time. A result of these interactions is a shared identity (Yaeger and Canuto 2000, Watanabe 1992). A plausible argument is that this identity does not necessarily have to be based on ethnicity, rather as is stated above identity is based on a whole host of factors, such as being at the right place, at the right time with the right people. As Ian Hodder puts it, *a community is defined not just by spaces, people and their synchronized interaction but also by its historical context* (Hodder 1987:102). This is the real crux of the situation in Finnmark as outlined in Chapter 1.3. Regardless of why the multi-room houses were built they are representative of a community.

Since the discussion has turned to a shared identity based upon interactions of a community, in this case the proposed traders along the Finnmark coast, a plausible way to determine a hint of commonality in identity among these traders is through practice theory. Practice theory focuses on the daily tasks of individuals, or communities. It is through the daily practices of individuals that order and a sense of identity are brought to the lives of people (Lightfoot 1998:201). What specifically does this mean? Well, the everyday tasks of disposing of garbage, organizing a kitchen and cutting up meat are culturally constructed (Ortner 1984). This fact produces a discernable pattern in the archaeological record. The underlying idea being that what we are seeing is social reproduction, meaning *people repeatedly enact and reproduce their underlying structural principles and belief systems in the performance of ordering their daily lives* (Lightfoot 1998:201).

Kent Lightfoot views the importance of daily practices as critical especially in the context of culture contact situations. In these situations new social contexts are placed upon a culture to the point that it is believed that these will "*reorder or reinterpret daily practices*" (Lightfoot 1998:201). Why this happens is because people are trying to make sense of the "other" but they are also looking out for their own interests as well (Sahlins 1977). This entire process of culture contact can and does bring about new cultural values. A plausible result of the process is that it influences what might become a commodity and what does not in this new context. It is through the analysis of daily practices that change as a result of this new pluralist context can best be seen. As Lightfoot aptly states, cultural practices that are often visible in the archaeological record, such as food preparation and the care of household space, may speak volumes of a person's social status (Lightfoot 1998:202). But in this context of culture contact it is also appropriate to state that a change in identity maybe an outcome as well.

Posed at the beginning of this thesis was the question, "Are there economic differences along the coast of Finnmark during the Late Medieval and Early Modern periods"? The preceding section outlines the theoretical approach adopted in this thesis to best furnish some answers to this question. This is an economic question and therefore an economic approach has been taken. The subsequent section will attempt to illustrate the bridging arguments laid out above using the historically and archaeologically known social relations of the periods in question.

2.5. Ethnicity

Within archaeology the definition and usage of the term ethnicity has changed through the years. To avoid a long histography of the term this discussion will begin with the rise of nationalism during the 19th century and its infusion into the archaeological discipline. For many European archaeologists national pride and duty to their nation fuelled their efforts to trace their nation's history and identity (Díaz-Andreu and

Champion 1996, Sklenár 1983, Trigger 1989). A good example of national archaeology was German prehistoric archaeology were R.L.K. Virchow and Gustaf Kossinna represent two prominent figures from the late 19th to early 20th century. The nationalistic undertones of archaeology at this time were supported by the normative concept of culture and the culture historical paradigm. Among the two scholars Kossinna (1911) was the more influential for archaeology during the late 19th century and beyond influencing notable archaeologists like V.G. Childe (e.g. 1925, 1926) (Zvelebil 2001, Brather 2004). The normative concept had an almost exclusive hold on explaining culture change within archaeology until the 1960‘s, even after World War II which witnessed the emergence of both the functionalist ecological and the economic approaches (Zvelebil 2001). The reason for its long duration in the archaeological consciousness was its simplicity of explanation (Zvelebil 2001:27, Brather 2004).

When it came to explain ethnic identity the normative view presented a very simplified understanding of ethnicity. Because ethnic identity was observable in artifacts it was easy to trace a groups distribution. An example of how this was put into practice was Richard Indreko‘s (1948) research of prehistoric Fennoscandia and his use of the Pit-Comb Ware as an indicator of Finno-Ugric speaking people. The cultural-historical methodology allowed for the easy identification of Finno-Ugric settlement areas based on the distribution of Pit-Comb Ware (Zvelebil 2001:26, 38). As Siân Jones points out the normative view assumes that ″transmission of culture knowledge/traits was a function of the level of interaction between individuals or groups″, which is measurable based on the degree of similarity in the archaeological record (Jones 1991:25). Thus, in cases of differences in material culture this was explained as evidence of ethnic variation, or if a specific material culture was being replaced by another this was seen as evidence of migration and population replacement (Zvelebil 2001:27).

Beginning ca. 1960 the processual movement within archaeology called for less focus on descriptive archaeology and greater devotion to social processes and cultural evolution. In contrast to the normative approach, variation within the archaeological record was common, in fact it was expected (e.g., Binford 1962, 1965). At this time the evident complexity of the archaeological record was not reflected by the normative concept. However, an unfortunate outcome of the functionalist and processual analysis of the past was the almost unanimous perception that ethnic studies were too attached to the descriptive tendencies of the culture historical approach, which resulted in the marginalization of ethnic studies in the academic literature (Olsen and Kobyklinski 1991:10, Moberg 1985:12 in Jones 1997). An exception was within historical archaeology where the availability of historical documentation which allows sites to be connected with specific ethnic groups, and where there has been a focus on correlating style of material culture with ethnic groups (Jones 1997:27). McGuire (1981) examines how ethnic boundaries shape and form customary behavior to the extant that they are recoverable within the archaeological record. In short, it is during the processual and post-processual movements within archaeology that eventually ethnic identity soon became viewed in relation to two main areas of research: understanding material culture and ethnic symbolism (and their relationship) and the role of ethnicity in the structuring of economic and political relationships (McGuire 1981, Jones 1997, Zvelebil 2001). However, nothing is perfect because there are still problems with the concept of ethnicity today (e.g. Barth 1969, Moore 1994, Pluciennik 1996, Mac Eachern 2000, and Romanucci-Ross et al. 2006).

The ethnic identity of those living on this emerging pluralistic landscape can be understood and defined by briefly mentioning the significance behind the commodities they produced, used and consumed. The use of the term commodity in this paper is appropriate because it historically dates and connects these sites, and the material culture found within them, to the emerging capitalistic system of the late medieval and early modern periods. The implication is that the objects under study had been objectified and appropriated with value (exchange or use) through the social process of commoditization. A benefit of this bottom-up analysis is that it begins with the material in question followed by the inclusion of the individuals and their actions behind the cutting, slicing and filleting. It will be these telltale signs of the butchery captured and embedded within the osteological remains of the fish that will reveal the identity of the agents whose butchery technique we now study, a technique which was structured by the structures in which these individuals operated under and which this butchery technique served some kind of function. It is from this point of view that the relations between people are best characterized and understood through their interwoven relationship resulting from the production, consumption, use and movement of specific commodities (Wolf 1982: 511). The result is an intertwined relationship that not only changes individuals but the relationship between them as well (Wolf 1982: 511). In terms of ethnicity this change is a self-expression of identity brought about by one's self-reflection when confronted with the "other". And, as McGuire (1981) discusses it is the mantainence of this boundary between different ethnic groups through socialization of ethnic behavior which perpetuates these differences. Like commodities, ethnicities have their own social histories and change in relation to their temporal and spatial context. For archaeologists the empirical by-products of commoditization, and the daily-practices which it represents, are significant because they faciliatate an understanding not only of the social processes of commoditization but other social processes like the emergence of ethnicity.

2.6. Daily Practices

Ways of doing things is a socialization process that forms the practices of everyday life (Bourdieu 1977, 1984, and 1990). Within any action of doing there are discernable patterns. These patterns reflect the shared commonalities and expressions of social experiences, both past and present, that are articulated in the production of regular actions-a firm but pliable core of structured behavior (Bourdieu 1977, 1985, and 2002). These are practices and they are defined by socially contemporaneous and historical conditions and processes which produce the habitus, which in-turn brings about the various practices of everyday life (Bourdieu 2002). These are nonspecific habitual activities that characterize the mundane tasks that are carried out on a day-to-day basis that once learned require little thought or reflection on behalf of the actor into the tasks operational importance and preciseness (Bourdieu 1977, McGuire 1981). These practices range in form and style from the position in which a knife is held in the hand of a butcher and its resulting butchery signature, to the way a house is constructed and, to where the household refuse is disposed (McGuire 1981, Ingold 2002). The individuals who use these practices have been “enskilled” with a way of doing things in a particular manner; in a few cases enskillment leads to a certain standardized way of doing things that homogenizes an entire class of material culture (Ingold 2002). Both of these social processes are based upon structured behaviors that function in a manner that in some cases is reflective of the ingrained practices of identity.

At an unconscious level through the enskilled action of actors the identities of those practitioners are embedded with in material culture. Looking closely at the concept of enskillment and where there might be examples of it outside Finnmark attention immediately turns to the regional level of the greater North Atlantic for comparison where the processing of fish, specifically cod, has deep historical roots that possibly stretch far-back well into proto-Viking culture, at least with in Norway. This practice of processing fish was surely a cultural construction and production inspired by the cultural history of the area. And it is believed that this practice was also not dictated exclusively by an invisible hand, but rather a more arguable and accurate assumption was that this style of processing served some functional purpose, like ease of packing and transporting as well as procuring and preserving as much of the product as possible (Pauketat 2001). Or, as a culinary practice which served at some rational level as a mechanism to distinguish and establish ethnic borders (Otto 1977, 1989; Deetz 1977; Ferguson 1980; Baker 1978, 1980 in McGuire 1981:163). As a way of doing things this practice is also a form of use which involves both tools and the body. It is the incorporation of the fisherman, knife and fish working together and executing a task in a seamless experience (Ingold 2002:352). To understand skill, and this skill in particular, it must be viewed in the totality of all the relations involved which are the individual, the body, the mind and the structured surroundings (Ingold 2002:353). These skills will be eventually "incorporated into the modus operandi" through the physical connection of the body to the environment through one's experiences, training and daily practices (Ingold 2002:5).

The archaeological evidence from the multi-room houses points to this enskillment. If we view skill as the total body and mind involvement of an individual where judgment, care and dexterity are all playing a role then it would be most observable in patterns of butchery (Ingold 2002:353). In this scenario the attentiveness of the novice and even the practitioner is crucial. If skills are learned through improvisation and imitation of the practices of others the novice will be reliant upon his/her own responses to the surrounding environment where situations and stimuli change all the time, which require the individual to "tune" into and adjust his/her own movements to the task at hand. In the archaeological data the butchery patterns we have discussed on the whole represent a standard way of doing things, but individually no two butchery marks are exactly alike. Even within these larger "styles" of butchery there is variation but the general "design" is still there. Therefore, one could argue that by way of "sensory corrections" the individual is always adjusting and readjusting to the moment (Ingold 2002:353), which means that the connection between the man, the knife and the fish are not always going to re-produce the "ideal" design. It is there correct to state that it is the act of cutting fish which produces the design, which goes back to the saying, "actions speak louder than words". Meaning, the process of use, rather the use in and of itself, determines what the outcome is or what a commodity is.

Practices are mutually exclusive to the habitus which produced them. This does not mean they are rendered un-malleable and static. On the contrary they can and do adjust to their surroundings all the time, and exhibit symbols of social reproduction

(Bourdieu 1977). This is a socialization process where the weight of cumulative past experiences structure and mold the newer experiences (Jones 1997). Throughout this process the agent is unaware of his/her structured behavior, the result being objectified intentions outside the control of the individual. This unconscious feature of the habitus partly explains how some practices, although out of step with contemporary and/or envoque ways of doing persist (Jones 1997:89). This also partially explains how commodities of a homogenous class once standardized continue (Bourdieu 1977:533).

A standardized method in the modification of one type of commodity signals culturally specific markings of unchanged and unchallenged practices which define a commodity to a particular culture. It is the material correlates of specific ethnic behavior which reveal themselves in the archaeological record, typically in the form of food remains, pottery and/or architecture (McGuire 1981:163). For example, while across the Norse North Atlantic there has been a consistent presence of two ways to process cod, this consistency is lacking from the Finnmark material. This example illustrates the standardization of the functional aspect of the habitus, which has a dialectical tendency, meaning the habitus is both structure, and is structured by, social practice (Jones 1997). Therefore, the structure that is being mentioned is created by a very specific social situation which facilitates the creation of a specific cultural practice unique to that point in time. In the end, what we see is a functional end to human behavior which has met either the needs and/or the interests defined and negotiated by people within a culturally structured situation (Jones 1997:117). Thus, as stated by Jones, structure provided the framework through which function is defined (Jones 1997:119). The one linking common denominator connecting all of these sites has been the descent from Viking traders, and later Norse farmers, who transported their "way of doing" in culturally marked items across the islands of the North Atlantic, such as, brooches, spindle whorls, baking plates. These Norse sites are identified by a series of commonalities and cultural markers.

The recognition of ethnicity is derived from commonalities of habitus. Jones (1997) makes the argument that there are strong psychological attachments often associated with ethnic identity and ethnic symbolism. Further, she points out that ethnic identity and symbolism are generated by the function of the habitus which inscribes individuals with a sense of identity, or what she calls social self (Jones 1997). In the case of medieval society, and probably all societies, Wenkus discusses "kernels of tradition" as being important factors in partly creating ethnic identities, therefore tradition, or traditional ways of doing things, plays an important role in creating identity, one that also has a political aspect (Curta 2001:19).

2.7. Conclusion

The lack of congruent similarities within the Finnmark material compared to the North Atlantic material goes well beyond the processing of fish. The lack of homogeneity as mentioned before is also seen in the house construction, the use of living-work space, and utilitarian items (see Spicer 1971). The emphasis on the practice of processing fish demonstrates something substantially traceable and represents a practice outside the "norm" of cultural practices thus far documented in the North Atlantic. The types of butchery and processing practices observed are significant and beg the question why things are less standardized, or, are we seeing a different standard, at the Finnmarkian sites? To possibly answer this question the discussion must turn to the importance of ethnicity in this pluralistic backdrop and how it relates to food-ways and style and the maintenance of cultural boundaries, specifically in regard to oppositional processes (Spicer 1971).

Chapter 3. Nature and Environment

The purpose of this chapter is to introduce the nature and environment of the setting of the multi-room house sites. This chapter is organized into three sections: physical setting, animal communities and climate history. The physical setting addresses the Arctic terrestrial environment, specifically the general topography of Finnmark County. The marine environment will be explored, specifically the complexity of oceanic and atmospheric processes of the greater North Atlantic. This will be followed by a closer examination of the Barents Sea, with special attention focused on marine productivity. The section on animal communities addresses some generalities of Arctic – primarily terrestrial-species adaptations to the environment. However, this section will also examine the individual taxa, although some species will be emphasized more than others due to their frequency within the archaeological collection and the amount of information available in the literature. Finally, the climate history of the North Atlantic/northern Fennoscandia will be reviewed with focus on the Medieval Warm Period (MWP) and the Little Ice Age (LIA).

3.1. Physical Setting

This section will discuss both the general and the specific physical setting of the project. The description of the terrestrial setting will focus on Finnmark and its geography, including descriptive accounts of the general climate, a brief discussion of the proximity of warm Atlantic Water and its effect on local climate, and then a brief mention of local vegetation. The second section will focus heavily on the marine environment by discussing the distinctive processes of the Atlantic Ocean, then move specifically the eastern North Atlantic Ocean and the Barents Sea. The emphasis on the marine component has to do with the proximity of the archaeological sites to the sea and the ocean's immediate impact on coastal life.

3.1.1. Northern Fennoscandia: Finnmark

The coastline of Finnmark is characterized by its deep fjord-system that cuts well into the interior of the county. Mountain peaks range from 1000 to 1500 meters (Sollid et al. 1973, Vorren et al. 1984, Townsend 1987). The major fjords of this system are Altafjord, Tanafjord, Porsangerfjord, Laksefjord and Varangerfjord (Figure 6). Associated with a few of these fjords are some of the major rivers of Finnmark: the Tana River, the Alta River and the Pasvik River (Figure 6) (Ebert 2002). As one moves from the western region of the county to the eastern half there is a sharp decrease in the overall relief, from 650 m.a.s.l. in the west to slightly less than 200 m.a.s.l in the east (Vorren et al. 1984, Sigmund 1992, for a discussion on the relief of the east see Sørbel 2003). The interior of the county, Finnmarksvidda, is a relatively flat plateau that is 400 to 600 m.a.s.l (Vorren et al. 1984, Sigmund 1992,).

Much like the physical geography, the contemporary climate of Finnmark is a mixture of contrasts and it is largerly determined by the warm Atlantic water. The Gulf Stream is an influential force in the region's climate. The Gulf Stream exits from the Gulf of Mexico, bringing the warmer waters of the Gulf-coast up along the coastline of Norway and eventually along coastal Finnmark (Loeng 1991). North of Finnmark the warmer and more saline waters of the North Atlantic converge with the cooler and less saline waters of the Arctic Ocean (Loeng 1991). In terms of climate, this has resulted in a mild Maritime climate along the coast and a more Continental climate in the interior (Ådlandsvik and Loeng 1991). Coastal areas typically have moderately warm summers and mild winters, with recorded temperatures in the range of ca. -5° to 12° C, while inland areas have warm summers and cold winters with recorded temperatures in the range of ca. -25° to 20° C (Johansen 1947, Kanestrøm et al. 2003).

With the warmer waters come the prevailing westerly winds. These winds are warmer and carry more moisture than the colder and dryer Arctic air from the north. As these two air masses meet they create several phenomena that affect coastal Finnmark. One factor is the high precipitation rate for the coast, which receives more annual rainfall than the inland and the higher altitude upland regions. Another phenomenon brought about by this meeting of warm and cold air masses is the frequent occurrence of violent storms (Loeng 1991).

Finnmark's local variation in flora is represented by three ecosystems: sub-arctic, alpine and arctic (e.g. Ahti et al. 1968, Dahl et al. 1986, Oksanen and Virtanen 1995, Fremstad 1997, Påhlsson 1998, CAVM Team 2003). The greatest influence on floral distribution comes from the warm coastal waters (Dahl 1975, Moen 1987, 1999, Chapin and Körner (Eds.) 1994), which facilitates the existence of a belt of birch forest (*Regio subalpina*) which separates the conifer forest zone (*Regio silvation*) from the alpine and/or arctic zone (Hämet-Ahti 1963). This contrasts with other northern regions where the conifer forest determines the transition from the taiga to the tundra (Oksanen et al. 1995). In comparison to other areas in northern latitudes, (excluding Iceland and Greenland), the presence of conifer communities in Finnmark is mostly a local phenomena found in isolated patches, as in Porsanger fjords pine Stabbursdalen community (*Pinus silvestris*) (Dahl et al. 1986). As one moves along the coast in an easterly direction the altitude and distance from the shoreline of the birch belt decreases, this is a consequence the regional topography across Finnmark (Hämet-Ahti 1963).

Within the forested and un-forested areas there are other floral communities. Parts of the sub-alpine birch forest include other deciduous tree species, like alder (*Alnus incana*), aspen (*Populus tremula*), rowan (*Sorbus aucuparia*), bird-cherry (*Prunus padus*) and willow species (*Salix* sps.) (e.g. Svoboda 1982, Pedersen 1990, Myklestad 1993, Giesler et al. 1998, Karlsen et al. 2005). Also, characteristic of this sub-alpine zone of the northern part of Norway are the mires (Haapasaari 1988). There are three classes which can be found throughout Finnmark: raised bogs, fens and pals mire (Haapasaari 1988). Also present are various species of lichen, mosses and assorted berry-producing plants (Santesson et al. 2004).

3.1.2. The Atlantic Ocean: North Atlantic Currents and Waters

The Atlantic Ocean is the world’s second-largest ocean after the Pacific Ocean. The Mid-Atlantic Ridge runs north and south and divides the ocean into eastern and western basins. These basins have a strong impact on the circulation in deep layers of the ocean.

The Equator splits the Atlantic Ocean into North and South oceans (Figure 7). These two oceans are also divided by two major upper water circulation systems. These two great anticyclone circulations are separated by the easterly-flowing counter-current at the Equator (Leetmaa et al. 1981, Pikard and Emery 1990). In the South Atlantic there is a counter clockwise circulation, while in the North Atlantic there is a clockwise circulation, which includes the Canaries, Gulf Stream and North Equatorial Currents

(Figure8). The driving forces behind the circulation for both are the hemispherical trade winds.

The North Atlantic is comprised of subtropical and sub polar gyres (Figure 8). The subtropical Gulf Stream originates in the warm surface waters of the Equatorial Pacific Ocean and drifts its way into the Western Caribbean Sea (e.g. Olbers et al. 1985, Krauss 1986, Schmitz and McCartney 1993, Brugge 1995, Rossby 1996, Meinen 2001 and Reverdin et al. 2003). It then exits from the Gulf of Mexico through the Straits of Florida as the Florida Current (Lund et al. 2006), running along the east coast of the United States. As the Gulf Stream goes up the east coast of North America it separates from the continent around Cape Hatteras and flows to the Grand Banks (Newfoundland Rise), where significant changes to the current take place. As the water moves north the transport decreases as water leaves the current and re-circulates south to the Sargasso Sea. Once east of the Grand Banks the Gulf Stream separates into two branches. The largest of these branches goes north to become the North Atlantic Current while the other branch heads east as the Azores Current (Figure 8). Near the Tail of the Grand Banks the southerly moving Labrador Current meets with the Gulf Stream. As these two gyres meet, a major portion of the Labrador Current joins the Gulf Stream and is thus incorporated into the North Atlantic Current.

The North Atlantic Current flows between Scotland and Iceland and enters the Norwegian Sea (Leetmaa et al. 1981, Rossby 1996). Before it approaches and crosses the Mid-Atlantic Ridge it spreads warm waters in the sub-Polar Front, ca. 4-8 degrees C isotherms (Rossby 1996). As this current flows north it is separated by the Faroe Islands into two main flowing branches. The larger of the branches is composed of the warmer water mass known as the Atlantic Water which crosses over the Greenland-Scotland Ridge into the Norwegian Sea (Rudels. et al. 1999, Skardhamar et al 2005). While in the Norwegian Sea the Atlantic Water is cooled due to convection. As a result the Atlantic Water becomes denser as it flows north, prompting it to sink, and at the same time it becomes less saline (Rudels et al. 1999, Skardhamar et al. 2005). While in the Norwegian Sea a portion of it turns into the Norwegian Atlantic (Coastal) Current which moves north along the Norwegian coast and branches into the North Sea and Nordic Sea. This portion is composed of Norwegian Coastal Water which is relatively cold and of low salinity. As this water mass moves along the coast other sources of water are added to it; for example, runoff from continental Europe going into the North Sea, from the Baltic into Kattegat, and from rivers and fjords along coastal Norway (Skardhamar et al. 2005). At this point it should be pointed out that the main water masses of the North Norwegian coast are the Norwegian Coastal Water (NCW) and the Atlantic Water (AW). At about 62º N up the Norwegian coast, just along the continental shelf, the NCW merges with the AW. At the western boundary of the Barents Sea the Norwegian Atlantic (Coastal) Current bifurcates into the North Cape Current flowing eastwards into the Barents Sea (it is at this point that the Atlantic Water also enters the Barents Sea), and West Spitsbergen Current which flows northwards through the Fram Strait (e.g. Hopkins 1991, Simonsen and Haugan 1996 and Furevik 2001). As the North Cape Current moves along the coast it becomes homogenized by convection and is cooled to freezing temperature by the time it reaches the eastern part of the Barents Sea. This heat loss leads to ice formation and brine rejection, and cold, dense bottom water is formed over the shallow banks. Also cooling the Barents Sea is the returning Atlantic Water from the Hopen Deep, which has become cooler and less saline (due to a variety of factors). The Barents Sea therefore experiences a large amount of heat loss because of its shallowness.

3.1.3. Major North Atlantic Atmospheric Systems.

The North Atlantic Oscillation (NAO here after) is a major atmospheric mass that lies within the North Atlantic. It is situated between Iceland, where there is a sub-polar low-pressure region, and the Azores, where there is a high-pressure region in the subtropics. The difference in pressure drives the surface winds and wintertime storms from west to east across the North Atlantic and is marked by seasonal and inter-decadal global climate variability (Lamb and Peppler 1987, Hurrell 1995 and Wanner et al. 1999:367). The production of inter-annual and inter-decadal climate variability by the NAO in the North Atlantic region has major impacts in Europe, explaining about one-third of the interannual surface temperature variance during winter (Hurrell 1995, Hurrell and Dickenson 2004:20-21). However, it is not a regularized and all-encompassing atmospheric circulation system there are local variations which fall outside the normative pattern (Wanner et al. 1999, Uppenbrink 1999 and Hilmer and Jung 2000).

What are the physical influences of the NAO on the North Atlantic? The NAO is described in the climate literature as being either positive or negative, referring to the seesaw effect of contrasting air pressure between the standardized difference (in air pressure) of the Iceland Low and the Azores High. The measurement of this difference, known as the NAO index, measures the strength of the westerly flow, i.e. a positive NAO has strong westerlies while a negative NAO has weak westerlies (Figures 9 and 10). The physical impacts of the NAO can be observed in its influence on sea-level variation (Woolf et al. 2003) and winter temperatures (both surface air temperature and sea-surface temperature) across the Northern Hemisphere, and in the amount of precipitation and storminess (Hurrell and Dickenson 2004). These major impacts on oceanic and some continental ecosystems ultimately influence North Atlantic fish stocks as well (Marshall et al. 2001, Rogers 1997).

A positive NAO brings westerly winds across the North Atlantic during the winter, bringing warm and moist maritime air over Europe and Asia, at the same time as cold air is brought across the western North Atlantic from Greenland and northeast Canada, which decreases surface air temperature and sea-surface temperatures in the latter regions (Figure 9).

During a positive NAO index phase there is a northeastward shift in water storm activity in the Atlantic. More storm activity is generated from southern Greenland across Iceland and into northern Europe, with a decrease in activity in the south, i.e. from the east coast of North America to the Iberian Peninsula and the Mediterranean. In the higher latitude areas storm activity is very intense and frequent near Iceland and Norwegian Sea. As a result, Iceland and Scandinavia experience a rise in precipitation levels while elsewhere precipitation rates are lower in arctic Canada, central/southern Europe, the Mediterranean and the more westerly parts of the Middle East.

A negative NAO index is described by a weak subtropical high and a weak Icelandic low (Figure 10). The result of the reduced pressure is fewer and weaker storms during the winter. These storms are moving in a more easterly direction. These storms bring cold air into northern Europe and the east coast of the North America. However, in the more northernly latitudes in northwest Atlantic the winters are milder like in Greenland.

The Arctic Oscillation is a conceptual view of how to examine atmospheric circulation in the North Atlantic (e.g. Deser 2000, Wallace 2000 and Ambaum et al. 2001). In comparison to the NAO, which examines ocean-atmospheric-sea-ice interaction to explain hemispherical scale zonal circulation, the Arctic Oscillation examines the upper troposphere and stratosphere, thereby focusing on planetary scale processes (Wanner et al. 2006). Some researchers consider the AO view as a better explanation for Northern Hemispherical temperature variability than the NAO (Wanner et al. 2006:339), but the AO could be considered to be a higher level interpretive model, while the NAO is more descriptive of spatial differences (e.g. Deser 2000, Wallace 2000 and Ambaum et al. 2001).

3.1.4. Up-close: The Barents Sea

The Barents Sea is the largest of the pan-Arctic shelf seas, that surround the Arctic Ocean, comprising about 30 % of the shelf (Figure 11). Research into the Barents Sea goes back to the first half of the last century, with Russian researchers examining plankton and benthic communities. By the latter half of the 20th century Norwegian researchers also became interested in the Barents Sea (see Wassmann 2005 for an extensive list of references and more detailed research history). Today, given the recent debates about global warming the Barents Sea has become a major arena of climate research (e.g. Zenkevich 1963, Bogorov et al. 1968, Sakshaug 1997, Vetro and Romankevich 2004). Within ecology the Barents Sea is known as a ″flow-through″ ecosystem because the water masses entering the shallow sea are not cooled enough to sink and re-circulate; instead, all water masses entering the Barents Sea flow through it (Wassmann et al. 2006). Generally, there are mild temperatures in the Barents Sea in comparison to other seas, (central Barents Sea January Temperature mean/min = -5.0/-

24.0, April Temperature mean/min = -3/-22; Rudels et al. 1999), however, the Barents Sea can have the most severe wave action and currents of the seas in the eastern Central Arctic Ocean. In this section discussion will focus on the physical properties of the Barents Sea, specifically the bathymetry, waters and currents, and ice conditions.

The physical geography of the Barents Sea will briefly cover its bathymetry and shelf sediments; for a more detailed discussion see Tantsiura (1959) and Loeng (1991, 1992). The Barents Sea is noted for its complex bathymetric features and extensive shallow areas, with a maximum depth of 230 meters. Some key features are the isolated banks (the Central Bank, the Great Bank and the Svalbard Bank), the deep troughs (the Bear Island Channel, the Victoria Channel) and depressions (Hopen Deep). The sediments of the sea bottom are variable, ranging from fine mud (clay and silt) to rocks and stones (Elvehøi et al. 1989). The composition of sediments is determined by depth and slope. For example, the fine mud sediments are found in deep waters where water movement is slow, while in contrast rocky bottoms are found in areas of high water movement and in shallower waters. The topography of the Barents Sea floor and the composition of its sediments is especially relevant to the distribution of fish stocks which will be discussed later.

The main water mass flowing into the Barents Sea is the Atlantic Water which flows between Norway and Bjørnøya (Bear Island), but it is just part of a complex system (Figure 8)(Schauer et al. 2002). Another water mass, the Arctic Water, flows in from the north partly originating in the Arctic Ocean; this is a less dense and less saline body of water. The boundary between the Atlantic and Arctic waters is known as the Polar Front. The Arctic Water mass is carried by the Persey Current westward along the Polar

Front where it is picked-up by the Bear Island Current and the West Spitsbergen Current near the Svalbard Bank, eventually to be re-deposited in the Arctic Ocean. The Atlantic Water originates from the North Atlantic Current. It is carried into the Barents Sea by the North Cape Current via the Bear Channel, where it splits into three branches.   Two of the branches flow eastward as separate currents until they are joined together again to form the Murman Current. The other branch flows north into the Hopen Deep where it divides repeatedly into branches that flow in various directions, one of these flows back into the Norwegian Sea as colder and denser Atlantic Water (Wassmann et al. 2006: 235).

The northern Barents Sea has a seasonal ice zone, which is part of the Arctic Ocean (Figure 11). In some years the ice melts or withdraws totally from these waters during the summer, however, ice can remain in the NW and NE Barents the whole year. During the winter about 90 % of the Barents Sea can be covered with sea-ice, but locally produced multi-year ice is absent (Vinje and Kvambek 1991). The most common type of ice in the Barents is first-year ice, which can be up to 1.8 meters thick while multi-year ice is 3-5 meters thick. Pack ice and landfast ice also forms in the SE Barents Sea; here, the ice limit is to the west of the mouth of the White Sea. Icebergs regularly invade the Barents, either drifting in from the Franz Josef Land archipelago or descending from glaciers on Svalbard‘s east coast (Løset 1993).   The interannual variation of sea ice extension and ice edge location is highly unpredictable and can vary up to hundreds of kilometers. Typically the maximum southern extension is in March and a minimum extension is in September (e.g. Gorshkov and Faleev 1980, Maykut, 1985, Vinje and Kvambek 1991, Gloersen et al., 1992, Johannessen et al., 2002). The area between ice-free and ice-covered, known as a marginal ice-zone, is extremely important to the production of organic matter (Sakshaug and Skjoldal 1989).

3.1.5. Up-close: the Barents Sea Marine Productivity

Food-webs are complex and the food-web of the Barents Sea is no exception; in fact, this sea is the most productive within the pan-Arctic shelf and it boasts one of the largest fisheries in the world (Sakshaug 2004). As a shelf area, the topography of steep slopes and banks traps currents which creates fronts of high productivity, e.g. high zooplankton and fish production (Skardhamar and Svendsen 2005, Brander and Hurley 2005). The inflowing Atlantic Water controls the nutrient concentrations in south and central Barents Sea (Wassmann et al. 2006).

There are several reasons for the high productivity of the Barents Sea. One reason is the winter convection and the lack of sea ice-cover in the south and central areas that allows for a well-mixed water column. This turbulent mixing of nutrient-rich Atlantic Water takes place in the upper stratified Arctic Water layer along the Polar Front, which is often associated with the highly species diverse ice-edge (Slagsstad and Stokke 1984, Wassamann et al. 2006). By early spring (March) across the Barents Sea there is an even vertical distribution of nutrients (Reigstad *et al.* 2002). This leads into the most bountiful period from May, known as the ″spring/phytoplankton bloom″, to early September when a new production of phytoplankton biomass occurs. However, this period of primary production can be highly variable and there are differences in start date, intensity and duration from south to north, where the marginal ice-zone is located (Wassmann et al. 2006). This blooming period begins at the marginal ice-zone in April, when it is initiated by increased solar radiation, stratification due to ice-melt, and accumulated nutrients (Wassmann et al. 2006:246). Finally, the contribution of ice algae from the north, specifically diatoms, provides a large and seasonal food source (Stabeno and Overloud 2001). The following will outline the complex ecosystem of the Barents Sea because of its importance to the societies inhabiting the archaeological sites used in this research. The diversity and richness of coastal areas with marine mammals and marine birds has been an important source of nutrition.

Beginning with the lower trophic levels, the zooplankton of the Barents Sea and the surrounding north Norwegian coastal shelf exhibits a high production of biomass which attracts the large numbers of diverse species into the area. The shelf off Troms is a key area for the advection of Atlantic zooplankton (*Calanus finmarchicus*) into the Barents Sea (see Skardhamar et al. 2005 for references). The reason for high productivity and biomass of zooplankton is a complex topic with multi-faceted explanations (e.g. Falk-Petersen 1981, Halvorsen and Tande 1999, Melle and Skjoldal 1998, Edvardsen et al. 2003). Briefly, the annual phytoplankton spring bloom provides food for herbivorous zooplankton, which are transported into the Barents Sea via the Atlantic and Norwegian Coastal waters. The Arctic Water with its sea-ice and ice fauna/flora provides an additional source of food production. The size of these zooplankton aggregations is variable due to seasonal and interannual variations related to external forces (Edvardsen et al. 2003). Species diversity is higher in the Barents Sea than any other Arctic sea, although species diversity decreases towards the east because of influence from the Arctic Ocean (Sirenko 2001).

The benthic community constitutes a large portion of the species diversity of the Barents Sea and thus is a key component of its complex ecosystem (Zenkevich 1963).

There are 3245 faunal taxa recorded in the Barents Sea (Sirenko 2001). Together, the benthic macrofauna (60 %) and meiofauna (34 %) make up 94 % of this diversity. Of this, the dominant species comprising this biomass are bivalve molluscs (35 %), echinoderms (19 %), polychaets (17 %) and crustaceans (15 %). Spatial variation in biomass values is related to the bathymetric complexity and sediment distribution of the Barents Sea (see, Vorren et al. 1980). The highest biomass values are found in shallow areas around Spitsbergen and the Central Banks, the Pechora Sea and the Northeast Plateau to the west of Novaja Zemlija (Wassmann et al. 2006). The reasons for this are high primary production at the western banks, strong water currents (re-circulated food material), and a hard substrata. The lowest levels of benthic biomass are found in deep trenches. Of course other things need to be considered in regard to distribution, such as feeding strategies and life histories (Zauke et al. 2003).

The upper trophic levels of the Barents Sea are comprised of fish (planktivorous and piscavorous fish), mammals (including humans) and seabirds. Beginning with fish production there are three species (and their stocks) that are most important to the Barents Sea food web (Wassmann 1999:265). Total fish production within both the Norwegian and Barents Seas is linked to the following fish stocks: the Northeast Atlantic cod (*Gadus morhua L.*), Barents capelin (*Mallotus villosus*) and Norwegian spring-spawning herring (*Clupea harengus*) (Wassmann et al. 2006:265). Capelin-a planktivorous fish- (e.g. Gjøsæter and Ushakov 2003, Gjøsæter 2006) is an ecological ″keystone species″ of the Barents Sea (Hamre 1994) because it is a bridging species between lower and higher pelagic trophic levels (Wassmann et al. 2006:265; for discussion of the ″capelin front″, see Hassel et al. 1991, Folkow et al. 2000, and Nilssen et al. 2000). The overall top predator in this ecosystem is the cod and for that reason its diet is a good indicator of the state of the Barents ecosystem (Godø 1989). The biomass of other piscivorous fish is low in comparison to cod (Wassmann et al. 2006:267, Bogsted et al. 2000).

The Barents Sea is inhabited by an assortment of permanent and seasonally resident sea mammals and seabirds which mainly subsist on marine flora and fauna. The impact these taxa have on the ecosystem is positive because of the large return of nutrients to the marine as well as the coastal terrestrial ecosystem as excrement. For example, in Svalbard the interior tundra is home for marine birds and their presence has had a positive effect on the local environment with the eutrophication of the interior tundra ecosystem (Sendstad 1977, Gabrielsen and Strøm 2004, Croll et al. 2005; see Barrett et al. 2001 for estimated consumption of prey by seabirds). Peak abundance of seabirds and sea mammals is in spring-summer.

3.2. Animal Communities

The animal communities of the high latitudes can be characterized as living in extreme conditions. In general, the stresses of the polar region on land include temperatures far below 0°C, strong winds and storms; up to 6 months of no direct sunlight, permafrost (making underground burrows and other such shelter impossible) and minimal primary productivity. Polar marine environments, in contrast, are much less extreme. Except for seasonal ice shelves, they have year-round temperatures above seawater's freezing point. These conditions have led to unique evolutionary adaptations which have made living possible in the high latitudes. An adaptation to live in the high latitudes involves the physiological ability to store somatic energy during periods of food availability and reduce energy expenditure during periods when food is unavailable (Chen et al., 1997, Shushkin and Ustyuzhaninova 1997 and Wöhrmann 1995). Thus, natural selection favors organisms which can endure long periods of food shortage, i.e. those individuals with the right physiological or other attributes (behavior) to sustain themselves (Waterman 1999).

Climate influences a number of ecological processes which consequently have an impact on population abundance and diversity as well as temporal and spatial patterning. Under the conditions of energy limitation the biodiversty of these environments is relatively low (Waterman 1999). It is these energy-poor environments that do not support complex food webs (Cloudsley-Thompson 1996). The main feature of Arctic biological diversity is the progressive decrease of diversity within the Arctic, which illustrates the sharp thermal gradients within this region. At the higher latitudes there is a decrease in heat input and this is where diversity is lowest. However, there is an inverse relationship between diversity and density; where there is a low number of species there are high densities of individual species, e.g. lemmings. Given that diversity of fauna is low and landscape diversity is low, a large proportion of these species are found within a given community (Chernov 1995). The following will present in capsulated form the unique qualities of Arctic vertebrate communities that have made it possible for them to survive.

One of the general characteristics of Arctic animals, at least the terrestrial species, is the presence of population fluctuations or cycles, which were first established by Elton (1924) and discussed in their complexity by Krebs and Meyers (1974). There are several ways to characterize population cycles: either mathematically via the amplitude of population changes or via specific demographic and physiological changes (Krebs 1996:9-10). Population cycles become more pronounced the further north one goes. Typically much research has focused on the four-year cycle, e.g. the lemming and vole cycles, in which there is a simultaneous occurrence of density maxima and minima in all species in a particular locality, both predators and prey (Remmert 1980). However, there are other cycles including the 9 year cycle and the 70 year cycle of reindeer in North America and Svalbard (Remmert 1980) and Greenland (Vibe 1967, Meldgard 1983). Krebs (1996) sees the causality of population cycles as a joint product of processes involving spacing behavior, predation and food. Spacing behavior produces the dispersal necessary for population regulation, while predation affects the rate of decline and the duration of the low phase. Without predation, food-limitation and the minor role of disease and parasitism affect the fluctuations of populations (see Krebs 1996 for references).

Seasonal migration is a common property of animal populations in the arctic, with the majority of birds and some mammals leaving the region before the onset of winter to avoid starvation. This is an adaptive response to the stressful situation of the winters, i.e. the lack of photosynthesis and catabolism (Remmert 1980, Boonstra 2004). With winter comes near or complete darkness for months on end and a snow-covered landscape lasting well into the spring months. The result of such conditions is a low availability of food and low temperatures, both of which increase an individual's risk of predation (Boonstra 2004). In addition, the migratory departure of animals, especially the large herbivores, has a positive impact on the landscape in allowing it to regenerate and thus to re-acquire enough sustainability to carry the population upon its return (Remmert 1980).

In the Arctic there are about 120 species of bird, many of them migratory. A large portion of these migratory birds are shorebirds (Charadriiformes) (O'Reilly and Wingfield 1995). These birds migrate either to tropical regions or to Subarctic and northern temperate regions (Boyd and Madsen 1997, Murray 1998). Out of the 100 plus bird species that reside in the Arctic during the warmer sunny months, only a handful of these species stay year round in the region (Pielou 1994). However, in the event of scarce food even these species will leave the Arctic entirely. Terrestrial mammal migration only involves the large individuals such as caribou/reindeer and wolves, which move to the northern boreal forest (Klein 1999). The smaller terrestrial mammals stay in the region and have other adaptive strategies for dealing with the winter (i.e. Whittaker and Thomas 1983, Southwood 1988, Scott 1993, Boonstra et al. 2001). Whales and other marine mammals also make long-range annual movements. The end result is that for a large portion of the year the northern regions experience large population swings.

3.2.1. Mammals

The contemporary terrestrial fauna of Finnmark is less diverse now than in past historical and pre-historical times. The landscape was once home to the wolf (*Canis lupus*) (Wabbakken *et al.* 1983) and the lynx (*Felis lynx*). Also absent is the European beaver (*Castor fiber*). The present landscape is the habitat of the fox (*Vulpes vulpes*), arctic fox (*Alopex lagopus*), ermine (stoat) (*Mustela erminea*), and the weasel (*Mustela fremata*). In certain areas one can also find the brown bear (*Ursus arctos*) and the otter (*Lutra lutra*). Other species present are the arctic hare (*Lepus articus*), tundra (Root) vole

(*Microtus pennsylvanicus*), Norwegian lemming (*Lemmus lemmus*), caribou (reindeer) (*Rangifer tarandus*), and the wolverine (*Gulo gulo*).

Family Muridae

Throughout the Arctic there are 3 species of lemming and 4 species of voles. Here discussion will center on those species recovered from the excavations, i.e., the Norwegian lemming and the water vole (*Arvicola amphibius*).

The Norwegian lemming is the only endemic vertebrae species in Fennoscandia (see references in Oksanen and Oksanen 1981, Oksanen and Oksanen 1992, and Stenseth and Ims 1993) and is a congener to the Brown lemming (*Lemmus sibiricus*) found in the North American Arctic. Its habitat ranges from the mountains in southern Norway to north Norway and the northern territories of Sweden and Finland and also the Kola Peninsula (Stenseth and Ims 1993). Seasonally, lemmings change their habitats by migrating either in the spring and/or autumn depending upon population density and food availability. The distance covered during the migration depends upon population density, which differs yearly. Their habitat ranges from alpine areas at or slightly above the treeline that consist of both open bog areas and thickets of willow dwarf shrubs, to sub-alpine areas which can be comprised of peat lands and birch forest, bog areas or low lying areas of willow thicket and small meadows and dwarf shrubs. Lemmings can breed all year round but primarily they breed in the middle to late winter, although they have been known to breed in the summer, from late June as well as in autumn if conditions are right (food and habitat). Their main sources of food are vascular plants, i.e. dictoyledons and monocotyledons. When these run out they switch to mosses (*Dicranum, Polytrichum* and *Drepanocladus*) (Kalela and Koponen 1971). Numerous lemming remains were recovered in the excavations but these are most likely intrusive individuals, so it would be difficult to draw an interpretation based on their presence alone.

The water vole, also known as the water rat, is found throughout Britain, central and northern Europe and parts of Russia (for references see Stoddart 1970, Oksanen and Oksanen 1992 and Oksanen et al. 1999, Strann et al. 2002). It is one of three species of voles in Fennoscandia, i.e. the grey-sided vole (*Clethrionomys rufocanus*), meadow vole (*Microtus pennsylvanicus*) and the root/tundra vole (*Microtus oeconomus*). This is a semi-aquatic mammal that lives near bodies of fresh water, i.e., rivers, streams, ponds, lakes. During the more favorable months they make their homes in burrows dug into the banks of slow moving rivers or other calm bodies of water, or if a reed bed is available they construct nests. The mating season is from March to late autumn. These are solitary and territorial animals. They primarily eat grass and plants located near bodies of water. The vole is not common in Finnmark's archaeofauna although from a ecological and biological perspective its presence is of some importance.

Suborder Caniformia

The Caniformia is a suborder to the order Carnivora and includes dog-like carnivores. Several Caniformia were recovered from the multi-room monuments.

The otter is part of the large Family Mustelidae (see Kruuk 2006 for detailed references). Throughout much of Europe in the past century, otter populations have declined (Kauhala 1996). Otters inhabit a wide variety of aquatic environments, both coastal and fresh water (Mason and Macdonald 1986, Kruuk 1995). Those otters that inhabit coastal waters often live in dense populations and have small home-ranges which are different than those inhabiting inland bodies of water, i.e. rivers and streams. Fish is a major part of the otter diet (Erlinge 1969, Chanin 1985), although it is less so for inland animals (Jedrzejewska et al. 2001). The presence of otter at the multi-room sites is significant based on the possibility that their presence is connected to fur trappers/mongers and thus, possibly the fur trade.

Canidae in the Arctic are represented by the red fox, arctic fox, the European wolf and the domestic dog. The former two will be the main point of discussion here because of their presence within the archaeology and possible connection to the fur trade. Both arctic fox and red fox have opportunistic food habits, consuming a variety of foods (Hersteinsson and Macdonald 1982). The arctic fox diet is more restricted because it has fewer prey species in its range (Elmhagen et al. 2000). Both species are sympatric through a large part of the northern tundra region and alpine region of Fennoscandia, thus likely to compete for food (Frafjord 1995). The distribution of red fox is limited by the productivity of the environment, while red foxes may limit the distribution of arctic fox (Frafjord 1995). When available, rodents make up a large portion of both species' diet, (see Frafjord 1986 for references) but diet can and does vary as observed in a study by Frafjord who found quantifiable differences and varied prey choices. For example, arctic fox were more likely to select lemmings over voles. Another example is the summer diet of arctic foxes, which can comprise 60 to 100 % lemmings with birds (ptarmigan), eggs and reindeer making up the rest (Frafjord 1986). Although they are not considered very specialized consumers there is a strong predator-prey relationship between the arctic fox and the Norwegian lemming (Angerbjörn et al. 1999). Arctic fox is a solitary animal outside its breeding season and is a territorial animal (Frafjord 1993). However, they travel long distances in the search for food (Prestrud 1992).

Red foxes (*Vulpes vulpes*) are found in a wide variety of environments from semi-arid deserts to tundras, although they are less frequent in the latter. These are reclusive animals that inhabit sparsely populated open ranges (Henry 1986). Diet is variable, including small mammals like lemmings/voles, lagomorphs and sciurids (Lund 1962). Birds are also a common prey; especially Galliformes, followed by less important birds: Passeriformes, Columbiformes and Anseriformes (Larivière and Pasitschniak-Arts 1996). In warmer months they are known for eating nesting birds and eggs. These are highly mobile animals, but their home ranges are exclusive with non-overlapping territorial borders that are defended. Their activities are mainly nocturnal (Henry 1986). Winter terroritories are larger, while in the warmer months their ranges decrease during periods of rearing (Kolb 1986). The basic social unit is a monogamous pair with their dens in sandy soils, pastures and/or agricultural land (Lindström 1980, Larivière and Pasitschniak-Arts 1996).

Family Cervidae

Reindeer are the largest northern ungulate found in Eurasia and through out the circumpolar region including North America, Greenland and parts of China and Mongolia. There has been much research devoted to reindeer (e.g. Skjenneberg and Slagsvold 1979, Zhigunov 1968, Parker 1972, Miller 1974, 1976) and this section will only cover reindeer at a general level, with specific focus on northern Fennoscandia. However, it is worth mentioning that there are several subspecies of reindeer (and caribou), e.g. Svalbard reindeer (*Rangifer tarandus platyrhynchus*) which are short-legged and the long-legged reindeer of Mongolia (*Rangifer tarandus valentinae* (Skjenneberg and Slagsvold 1979, Bergerud 2000). Throughout Norway there are numerous populations of both wild and semi-domesticated herds. The area with the largest herds of semi-domesticated reindeer in north Norway, and the entire country for that matter, is Finnmark with close to 100, 000 reindeer using the entire county of approximately 47, 000 km^2 for herding. However, herds, both large and small, occur in other counties throughout north Norway and in some of the alpine regions of south Norway, where wild (ca. 40 000) and semi-domesticated reindeer populations are found, e.g. in Hardangervidda, North Ottadalen and Rondane (Reimers et al. 1983). It is worth mentioning that the contemporary term “wild reindeer” is a misnomer because in reality what is really being described are wild herds that have mixed with domestic individuals over the years, so there are no true “wild” herds left (Skjenneberg and Slagsvold 1979). The last reported accounts of wild reindeer in the North date to the turn of the last century when historical documents cite their presence in Tana, Alta and Kvanangen, Finnmark (Collet 1911-1912 in Skjenneberg and Slagsvold 1979). In north Norway reindeer are herded by the Saami, although these are not exclusive legal rights there are also a few Norwegian families in the south of Norway who own small domesticated herds who also have legal rights to herd reindeer (Ingrid Sommerseth personal communication). Of concern here is the life history of the reindeer with special consideration of the annual cycle of migration; their foraging behavior with reference to strategies of management and general husbandry with some general comments on predation and the lack thereof.

The following life history generalities are based upon combining data from wild and semi-domestic reindeer demographics. Reindeer are one of the most polygynous of the large herbivores (e.g. Trivers and Willard 1973, Skogland 1989). The species is highly sexually dimorphic with differing body and antler size (e.g. Reimers 1972, 1983, Geist 1999). The mating season is in a few weeks in autumn (Røed et al. 2002). It is at this time that temporary mating groups form known as rutting groups. A recent study by Røed et al. 2005 demonstrated that mating success of males is a much more complicated process than previously assumed and is not correlated entirely with just being the most alpha-male (e.g. Hirotani 1994) as previously believed (Røed et al. 2005). What was observed is that during the mating season reindeer although not typically territorial become extremely territorial. This however did not guarantee exclusive rights to females by alpha-males given that in fact two-thirds of the males within a herd had offspring the following spring (Røed et al. 2005, Tveraa et al. 2007). Finally, reindeer herds roam the landscape with no real leaders directing their travels. Rather it appears that leadership within the herd is informal and temporary. For example in smaller herds, where social behavior is more easily observable certain individuals will rise to occasions by taking a leadership role but this is situational and variable (Tveraa et al. 2007).

Seasonal migration to summer and winter pastures is a major aspect of the annual cycle of reindeer. The original migration routes of wild reindeer in north Norway are not known because of their subsequent domestication and a lack of documentary or oral evidence, so one can only speculate how much of it changed today. In Finnmark the herds are moved from coastal summer pastures to inland winter pastures in the autumn to ensure their survival (Riseth 2005, Storeheier et al. 2003). During the summer/spring months the coast offers lush vegetation where reindeer can maximize their caloric and nutritional intake. Reindeer are foragers who prefer willow and birch shoots, growing forbs, grass and sedge shoots and fungi (lichen) (e.g. Spiess 1979, Mathiesen et al. 2000, Storeheier et al. 2002). Lichen becomes more important as a primary food to reindeer in the winter when food sources are scarce even though it is nutritionally poor so reindeer are left to economise their stored reserves from the previous summer (Staaland and Hove 2000). Lichen is foraged in the inland pastures during the winter because of a low and stable ambient temperature and the lack of freezing snow cover, which occurs more frequently along the coast making access to lichen very difficult for the reindeer (Storeheier et al. 2003). In regard to general management strategies for both wild and domesticated reindeer much of the emphasis has been placed on the amount and availability of winter forage. But what regulates body size and reproductive success most, as observed in southern Norway, is the summer/spring pasture conditions (Reimers et al. 1983). As with most cervids consumption during the winter is much less (e.g. Kay 1979, Loudon et al. 1989, Barry et al. 1991, Rhind et al. 1998) and it is during this period that the reindeers' adaptive qualities are essential: capacity to store large fat reserves; reduce activity rates, and survive on limited and nutrient-poor winter forage, like lichens. Regardless of these adaptive qualities, and animal husbandry management, the over-all productivity and growth of reindeer has decreased (Reimers et al. 1983).

Natural predators of reindeer in Fennoscandia are virtually non-existent, but reindeer are still occasionally preyed upon. It is a policy to ensure protection of sheep and semi-domesticated reindeer by removing predators. In some regions of Norway wolves are coming back (see Nilsen et al. 2005) but they are not allowed to establish packs in reindeer herding areas. Other common predators of reindeer are the wolverine (*Gulo gulo*), red fox (*Vulpes vulpes*), Lynx (*Lynx lynx*) and, golden eagle (*Aguila chrysaetos*) (Tverra et al. 2003). The lack of predation, which is primarily due to low numbers of predators, has had a negative impact on the landscape, because the population density of the reindeer has exceeded the carrying capacity of the environment (Moen and Danell 2003).

What has been the impact of reindeer husbandry on existing reindeer populations in Norway? Prior to semi-domestication the indigenous populations in the North hunted wild reindeer as a large portion of their economy. It is not clear what impact that hunting had on past reindeer populations. In the present human predation of reindeer populations involves the yearly culling of the domesticated and wild herds, with the latter being regulated by quotas. In Norway a total of 1, 414 tons of reindeer are slaughtered annually (see Table 1 in Riseth 2006:544).

3.2.2. Birds

This section will not discuss specific individuals, since a huge number of taxa would need to be covered. Instead, groups of birds will be discussed, i.e. seabirds, shorebirds and birds of prey. There are some 110 species of birds that reside in the Arctic. The arctic has about 11 or so species that can live there year round but most of the Arctic birds are migratory, coming for breeding in the warmer months when food is bountiful (Pielou 1994). Of these resident birds most will move southwards, but not completely out of the area during the winter.

Seabirds comprise variety of trophic levels ranging from herbivores, zooplankton consumers to fish eaters. The Barents Sea and the adjacent areas in the Arctic contain a diversity of abundant seabird communities. At higher latitudes seabirds generally are high in numbers but low in species diversity (e.g. Mehlum 1989, 1997 who counted 22 species). In terms of biomass Brünnich‘s Guillemot (*Uria lomvia*) is the most dominant followed by the Atlantic Puffin (*Fratercula arctica*), Kittiwake (*Rissa tridactyla*) and the

Common Guillemot (*Uria aalge*) (59 %, 17%, 9% and 6% respectively) (Wassmann et al. 2007:271). The period of migration and breeding is during spring-summer, when the greatest amount of seabirds is present. During the breeding period there are large colonies located on islands, coastlines and in some cases within the interior. The main colonies of the Barents Sea are on Bear Island; Hopen; SE Svaldbard; Troms and Finnmark County; the Murman and Nenets Coast; Novaja Zemlja and Franz Josef Land (e.g. Sendstad 1977, Mehlum and Gabrielsen 1995, Gabrielsen and Strøm 2004, Croll et al. 2005). Prior to forming colonies, i.e. in early spring found near the Polar Front, the distribution of seabirds is primarily dictated by food availability (Barrett et al. 2002, 2006).

The diversity of shorebirds within the Arctic is varied (Zöckler 1998). The dominant species of the Arctic, and also in the Barents Sea region, are from the Charadriiformesi families: Charadriidae, Scolopacidae and Heaematopodidae, which comprise about 50 species (Henningsson and Alerstam 2005). Shorebirds can be found in a range of habitats in the Arctic tundra subzones: low shrub, grass, sedges, lichen, shoreline mud flats and above the tree line (Piersma et al. 2003, Henningsson and Alerstam 2005). Much like seabirds, most shore birds are migratory and appear in the region in spring-summer.

The Arctic is home to a few birds of prey. The Arctic raptors include: snowy owls (*Nyctea scandiaca*), Rough-legged hawk (*Buteo lagopus*), Peregrine falcon (*Falco peregrinus*), Gyrfalcons (*Falco rusticolus*) and Merlins (*Falco columbarius*). For example, the Rough-legged hawk (*Buteo lagopus*) prefers tree-less landscapes like tundra. Most raptors in the Arctic adjust their ranges during the winter by moving south

(Sonerud 1986). For birds of prey in the Arctic the diet consists of small mammals such as voles and lemmings, and other birds. Most birds of prey are nomadic predators and in the case of Fennoscandia they are connected with the previously discussed rodent cycles, and are believed to extend the cycles (Korpimäki 1985, Ydenberg 1987 and Ims and Steen 1990). Raptors build their nests in tree tops and rock outcrops. For the nests of the Rough-legged hawk are typically made on the face of cliffs. One unique aspect of raptors is their relationship with other birds such as the Barnacle Goose (*Branta leucopsis*), especially in regard to nesting behavior, with the latter relying upon the former for nest protection (Syroechkovskiy et al. 1991 in Haemig 2006).

3.2.3. Fish

The marine animals of the Barents Sea are made up of a diverse and rich population. The major fish species of economic importance in the Northeast Arctic are the Northeast cod (*Gadus morhua L.*), capelin (*Mallotus villosus*), and herring (*Clupea harengus L.*) (Hamre 1994, Bogstad et al. 2000). There are other species of some but lesser economic importance: coalfish (*Pollachius virens*), haddock (*Melanogrammus aeglefinus*), halibut (*Hippoglossus hippoglossus*) and ling (*Molva molva*) (e.g. Bergstad et al. 1987, Nakken 1989, Albert 1994, Godø et al. 1997, Michalsen 1999, Bowering and Nedreaas 2000, Huse and Soldal 2000, and Høines and Korsbrekke 2003). Including these important fish there are 144 fish species in the Barents Sea with newer species being introduced, like the Berlevågfisk which is a Pacific gadoid that has immigrated into the Barents Sea in recent decades. The following will discuss the demographics of the economically important species of fish. Included is an expanded discussion on the impact of sea temperatures on these fish species, with special consideration of the cod.

In the north-east Arctic there are 3 stocks of cod: the north-east Arctic cod, the Norwegian coastal-cod and the Murman cod. The first two will be discussed here (e.g. Godø and Moksness 1987, Smedbol and Wroblewski 2002, Westgaard and Fevolden 2007). The Norwegian north-east Arctic cod is a migratory species which feeds in the Barents Sea during the summer and early autumn months (Bogstad and Mehl, 1997, *Bogstad et al.* 2000). Around late autumn to early winter both mature and immature individuals begin to make their migratory trip to the spawning grounds; the mature spawning cod are known as Skrei cod at this time. The main spawning grounds are located in the north and south of the Lofoten archipelago above 62º N to 71º N south of Sørøy Finnmark known as the vårfiskeri or spring fishery (Bergstad et al. 1987, Larsen et al. 1997). Spawning takes place in late January with its height in mid-March to mid-April by the mid-summer post-larvae and immature cod have made their way back north-east from the spawning grounds. These young juveniles, or fry (0 group), are found pelagically after drifting for the last six months in the warm waters (Norwegian Coastal water) of the south Barents Sea and around Spitsbergen. By early fall the cod fry move into the sub-littoral/littoral zone within the Barents Sea. The arrival of mature cod back into the Barents Sea begins around May (feeding migration) and is associated with the spawning capelin whose spawning grounds extend from the north Norwegian Coast to the Murman Coast. However, by December the migration has begun again and the cod are moving westward across the Finnmark coast.

The coastal-cod is a non-migratory species which stays within the intertidal zone and throughout the fjord system (Jakobsen 1987, Berg and Pedersen 2001, Pedersen and Pope 2003). In the cod fisheries along the Norwegian coast above 62º N, coastal-cod make up approximately 5 percent (Jakobsen 1987:223). The Finnmark coast has the greatest concentration of coastal-cod. However like north-east Arctic cod it is most abundant above 67° N (for specific reasons see Berg and Albert 2003). Coastal-cod spawn in the fjords, where they reside for most of the year, and in some of the same coastal areas as the northeast Arctic cod such as Lofoten (Godø 1984, 1986, Salvanes et al. 1994). Based on tagging and recapturing experiments mature coastal-cod have been found outside of fjords along the coast, but this is believed to be only for a small portion of the year after which these individuals return to the fjords for spawning (Jakobsen 1987:232).

Based upon numerous studies there is evidence that the North-east Arctic cod and the coastal-cod differ in life history. Coastal-cod is different from north-east Arctic cod based on: differences in otolith structure (growth zones) (Rollefsen 1933, Berg and Pedersen 2001); number of vertebrae (Løken et al. 1994, Løken and Pedersen 1996, Nordeide and Pettersen 1998) and haemoglobin and genetic characteristics (Møller 1968, Dahle and Jørstad 1993, Fevolden and Pogson 1995), specifically the PanI-genotype which is used to distinguish North-east Arctic cod from coastal-cod. Over the years there has been much debate over the classification of coastal-cod and Atlantic cod. The current view is that coastal-cod is a separate species (Torstein Pedersen personal communication). Other differences include maturation rates and length. Coastal-cod mature faster than north-east Arctic cod. When both are juveniles there is little difference in length between the two, but over time the length differences between the two increases with the northeast Arctic cod being typically longer than the coastal-cod but the former matures much later than the latter (Roff 1988, Berg and Albert 2003). There are various possible reasons for this: environmental, direct or indirect consequences of selection by fishing or genetic (Berg and Albert 2003). North-east Arctic cod are larger than inshore and offshore coastal-cod but both types are larger than inshore coastal-cod. In regard to early life history strategies, juvenile coastal-cod have a different settling strategy than northeast Arctic cod, the former settling in fjord systems seeking the protection of the/a macro-algae belt whereas the juvenile north-east Arctic cod settle in deeper water (Berg and Albert 2003). However, both cod typically only inhabit inshore and offshore waters not exceeding 300 m in depth. The bathymetry of this area extending from ca. 62º N to Russia is characteristically shallow (<300 m). In comparison, the southern waters of Norway, both offshore and inshore, are greater than 300 m in depth and in these waters cod is not as dense.

Capelin is found during the autumn months feeding from the north central to south eastern sections of the Barents Sea. By late autumn and early spring mature capelin migrate to the coastal waters of Finnmark and the Kola Peninsula for their April spawning. Capelin is a primary food source for north-east Arctic cod and harp seals (Bogstad and Gjøsæter 2001, Jørgensen et al. 2004).

The Norwegian spring spawning herring resides primarily in the Lofoten archipelago, where it spends the autumn and early winter months (e.g. Devold 1963, Hassel et al. 1991, Olsen et al. 2007). Migration in search of food starts around February. It is at this time in March and April that spawning takes place almost along the entire Norwegian coast, extending as far south as Karmøy (Beverton et al. 2004). Throughout the summer months the mature herring spend their time migrating and feeding across the NE Atlantic. In September, they head back to their original residence in Lofoten (Slotte

1999, Kvamme et al. 2003). The young herring stay in the Barents Sea until the age of 3 or 4, after which they join the mature herring stock in the Norwegian Sea (Kvamme et al. 2003). Like all fish populations in the Barents Sea the herring stock is also subject to the influences of local environmental conditions.

Within the Barents Sea changes in local environmental variables such as water temperature have noticeable impacts on the population dynamic and geographical distribution of fish populations. There are several environmental variables that affect fish including ocean-climate fluctuations, bathymetry, changes to biological environment, e.g. predation, and fishing pressure (Ottersen et al. 2004). However, sea temperatures are the most heavily studied of all the environmental factors in the Barents Sea and for the purposes of this dissertation they are the focus of this discussion because of their possible relevance to past climatic events (Ottersen et al. 2004). Variables like temperature directly and indirectly affect fish populations by either influencing dynamics like growth (direct) or predation (indirect). The types of responses to changes in environmental variables can be physiological effects like metabolic and reproductive responses or behavioral like changing distribution. Of course, temperature variables are not the only influences salinity, mixing and water transport are also factors but these will not be discussed (for details see Ottersen et al. 2004:74). Here the focus will be on the sum of direct influences on the population dynamics such as spawning and reproduction, growth and survivability and distribution of stocks with special attention being paid to the Barents Sea and the north-east Arctic cod stock.

The rate at which a fish reaches sexual maturity to spawn is connected to its ambient water temperature. An example would be the various cod stocks across the North

Atlantic which have distinct maturation rates, e.g. North-east Arctic cod mature 6 to 7 years while coastal-cod mature 2 to 3 years (Drinkwater 1999). One general influence water temperature has on spawning is that it influences gonad development, whereby lower temperatures than optimal retard development and high temperatures speed-up gonad development. It is known that warmer water temperatures speed-up maturation. In regard to the Barents Sea the north-east Arctic cod seem not to be significantly affected by this (Cushing 1969, Ellertsen et al. 1989).

However, for some fish the location of their spawning grounds is influenced by water temperature. For cold water North-east Arctic cod, high water temperature is necessary for the production of strong year classes (Ellertsen et al. 1987). It is at the Lofoten spawning grounds having gone upstream following the warmer water masses emptying into the Barents Sea that North-east Arctic cod find suitable conditions to spawn. Although, the thermoclines depth may vary the desired temperatures are found at the same latitude annually (Ottersen et al. 2004).

Growth within fish is also partly influenced by water temperatures, both directly and indirectly which is most apparent at the early life stages. There are two ways that temperature influences growth and overall survivability, specifically of the north-east Arctic cod stock. The first is the rate of development of fish larvae. For example, in the Barents Sea which is a cold water ecosystem a temperature increase creates more available biomass, making food availability a minor issue for young cod and thus ensuring an increase in growth rates and greater survivability and eventual recruitment. Another is that higher temperatures directly increase the development rate of young cod whereby they pass through very vulnerable life stages more quickly thus lowering their overall mortality. So temperature directly influences physiology and is indirectly linked to ecosystem productivity; length of feeding season and the overall distribution of fish, prey, predators and competitors. There is inter- and intra-stock variability in growth as well. For example, as mentioned previously, there are differences in the various cod stocks throughout the North Atlantic and one of those differences has to do with growth rates as well (Berg and Pedersen 2001, Brander 1994, 1995). A more local example is given by Berg and Pedersen (2001) who demonstrated differences in rates of growth for coastal cod within a fjord system; however they concluded they were dealing with two separate stocks. Within a stock the different age-classes are influenced differently. Temperature is more of an influence on juveniles than it is on adults as in the case of the North-east Arctic cod (e.g. Loeng et al. 1995, Michalsen et al. 1993 and Ottersen and Loey 2000).

Finally, temperature is influential in the distribution of fish populations (e.g. Eggvin 1938, Lee 1952; Hylen et al., 1961, Beverton and Lee 1965; Woodhead and Woodhead 1965; Konstantinov 1967, 1969, Mukhin 1979). Fish prefer certain temperature regimes so they will seek those regimes out. They are also influenced by food availability which influences their behavior so much that they will inhabit waters with less than optimal temperatures in order to access food (Sundby 1994). Regarding distribution, a noted study by Boytsov et al. 1986 examined the distribution of north-east Arctic cod during the feeding migration, i.e., post-spawning. They observed that the heat content of water masses coming into the southeastern Barents Sea (plus, secondary abiotic factors) determines the migration cycle (Boytsov et al. 1987). It is during the feeding migration period that abiotic factors (not physiological state as in the spawning migration) determine cod behavior. The North-east Arctic cod distribution in summer is influenced by size-age composition of its population. This is based on the age sensitivity of various age-classes and their response to fluctuations of environmental factors. For example, if the waters are warmer than usual by the the mid-late spring than the younger cod will be displaced to more easterly grounds by winter (Boystov et al. 1987). Similar to the results of a separate study by Nakken and Raknes (1987) they noted that older age groups of cod (6 and 7 years old) were distributed more westerly in the warmer waters than the younger age groups within the Barents Sea.

3.2.4. Sea mammals

Sea mammals residing in the year-round Barents Sea occupy various niches of the region (e.g. Gurevich 1980, Timoshenko and Popov 1990, Christensen et al. 1992, Gjertz and Wiig 1992, Hjelset et al. 1999, O'Corry-Crowe 2002, see Wassmann et al. 2006 for more references). The species that reside in the high-Arctic are: walrus (*Odebenus rosmarus*); ringed seal (*Phoca hispida*); bearded seal (*Erignathus barbatus*); white whale (*Delphinapterus leucas*); narwal (*Monodon monoceros*); and bowhead whale (*Balaena mysticetus*) (Gjertz et al. 1993, Hammil et al. 1991, Haug et al. 1995). Elsewhere in the Barents Sea the harp seal (*Pagophilus groenlandicus*) mostly inhabits the Arctic and sub-Arctic Barents, while both the harbour seal (*Phoca vitulina*) and the grey seal (*Halichoerus grypus*) reside in the more temperate areas located in the southern Barents (Bjørge 1991, Haug et al. 1991, Haug et al. 1994). The summer migrants which appear throughout the Barents Sea include: minke whale (*Balaenoptera acutorostrata*); fin whale (*Balaenoptera physalus*); humpback whale (*Megaptera novaeangliae*); white-beaked dolphin (*Lagenorhynchus albirostris*); harbour porpoise (*Phocoena phocoena*);

killer whale (*Orcinus orca*) and blue whale (*Balaenoptera musculus*) (Christensen et al. 1992, Folkow and Blix 1991).

3.3. Climate History

As briefly discussed above sea currents and atmospheric circulation impact Fennoscandia and this is of interest to researchers trying to reconstruct the climate history of the area. Reconstruction of past climates relies upon multiple data sources, for example ice-cores, pollen, sea-cores, tree-rings, speleothems and historical records. There are numerous scholars working on the climate of Finnmark (e.g. Briffa et al. 1990, Lauritzen and Lundberg 1999, Korhola et al. 2000, Korhola et al. 2002, Lindholm and Eronen 2000, Seppä and Birks 2001 and Shemesh et al. 2001). This section will discuss two very specific climatic regimes as well as provide a sketch of the climate history of north Norway.

3.3.1. The Medieval Warm Period

The Medieval Warm Period (MWP) is a less distinct climatic epoch than previously thought (Ogilivie and Farmer 1997) and was possibly more moderate than previously thought (Crowley and Lowery 2000). The period in question from the 11th to 14th centuries and occurs in the northern hemisphere, with regional differences (Lamb 1977, Hughes and Dias 1994, Pfister et al. 1998). Currently it is believed to have been more pronounced in areas adjacent to the North Atlantic (Crowley and Lowery 2000). Proxy indicators vary from tree-rings (e.g. Scweingruber 1988, Briffa et al. 1992), to glacial moraines (e.g. Holzhauser and Zumbühl 1988, Grove 1988 and Grove and Switsur 1994), to documentary sources (e.g. Ingram et al. 1981, Alexandre 1987, Ogilivie 1991, Buisman and Van Eugelen 1995 and Ogilivie and Farmer 1997). The MWP was warmer and had a lower frequency of extreme events in comparison to earlier and later cold periods such as the subsequent Little Ice Age (LIA) (15th to 19th century). Specifically, temperatures were 0.2 degrees C warmer on average than during the LIA, but in comparison to mid-20th century temperatures it was below (0.45-0.50 degrees C).

The MWP period was variable regionally, as well as hemispheric ally, and to describe it as a period of long warmth is misleading at best. Rather, it was interspersed with cool, even cold episodes and was regionally, even locally highly variable (see Kirchhefer 2005). For example, in the North Atlantic proxy data indicate that ca. AD 1000 it was warmer in the Western Settlement in Greenland but by the latter part of 11th century it had turned very cold (McGovern 2000). In Fennoscandia intervals of warm periods characterize the years from AD 971 to 1100 (Briffa et al. 1992).

3.3.2. The Little Ice Age

The LIA was a modest cooling event influencing the Northern Hemisphere, which was also spatially variable. The North Atlantic was heavily influenced by the LIA and it is believed that the LIA regional variability of cold reflects changes in atmospheric circulation, specifically the NAO (O'Brien et al. 1995). Within the North Atlantic temperatures were less than 1 degree C cooler relative to the late 20th century levels (Bradley and Jones 1993, Jones et al. 1998, Mann et al. 1998, 1999, Crowley and Lowery 2000). The timing of the onset of the LIA is heavily debated (Bradley and Jones 1993, Hughes and Diaz 1994, Crowley and Lowery 2000), but generally it is viewed as beginning around AD 1350 with two cold phases: 17th and 19th centuries with the coldest decades being mid- to late- 1600s, the early 1800s and late 1800s (Lauritzen and Lundberg 1999). Current and past research has focused heavily upon the impact of LIA on human communities in the North Atlantic islands, most notably Greenland and the

Western Settlement where investigators have for decades researched the demise of the Norse settlement and the onset of the LIA in ca. AD 1350 (Barlow et al. 1997, Buckland et al. 1996, Mayewski et al. 1994, Jennings and Weiner 1998, McGovern 2000) and Iceland where researchers have focused upon environmental degradation and human response (Ogilvie 1991, Ogilvie and McGovern 2000).

3.3.3. North Norwegian Coastal and Regional Temperatures

The following summary covers some of the findings of climatic data based on tree-ring analysis from northern Norway, northern Sweden and northern Finland. The primary data source comes exclusively from Scots pine (*Pinus sylvestris L.*). However, the relation between negative growth and temperature varies with altitude (lower altitudes are influenced by other factors, including precipitation), as well as along a north-south transect (more influence from precipitation towards the south) (Briffa et al. 1990, Linderholm et al. 1997, Linderholm 2001). Consequently, although the Fennoscandic tree-ring record records temperature variations related to atmospheric circulation patterns, sample sites vary due to local climate and ring growth variables. With this in mind the following will discuss the various data sets and provide a conclusion that integrates the data into a comprehensive summary.

Troms County in north Norway has several sample sets of tree-ring data. One sample from Dividalen, in interior Tromsø suggests that in terms of tree growth and distribution, half of the MWP resembles 20th century patterns after 1915. Kirchhefar (2005) also noted that the second half of the MWP was notably colder than the first half. As mentioned previously the MWP had spikes of cold events; one such is documented throughout Fennoscandia and large areas of the Northern Hemisphere around 1460 (see

Eronen et al. 2002, Esper et al. 2002, Gunnarson and Linderholm 2002, Grudd et al. 2002).

Other sites providing tree-ring samples from coastal north Norway cover the later periods. Three sample sites lie between the Lofoten archipelago and the modern city of Tromsø: Forfjorddalen, Stonglandseidet, and Vikran. The Fjorddalen chronology provides climate data from tree-rings for AD 1358- 1992. Kirchhefar's (2005) analysis revealed that from 1375 to 1440 summer temperatures were low, with the following period between 1475-1540 marked by relatively warm temperatures which ended in 1540 with a severe cold phase. Climate records from 1550 to 1700 based on samples collected at Forfjorddalen and Stonglandseidet reveal summer temperatures close to average from 1550 – 1600. From 1600 – 1715, Kirchhefar recorded three temperature cycles, each roughly 40 years long: beginning in 1605, 1645 and 1680. Based on the Forfjorddalen chronology from 1575-1650 (low pine recruitment) the first half of the 17th century was especially cold and unfavorable for pine growth. In 1601-1620 there was also a severe cold event. In the second half of that century it became slightly warmer from 1650-1713, with high summer temperatures.

Tree-ring data from northern Sweden and northern Finland provide different regional perspectives, with the Finnish data providing a closer match to the results from Berlevåg. The tree-ring samples from northern Sweden come from Torneträsk. Around AD 1000 the Tornträsk data corresponds well with the MWP as a period of warmth (Hugh and Diaz 1994). According to the Tornträsk chronology this period of warmth ends around AD 1100 with a colder climate setting in. Climatic deterioration at the end of the 12th century is regarded as the onset of the LIA (Grove 1988) with summers between 1570 – 1730 being especially cold (Briffa et al. 1992, Bradly and Jones 1993). However, there are periods of warmth within the LIA observed from 1360-1570, 1760 and 1820 (see Briffa et al. 1992, 1998).

Finnish Lapland, which borders Finnmark and Troms Counties, is the source for the Finnish samples. Several sources will be cited in this section to provide a generalized picture of climate for parts of Finland using mid-summer (July) temperatures. Lindholm and Eronen's (2000) reconstruction from AD 50 to 1985 revealed that the warmest anomalies, in terms of summer temperatures, were in the summer of AD 535 while the coldest summer was in AD 1601. Prior to AD 1601, Helama et al. (2002), reported that the warmest and coldest non-overlapping 100 year periods were AD 1501-1600 and 5200-5101 BC, respectively, with the 16th century followed by a warm 17th century.

The bigger regional picture of Fennoscandia requires integrating these data to determine where there are regional climatic similarities and differences. However, because of the variability of climate, both on the regional and local scale, correlations of climate are not that numerous over Fennoscandia, so that caution is necessary in applying these results to coastal north Norway. For example, a warm period reported in Helama *et al.* (2002) in the 17th century is not seen in the Swedish (or Russian) tree-ring data reported in Briffa et al. 1992, 1995, 1999, and 2001 or in the Norwegian data (Kurshhefar 2001). Consequently other data sources need to be considered in addition to the dendrochronological records. Historical records of climate fluctuations have been inferred from barley harvest records. Such records from Vesterålen and Senja are discussed in Fjaervoll (1961,1964) covering the years from A.D. 1611 to 1641 and 1714 to 1731.

There are accounts of poor or completely failed harvests from 1615/16 and complete failures in 1633, 1638 and 1641. These data are not so relevant to the period of research.

3.3.4. Conclusion

As Briffa et al. 1990 notes, northern Fennoscandia may have experienced different fluctuations in climate than the rest of Europe, and with noticeable differences between coastal and inland sites. The implication is that ocean currents play a larger role in climate (global and regional) than previously understood. Current research on temperature changes in the ocean currents of the North Atlantic and their relation to the North Atlantic Oscillation (Ottersen and Stenseth 2001, Ottersen et al. 2004) promises to provide a more fine-grained understanding of ocean-atmosphere coupling and its relevance for the climate of northern Fennoscandia which for archaeological purposes will refine our understanding human and local environmental interaction.

Chapter 4. Faunal analysis methods

4.1. Introduction

The following section will summarize the methodological procedures used in this dissertation. These procedures relate to the primary data and the questions posed at the outset of this dissertation. Section 4.2 will discuss the collection of the data, while issues of analysis will be presented in section 4.3: Osteological identification, recording and quantification. All methods follow the NABO Zooarchaeology Working Group recommendations and the established traditions of North Atlantic zooarchaeology. Section 4.4 will discuss the taphonomic variables this research confronted.

4.2. Data Collection

The collection of most of the archaeological material was carried out by the author, with the exception of the test-pits described in Chapter 5 and the trench at the site of Kongshavn In organizing the recovery process 1 x 1 meter units were assigned specific analytical units (AU), i.e. middens, house floors, etc, if applicable. Within these analytical units the archaeofauna was collected from stratigraphic units (SU).

The systematic recovery of zoo-archaeological deposits is a thoroughly debated topic (Rootenberg 1964, Thomas 1969, Payne 1972, Casteel 1977, Colley 1983, and Grayson 1984). In no other sub-discipline of zoo-archaeology is this more true than in the recovery of fish remains (Barrett 1997, Butler 1993, Casteel 1972, 1976, Colley 1990, James 1997, Jones 1991, Matsui 1996, Moss 1989, Cannon 2000, Nagaoka 2005, Partlow 2006, Wheeler and Jones 1989 and Zohar and Belmaker 2005). The primary method of data recovery was to sieve all 1 x 1 meter excavation units through 3 mm mesh unless otherwise specified, for example the material from Laukvika which was hand collected. Screen size has been a widely debated topic, especially in the analysis of fish remains (Casteel 1976, Wheeler and Jones 1989, Partlow 2006, Zohar and Belmaker 2005, Cannon 1999, Gordon 1993, James 1997, Shaffer 1992, Shaffer and Sanchez 1994, Vale and Gargett 2002). Justification of screening the faunal material and the size of the screen mesh has been well covered by previous scholarly work and will not be discussed here. All the investigated sites were not 100 % screened; decisions on what areas to sieve were made on a case by case basis, for example at both Skonsvika and Kongshavn it was decided to sieve only areas with relatively dense bone deposits. However, all middens and dwelling interior units used in this dissertation were screened.

4.3. Analysis

The analysis section will cover those methods unique to this research in the order of their execution. The sub-section 4.3.1 addresses issues of osteological identification. In sub-section 4.3.2 recording procedures are described and in sub-section 4.3.3 justifies the quantification approaches used. Sub-section 4.3.4 deals with the methodological practices of fisheries analysis.

4.3.1. Identification

In order to successfully reconstruct the past, the ability to accurately identify the morphological differences between taxonomic classes and species is fundamental. But to achieve a proficient level of taxonomic identification a skeletal reference collection must be used (Chaplin 1965, Olsen 1971, Uerpmann 1973, Wheeler 1978, Coy 1978, Reitz and Wing 1999), although a good collection of reference books is a necessity as well (Cannon 1987, Leach 1997, Rojo 1991). The more diverse a reference collection is, and the more it is representative of the taxa from the area of research the greater the likelihood that the reconstruction of past life ways will be accurate. The laboratory facilities used in the analysis were the Hunter College Bioarchaeology Laboratory, the Brooklyn College Zooarchaeological Laboratory and the Institute of Archaeology at the University of Tromsø. In the rare cases when sufficient identifications could not be made at these facilities, specimens were taken to the American Museum of Natural History in New York. All of these laboratories have comparative collections and comparative manuals that aided in the primary identification. However, even a well equipped laboratory with good species representation cannot alleviate some of the common problems of identification (e.g. Wheeler 1978, Wheeler and Jones 1989, Eda et al. 2006, Driver 1992, Newman et al. 2002, Halstead et al. 2002, Gobalet 2001). All fragments were identified as far as taxonomically possible and the selected element approach (Leach 1997) was not employed. The identifications of gadids follows the ICAZ Fish Remains Working Group recommendations (see Perdikaris et al. 2004, Cannon 1987, and Mujib 1967).

4.3.2. Recording

Recording procedures followed a standardized data entry form created by the North Atlantic Biological Organization (NABONE-Version 9). This data analysis packet includes data codes, and Access® data base and Excel® spreadsheets.

4.3.3. Quantification

Quantification methods have been the subject of prolonged discussion in zooarchaeology (e.g. Casteel 1976, 1977, 1978, Casteel and Grayson 1977, Crabtree 1990, Gilbert and Singer 1982, Klein and Cruz-Uribe 1984, Lie 1980, McGovern 1985, Speth 1983, Brewer 1991, Grayson 1979, 1984 and Lyman 1994). An extensive review of these discussions is beyond the scope of this dissertation, but it is necessary to justify the quantitative methods used here.

Since this research is based upon secondary, and possibly tertiary deposits, all primary data was recorded by specimen counts (NISP, number of individual specimens, see Grayson 1984:17, Amorosi et al. 1996). More specifically, all identifiable and unidentifiable bones were recorded as a single individual, i.e. indentified to taxonomic unit and element, along with individual context information and all relevant notations and comments regarding that individual bone. There are both positive and negative aspects to this method, but one reason for choosing it is the issue of comparability of different data sets, as raised by Amorosi et al. (1996). NISP facilitates inter- and intra-site comparability for regional and temporal synthesis (Amorosi et al. 1996) by providing a basic counting unit that, unlike other measures, is generated the same way in all contexts. It also serves as a basis for all other quantitative measurements. Comparability of NISP counts between assemblages is problematic (Grayson 1984: 20-22, Ringrose 1993). For instance, the data used in this dissertation was mostly comprised of fish which presents a problem of comparability to other taxa because fish have more bones which can be identified to species level. This fact can change the entire dynamic and interpretation of an assemblage. However, since one of the goals of this dissertation is to make the Finnmark material available to other faunal analysts and archaeologists by making the data as comparable as possible, NISP is the appropriate measure for primary data presentation.

The secondary data generated throws light on the relative frequency of taxonomic categories and /or elemental distribution. For the research questions poised in this dissertation the measurement of relative frequency of elements is dependent on MAU counts (minimum number of animal units, see Grayson 1984). Minimum number of animal units (also known as the relative frequency or RF, see Lyman 1994) divides the bones found per skeletal element by the number of times it appears in a live individual to obtain the mean of that skeletal element (Reitz and Wing 1999). This normalizes the effect of different frequencies of skeletal parts in different taxa thus allowing for a direct comparison of different taxa (Hesse and Wapnish 1985, Perkins and Daly 1968, McGovern 1985 and Reitz and Wing 1999). The bases of an MAU count is the MNE (minimum number of elements) count. When MAU counts are converted to percentages this permits comparison of element abundance between sites.

4.3.4. Methodology of fisheries zooarchaeology

This section will discuss a methodological package that has been developed over the years by Sophia Perdikaris (1996, 1998a, 1998b and 1999), and is used in this analysis, to unravel the development of commercial fishing and commodification in the post-Viking Age North Atlantic. A number of researchers and research groups, e.g. the NABO Fish Remains Working Group and NORSEC, have relied upon this methodological approach (Amundsen 2004, Amundsen et al. 2005, Edvardsson et al. 2004, Harrison et al. 2004, McGovern et al. 2001, McGovern et al. 2004, Perdikaris 1998b, Perdikaris et al. 2002, Perdikaris et al. 2003, Perdikaris and McGovern 2006). Unlike other approaches (Amorosi 1991, Barrett 1994, 1995 and 1997 and Bigelow 1985, 1991) which focused on a single method, Perdikaris' approach relied upon five methods: aggregation of fish remains; species diversity; total-length reconstruction; element distribution; and cut marks from butchery. Each of these will be discussed in turn.

An aggregation of large quantities of fish remains does not by itself necessarily represent a site specialized towards commercial fishery (Bigelow 1984, Amorosi et al. 1996), but it does suggest either intense and/or long-term activity. Such accumulations therefore warrant further investigation, which involves the other four methods.

Species diversity, as defined in Grayson (1984) and Cruz-Uribe (1988), refers to the number of taxa present and the relative frequency of each taxon (Cruz-Uribe 1988:179). In fisheries archaeology the diversity of species depends on several variables, not only archaeological and taphonomic but behavioral, e.g. fishing effort, catch per unit of effort (CPUE), by-catch, etc. (Perdikaris and McGovern 2005). In North Norway the advent of commercialization during the high Medieval period, and the ″industrialization″ of fishing, decreased species diversity on sites compared to the previous Iron Age sites (Perdikaris 1998a, 1998b, Simpson et al. 2000 and Perdikaris and McGovern 2005) when fishing was artisanal and specific species were not targeted to the same degree (for definitions of artisanal and industrial see Collaca et al. 2004:359).

The third method is osteological measurements used to estimate the total length of fish, in this dissertation only cod will be measured. Selective fishing methods are one of the distinguishing characteristics of a commercial fishery, so the size of fish caught can indicate whether a specific fishing strategy was employed (Perdikaris 1996, Perdikaris 1998a, 1998b, Greenspan 1998, Perdikaris 1999 and Perdikaris and McGovern 2005). One of the qualitative criteria for curing cod to make stockfish was a standardized size between 60 and 110 cm total length, which has been demonstrated to be the ideal length to air-dry cod. The ethnographic record also shows that fisher folk selectively choose size specific fish (Cutting 1955). Perdikaris (1998) demonstrated empirically that in medieval North Norway specific sizes of cod were targeted for the stockfish trade.

The single regression formula was chosen as the method of measurement (see Casteel 1976 for four other potential methods, and for critiques of the single regression formulae, see Rojo 1986, Mitchell 1988 and Orchard 2003). Regression analysis best describes the line which characterizes the relationships between two variables being compared. In this case the regression formula compares the length or weight of a fish to specific measurements of skeletal elements. The cod elements selected for measurement in this study were: the atlas, premaxilla, maxilla, dentary and cleithrum.

The atlas measurement points employed can be found in Enghoff (1994). The following is the single regression formula:

$$\mathrm{TL} = 8.73172 * X\ 0.8260 \qquad [1]$$

Equation 1 atlas.

The measurement points for the premaxillary, maxillary, dentary and cleithrum are from Rojo (1986). These single regression formulas are as follows:

$$\mathrm{TL} = 95.31 + 13.098\ \mathrm{Lm} \qquad [2]$$

$$\mathrm{TL} = 54.83 + 50.\ 285\ \mathrm{Hm} \qquad [3]$$

$$\mathrm{TL} = 145.88 + 137.719\ \mathrm{Sth} \qquad [4]$$

Equation 2 a,b, premaxillary.

$$\mathrm{TL} = 86.70 + 9.779\ \mathrm{Lm} \qquad [4]$$

Equation 3 maxillary.

$$TL = 105.38 + 9.098\ Lm \qquad [5]$$

$$TL = 153.39 + 23.864\ Hm \qquad [6]$$

Equation 4 a,b dentary.

$$TL = 82.62 + 5.630\ Lm \qquad [7]$$

$$TL = 159.68 + 14.642\ Lh \qquad [8]$$

$$TL = 96.\ 84 + 33.173\ Wm \qquad [9]$$

Equation 5 cleithrum.

Although otoliths were recovered from the Skonsvika and Konshavn sites these have yet to be measured. However, large quantities of otoliths were recovered from the Værbukta site and the measurements of those followed a methodology cited in Smested and Holm 1996. All measurements were made to the nearest tenth of a millimeter with an Eletronic Digital Caliper.

$$y = ax + b \text{ or unknown length} = 3.73(\text{known width}) + 0.729 \qquad [10]$$

Equation 6 otolith.

The differential distribution of body parts provides zoo-archaeological signatures that have proven useful as a means to decipher the differences between cultural (discard and processing behavior) and natural deposits (Butler 1987, Hoffman et al. 2000, Stewart 1991, Zohar et al. 2001), but also using body part frequencies to determine butchery practices (Colley 1984, 1986, Seeman 1986, Stewart 1991, Belcher 1992, Perdikaris 1998a,b, Amundsen et al. 2004, Krivogorskaya et al. 2005). Within the context of the medieval North Atlantic this has meant distinguishing between production (producer) and consumption (habitation) sites. This is accomplished by converting NISP data to MAU percentage for ease of comparison, then focusing on three analytical methods: comparison of major skeletal element groups, the relative proportions of the vertebral series and observations on selected individual elements, as demonstrated in Perdikaris (1996, 1998a and 1998b) and elsewhere (Amundsen et al. 2004, Krivogorskaya et al. 2005).

To illustrate the differences in discard and processing practices two sites will be used as baseline sites for all comparisons. The processing site will be represented by the 18th - early 19th century site of Tjarnargata 3c in Reykjavík Iceland which is a faunal deposit associated with a fully commercial cod fishery (Tables 2, 4 and 6; Figures 12, 13 and 14) (Perdikaris et al. 2002). The habitation site is represented by the late 17th century underwater shipwreck site Elizabeth and Mary (Tables 3, 5 and 7; Figures 12, 13 and 14) (Robert Grenier and Jim Ringer personal communication 2000). The faunal material was recovered from the ships hold and represents processed cod (Figure 15) (Grenier 2000). Although culturally and temporally different from the sites used in this dissertation these comparative sites are behavirorially distinct making it easier to distinguish discard and processing practices, which is often times difficult to do at a typical fishing site where practices are mixed.

The comparison of major skeletal element groups allows for a gross examination of elemental distribution. This examination concentrates on possible significant differences in skeletal part distribution. Tables 2 through 7 and Figures 12 through 14 illustrate both a processing site and a habitation site. The limitation of this approach is that it does not allow for a more specific perspective on behavior. Therefore a closer examination of proportions of particular elements provides for more detailed insight into the complexities of discard/processing practices.

Perdikaris and McGovern (2005) used two indicator elements to help differentiate site types, i.e. the premaxilla from the lateral skull bone series and the cleithrum (not shown) from the pectoral girdle (see Figures 16 and 17). Their argument was that if the utility of all fish parts was equal and whole fish were deposited at the site, then there would be an equal proportion of both elements, of course independent of natural taphonomic factors. This pattern would be expected at habitation sites in economies without a commercial fishery (Table 5 and Figure 13). In contrast, one would expect that in commercial fishery economies the premaxilla would be discarded at the producer site and the cleithrum would be transported to a habitation site (Table 4 and Figure 13). Added to this argument, which in the author's opinion strengthens their point, is the inclusion of the post-temporal element of the pectoral girdle. This element is a transitional bone between the cranium and the pelvic girdle (trunk portion) of the fish, so in this capacity it further illustrates the difference between differential transport and possible in situ destruction of skeletal elements (Norten et al. 1999).

The method of element distribution also includes proportional differences within the vertebral column and caudal skeleton (Tables 6 and 7; Figure 14). Marked differences in the distribution of the vertebral series (atlas, thoracic, pre-caudal and caudal) have been observed and used as indications of differential processing (Perdikaris 1998a and 1998b, Krivogorskaya et al. 2005). For example, the recovery of upper (thoracic and per-caudal) vertebrae and absence of caudal vertebrae is indicative of stockfish processing (Table 6; Figure 14) (Perdikaris 1996, Amundsen et al. 2004, Krivogorskaya et al. 2005), while an over representation of caudal vertebrae and a low frequency of thoracic and pre-caudal vertebrae are characteristic of a habitation site (Table 7; Figure 14). In conjunction with the expected frequency values for a processing and habitation site the expected values of a whole gadid will be added to provide an extra point of reference to the observed.

Finally, detailed description has been given of those bone elements which displayed butchery marks. Butchery marks may indicate changes in processing techniques related to commercialization or may be affected by other cultural factors such as ethnicity. A few samples were photographed (Figures 18, 19 and 20).

4.3.5. NABONE record form

The NABONE record form is the sole data entry form for this entire dissertation (see http://xweb.geos.ed.ac.uk/~nabo/nabone/nabone.html). The overall documentation scheme of the NABONE record form provides all pertinent information regarding the provenience of the collection, such as site name and excavation coordinates, and the character of the collection both descriptively and quantitatively, like species and the number count of individuals, all within nominal categories.

The majority of the fields document very general information. The species data field is defined by the genus name and/or a combination of the genus and species name. For example, the code BOS refers to *Bos taurus* (cattle) while the code PV refers to *Phoca vitulina*. The codes for the bone elements are typically only three characters such as MAN in reference to mandible, but this is not the standard, for example IN is coded for incisor. The data field header end refers to the portion of the bone represented in the collection. For example, PRO refers to the proximal end of a bone while F refers to a bone fragment or indeterminate bone fragment. The field frag, or fragment size, refers the overall maximum dimensions of an element(s). For example, a 1 in this field denotes a bone fragment less than 1 cm, a 2 is reference to a piece of bone between 1 – 2 cm in total length. The nominal categories range from 1, 2, 5, 10 and 11, although the data behind the numbers is interval.

With regard to more specific information there are two fields pertaining to age of individuals. The field fusion refers to the degree of maturity of bone based on fusion patterns. For example, F = refers to the bone being completely fused with fusion lines obscured. Based on the degree of fusion the age field denotes relative age, such as NN for neonatal based on unfused suture lines. Also, with in this category of specific data are indicators of stature based on osteological measurements. The field Ref # refers to the specimen reference number, for example KON 101 is in reference to a bone element 101 from Kongshavn. Bd, SD, GL refers to measurement points on the particular bone element. Bd refers to total length. SD refers to total thickness and GL refers to total width.

Indicators of bone modification are also present in the data form. The field butchery refers to the observed cut marks on bone. For example, CH refers chopped bone. The field burning refers to the degree of color change in bone as a result of burning, such as W referring to white-grey burned or calcinated bone. Gnawing refers to observed marks on bone as a result of a modifying agent such as a DG for dog via canine punctures.

4.4. Taphonomic Considerations: Deposition and Burial

Special consideration is given to taphonomic processes in this research. Taphonomy, the investigation of the incorporation of animal and plant remains from the biosphere to the lithosphere (Efremov 1940, 1950 and 1953, O'Connor 2005), has its roots in paleontology but it is as much a part of archaeological and zooarchaeological investigation. Identifying specific taphonomic processes that interact with a bone assemblage is challenging because of the equifinality between the cultural and non-cultural components. With any bone assemblage one must consider that: 1) a collection reflects multiple processes, 2) different processes produce similar effects, and 3) there are varying sequences of destruction in taphomomic processes (Behrensmeyer 1993:344).

Taphonomic studies concentrate on two lines of investigation. The first involves conducting actualistic studies of living populations to create analogous models to be applied to the fossil record (or, archaeological record). The second involves the study of the fossil assemblage to recreate the parent population and to understand the ecology and community structure of extinct populations (Olson 1980:5). The taphonomic process leads to a loss or a decline in the integrity of information because of the physical and chemical changes that take place within an organism (Dominques-Rodrigo et al. 2003). Biostratinomy and diagensis are two processes that further the progression of an organism towards fosssilization.

Within the Finnmark research biostratinomy played a larger role in shaping the assemblage. The following section will discuss the geological processes involved in the construction of the faunal assemblages used in this dissertation along with some of the taphonomic processes associated with these geological processes, which will be treated under the subheadings of biastratinomy and diagensis. Special consideration will be devoted to the damage of archaeological bone though fragmentation (trampling), burning, butchery and gnawing. This chapter concludes with a brief mention of a taphonomic variable in Finnmark which may have influenced the archaeological/zooarchaeological record of north Norway.

4.4.1. Deposition

The archaeofauna collections discussed in this dissertation were not only formed by anthropogenic means but by geological processes of deposition and burial. Deposition and burial are distinguished by a variety of different taphonomic factors. In this dissertation deposition refers to the placement of animal bones on the surface of, or in, a sedimentary unit but not buried (Lyman 1995:406). Lyman has noted at least four variables that affect deposition: the time interval between episodes of sedimentation; the thickness of sedimentary increments; the velocity of depositional forces in contact with bones or corpses, and the nature of the sediment in terms of the amount of compaction and grain size (Lyman 1995:405). Within the pre-depositional and post-depositional periods numerous taphonomic processes can act upon bone. For example, during deposition biostratinomic processes influence the character of the assemblage, like butchery and butchery-marks, while other taphonomic processes, like trampling, occur after deposition (Lyman 1995:405). Sedimentation, which is part of the depositional process, places a significant role in the formation of an assemblage.

Sedimentation, and sediments in general, is an important aspect of archaeology because it is through this geological process that archaeological material is placed in a stratigraphic matrix (sediments). One of the variables of sedimentation is the rate at which it covers bones either fast or slow which determines how long they are exposed to transformative agents like weather and scavengers prior to their incorporation into a soil matrix. Secondly, the mode of sedimentation is important, not only because particles are moved but because they are also sorted by weight and size. For example, aeolian deposition involves the movement, sorting (by wind speed) and deposition of fine grain sediments like silt, sand and clay (Dincauze 2000:264, Pye 1987 and Pye and Tsoar 1990 in Dincauze 2000). In terms of faunal analysis aeolian depositional processes act as a taphonomic agent by potentially moving bone material, leaving concentrations of more dense bone material in unmovable piles known as lag deposits, and causing abrasions on bone surfaces (Lyman 1995:411). Another mode of transport is fluvial deposition, which in comparison to aeolian transport is a high-energy system that moves the coarsest material. Along with heavy sorting there is also significant attrition of particles during the transport (Dincauze 2000:266). In regard to the zooarchaeological record fluvial deposition has been well studied in its impact on bone assemblages (Voorhies 1969, Behrensmeyer 1975 and 1982, Boaz and Behrensmeyer 1976, Hanson 1980 Butler 1993, Coard and Dennell 1995 and Trapani 1998).

4.4.2. Biostratinomic processes

During the depositional process (pre-burial) some biostratinomic processes must be addressed. Specifically, biostratinomy entails physical changes to an organism in a variety of forms: weathering, trampling (fragmentation), burning, butchery, scavenging and gnawing. Each of these variables was recorded in the NABONE record system and plays a role in the interpretation of the archaeofuana used in this dissertation. Therefore an in-depth assessment of each variable is warranted. The relevance this topic has to the Finnmark research is evident in the archaeofauna assemblages and the transformational processes they have undergone due to their unique depositional history. Specifically, seasonal residence, site abandonment and later re-use of the sites raise issues of natural aeolian sedimentation rates during interim periods of use. Natural house collapse versus deliberate destruction also plays a role in influencing the degree of transformation of the faunal material.

Weathering refers to either direct or indirect contact of a bone with the natural elements. The pioneering and influential work by Behrensmeyer (1978) chronicled several stages of weathering processes based on observational criteria, (see Behrensmeyer 1978:151 for stage descriptions). As defined by her (Behrensmeyer 1978: 154) weathering refers to the separation and destruction by chemical and physical agents of the organic and inorganic components of a bone. Recording of weathering stages allows for the interpretation of how long a bone was on the surface and the possible rate of the formation of an bone assemblage (Lyman and Fox 1989, Grupe 2007). Behrensmeyer determined that weathering may follow similar patterns in different environments and the stages established by her allow for easy comparison between different contexts. Within the Finnmark research weathering was not an issue although in a few instances it was recorded.

4.4.3. Fragmentation: unidentifiable bone and trampling

The degree of bone fragmentation is affected by several pre/post-depositional processes, such as diagensis, burning and trampling. Diagensis can contribute to a high degree of fragmentation. Fresh bone is composed of 60 – 70 % of dahllite crystals (carbonated apatite). In normal depositional conditions the diagensis process of recrystallation (the replacement of smaller crystals with larger ones) is a slow process, i.e. over millennia. However, when heated at high temperatures (above 650° C) this diagensis process is instantaneous where a solid state of recrystallation occurs rapidly (Stiner et al. 1995). The affect of this is that it lessens the strength of the bone (this varies with the extent of burning) making it more friable. As a result, the bone is more susceptible to fragmentation, although it is not heat alone that breaks burned bone up, but added pressure, such as trampling. In a cultural context trampling is the most direct and immediate cause of bone breakage. The severity of trampling will also be influenced by how long a site is used or how often it is visited (Stiner et al. 1995).

The severity of fragmentation makes it more likely that many of the diagnostic landmarks for bone identification will be lost. This, of course, is at the macroscopic level where positive identification progressively gets more and more difficult with the degree of fragmentation. In regard to the Finnmark research a comparison of the level of fragmentation between and within the sites will determine if the same level of transformation occurred influencing taxonomic diversity.

4.4.4. Burning

The process of burning is a dimension of taphonomy whereby excess heat modifies or damages the object. Excessive heat can involve high temperatures, temporally long exposure to heat, or both. Therefore, the initial act of cooking does not produce burned bone (i.e. carbonized or calcined) (Lyman 1994:384). The presence of scorched bone could be interpreted as food waste, but burnt bone is the result of either, multiple cooking events, or burning bone as waste or fuel. Lyman suggests that the mechanical processes acting on these bones are not a form of diagensis but of biostratinomy, because most of the bones were burned sometime between the death of the organism and burial of the bones (Lyman 1994:384).

Burnt bone poses a challenge of equfinality to understand human behavior, so an accurate assessment of burning damage and the context in which the damage occurred is necessary (Stiner et al. 1995). There are four possible avenues of evaluation to consider: color; microscopic morphology; crystalline structure and size relative to temperature stress (see Shipman et al. 1984).

There are three stages of burnt bone, through which it progresses in terms of physical distinction (color): from scorched to carbonized to calcined. This difference in coloration of bone (due to the decomposition of organic component) reflects temperature increases, or duration of exposure (Shipman et al. 1984). Estimation of the maximum temperature reached can suggest the possible heating method used (Shipman et al. 1984:308). For example, scorched refers to darkening (yellow/brown) of surfaces and occurs when temperatures are below 400° C, i.e. those in an average open fire (Shipman et al. 1984:308) (Lyman 1994). Carbonized is indicated by blackening which occurs between 390 and 525° C (Lyman 1994) and calcined refers to grey/white bone when temperatures reach 645° C (Lyman 1994). During moderate heating the organic stability of bone is weakened and therefore makes it more prone to a faster rate of destruction than unburnt bone (Lubinski 1996:175). Of course this is also influenced by the soil conditions whether acidic or alkaline. In acidic conditions it has been shown that moderately heated/burned bone has a higher destructibility, while in alkaline conditions the line is less clear (Lubinski 1996:1980). A small percentage of burnt bone was recovered from Finnmark, and although it is presumed that much of the bone was cooked, based on the presence of hearths and ovens, the low frequency of burned bones raises questions of overall survivability possibly due to the degree of moderate heating and its susceptibility to destructive components of the surrounding matrix.

4.4.5. Butchery

The analysis of cut-marks on bone is an important area of taphonomic study in zooarchaeology. Much of the orignal work on butchery patterns is attributed to paleoanthropologists, starting with the seminal work of Pat Shipman (1981). The history of butchery research reflects its connection with early hominids, specifically the numerous studies focusing on the identification of primary butchery agents (e.g. hominids or carnivores) and their primary means of modification (e.g. tooth, stone flake cutting edge, or hammerstone) (Gifford-Gonzalez 1989, 1991, Blumenschine et al. 1996 and Lupo and O‘Connell 2002). Other paleoanthropological studies focused on surface mark frequency and distribution in a fossil bone assemblage using high resolution actualistic and experimental models to answer pressing questions of early homind evolution (Blumenschine and Marean 1993, Blumenschine 1995 and Lupa and O‘Connell 2002). From a taphonomic perspective, the interest is in recording and describing the modification to bone, and if possible explaining the agent. Relevant information about butchery concerns the interpretation of butchery marks and specific tool types (Noe-Nygaard 1989), the material from which those tools were made, e.g. stone or metal (Greenfield and Miller 2004) and, when possible, detailed information on the user, specifically left or right handedness (Bromage and Boyde 1984).

The NABONE record system has 12 categories of butchery which range from distinguishing the implement used, e.g. KN = knife or CH = axe, to uncovering the butchery strategy, e.g. BP = biforated metapodials for marrow extraction (NABONE 9th Edition:8). For example, the identification of four butchery practices on cod within the Finnmark material reveals the importance of recording these practices and the marks left behind accurately. The frequency of these marks is variable but their distinction from one another could represent the introduction of new butchery practices or new peoples to the sites. In regard to the other instances at the sites it appears that butchery was influenced the degree of fragmentation.

4.4.6. Gnawing and Scavenging

As mentioned in the previous section on butchery, the identification of gnawing and scavenging (tooth marks), specifically by carnivores as transforming agents of an archaeofauna assemblage, has its roots in paleoanthropolgical studies (Brain 1967). Because north Norway lacks large carnivore scavengers the emphasis in this research is with smaller animals as transformers, i.e. rodents and carnivores such as fox and dog, to reveal the life-history of the assemblages. There are numerous species that can transform an assemblage through gnawing (Reitz and Wing 1999), so the interest is in the intensity and overall severity of gnawing behavior, as there is no systematic way of determining the specific agent involved (Coard 2007, Selvaggia and Wilder 2001). It is appropriate to compare the destructive characteristics of the two most likely animal agents to transform an assemblage, i.e. a carnivore and a rodent. Carnivores leave pits and irregular grooves while rodent gnaw marks are distinguished by parallel grooved marks at the end of a bone. Bone that has been digested leaves characteristic marks, which adds to the investigation of how intensively an assemblage has been transformed (Fisher 1981, Andrews and Evans 1983, Schmitt and Juell 1994). Digested bones are typically broken with their fractured surfaces thinned and rounded and polished, pitted and stained by the digestive stomach acids (Schmitt and Juell 1994:259). In some cases recovered bone will be encrusted with feces and fur.

4.4.7. Burial

The other geological process of interest is the burial, which begins when a bone is covered by sediments. There are various processes and variables influencing the characteristics of an assemblage as noted in Lyman 1994 such as post-burial root action, burrowing animals, permeability of sediments, chemical nature of the permeating solutions, sediment drainage, pH level, etc (Janaway 1987, Lyman 1994:406, Nicholson 1996) all of which comprise the burial environment and eventually determine overall preservation (Nielsen-Marsh and Hedges 2000). When we discuss the taphonomic processes of burial what we are referring to is diagenesis- the alteration of faunal remains after burial, specifically chemical alteration. Depositional environments and the influences of diagentic bone has long been a topic of interest in archaeology (Keeley et al. 1977, Lambret et al. 1984, Pate and Brown 1985, Pate and Hutton 1988, Whitmer et al. 1989).

4.4.8. Diagenesis

Prior to the first quarter of the last century (see Rogers 1924) little was known in the natural sciences (let alone archaeology) about the post-mortem interaction between organic and inorganic material and the surrounding substratum. The chemical alteration of bone is variable with regard to both longevity and severity of the process, and more than one transformational process can act on a single bone at any given moment. Numerous variables affect the survivability of bone: the species of animal, anatomical element to the nutritional state of the individual at the time of death, which might influence the condition of bone at burial (Stout 1978, Nicholson 1996:513). As demonstrated in Nicholson (1996) there are no hard and fast rules to bone degradation; all faunal collections are influenced in some way or another. This fact has been mentioned by a host of scholars (see Parker and Toots 1980:199 for references) trying to gauge the diagentic life history of bone based upon the degree of deterioration.

Diagenesis alters bones through several means of chemical transformation, either through the loss of molecular structure and/or its substitution, the reorganization of crystal structure to the more finalized outcome of disintegration (Parker and Toots 1980, Nielsen-Marsh and Hedges 2007:1139). One such way bone is transformed is that within its inorganic matrix (hydroxy apatite) there can be an element exchange between the calcium and phosphorus of the bone and the surrounding environment. The exchange rate between ions of calcium and phosphorus is variable and is based upon the soil pH. What takes place is an equilibrium reaction substitution whereby this reaction consists of solution and homoionic or heteroionic replacement (Lindsay 1979, Piepenbrink 1989). Influencing this process, and other diagentic processes, are the three primary factors which effect the preservation of bone in buried environments: soil pH, temperature and moisture content with the latter two influencing soil pH (Linse 1992).

The relevance of diagentic processes to this dissertation is uncertain, as no analysis was undertaken to determine the influence on post-burial variables on the collection. However, across the county of Finnmark, and possibly other areas of north Norway diagenses may play a significant role in the characteristics of collections and for that reason it is important to bring attention to it.

4.4.9. Taphonomic problems of Finnmark County and North Norway

North Norwegian archaeology has long observed a noticeable bias in bone survivability between western and eastern Finnmark with the eastern half of the County having better bone preservation. Bone has been recovered in West Finnmark, but it is either calcined bone or deposited in calcareous soils. Archaeologists have speculated that differences in preservation across the County related to higher precipitation in the western part and lower precipitation in the east, although no systematic investigation has ever been carried out to investigate fully these suggestions. But, because of its potential influence on the zooarchaeological record attention will be paid to soil pH levels which as mentioned before is influenced by temperature and precipitation, and how they may be influencing the zooarchaeological record of Finnmark.

Soil pH has been used as a general criterion to determine the overall quality of bone survivability. The level of hydrogen ion concentration in soils (pH) has been a topic of interest for archaeologists for decades (Gordon and Buikstra 1981, White and Hannus 1983, Linse 1992 see also Cook 1951, Cook and Heizer 1965, Graf 1949, Watanbe 1950).

The mineral portion of bone is composed of calicium phosphate, both in crystalline and amorphous forms, also known as hydroxy apatite. Because inorganic and organic components of bone change throughout the life of an individual, crystalline hydroxy apatite $(CA^{10}(PO^{4})^{6}(OH)^{2}$ becomes the dominant mineral (Glimcher 1984, Klepinger 1984:75). Because hydroxy apatite is a calcium phosphate it is highly susceptible to solubility in low pH acidic soils. However, as pointed out by Linse (1992) there is a threshold around pH 7.88 at which as the soil pH increases in akalinity the solubility of hydroxy apatite also increases.

At the most general level, in soils of high acidity the organic and inorganic components of bone are easily degraded and destroyed. For example, within acidic soils the crystalline hydroxy apatite of bone can be transformed either by dissolution, recrystallization or hetero-ionic substitution (Child 1995:21). The latter involves the incorporation of like-trace elements from the surrounding matrix into the mineral lattice. This is a slow process that eventually results in a fossilized replica, or as mentioned before, an ionic exchange between calcium phosphate and the soil (matrix). (Child 1995:21). In soils of high alkalinity osteological material preserves very well. For example, in calcareous sediments calcium from carbonates in the soil may replace other ions that are leached from hydroxyapatite in bone, thus impeding the dissolving reactions (Lambert et al. 1985, Nelson and Sauer 1984 and Linse 1992). These soils rich in carbonate tend not to dissolve the mineral component of bone except in cases when there is low phosphate in the soil (Child 1995, Nicholson 1995, Dincauze 2000). As the soil matrices of the Finnmark sites consisted of sand with a significant content of marine shell fragments, bone degradation was limited by the carbonate rich environment.

As mentioned before, the influence of pH levels are soil moisture content and soil temperature. In general, high moisture content, along with poor aeration, increases the buildup of carbonic acid, thus increasing the acidity of soil (Nicholson 1995). The water within a soil influences the level of chemical activity and weathering. Soil temperature, which influences the level of available moisture in a deposit, is a result of air temperature and soil radiation. An increase in soil temperature will lower the pH level and thus increase the decay the organic component of bone, i.e. protein (Ortner et al. 1972). The increase in moisture level and temperature is connected with the level of precipitation and other processes like evapotranspiration. High precipitation levels, as known in western Finnmark, increase the level of moisture and temperature in the soil which decreases pH levels, thus impacting the survivability of bone.

4.5. Conclusion

This chapter discussed the methods used to address the questions poised at the outset of this dissertation. Also addressed were the taphonomic transformers that had the potential of acting upon the bone material used in this research. Much of that discussion was heavily influenced by the paleontological definition of taphonomy but the archeological source of the material was not disregarded. And finally, this chapter brought to the discussion the issue of bone survivability in Finnmark that has been much discussed within north Norwegian archaeology and one that may not be influencing the material in this research but has influenced the survivability of bone material from other sites.

The next chapter (Chapter 5) will present the data from the archaeological test pits that were part of the initial phase of this research. The following chapter (Chapter 6) will present the data from the larger trenches from three archaeological sites, two of which make up the core data of the research.

Chapter 5. 2001 Fieldseason: Prelimanary investigations of the multi-room houses

5.1. Introduction

In the spring of 2001 archaeologists from Tromsø University in Norway conducted a walking survey of 17 potential multi-room house sites along the outer coast of Finnmark County and parts of northern Troms County. Figure 1 presents the distribution of these sites across these counties. That summer these sites were investigated through the use of test pit samples (TPS). The research goals of this investigation were three-fold: to recover organic material for radio-carbon dating, to acquire an understanding of site formation, and to evaluate organic preservation (see Henriksen 2002). This information was later used to decide which site(s) to excavate more fully in 2002. The data presented here assists in placing the multi-room sites in a broader context of Finnmark County during the Late Medieval and Early Modern Periods.

5.2. Materials and methods

A total of 11 sites was sampled resulting in a total of 39 TPS. Nineteen of the 39 TPs produced bone samples. Test-pit sampling has proven to be an effective method of sampling archaeological sites in Norway (see Bjerck 1989 and Bergsvik 2002 for details and references). Unless otherwise specified test-pits were excavated stratigraphically in 1 x 1 meter units (Henriksen 2002). The majority of the faunal material was hand-collected, with the exception of one site (Værbukta) (see discussion on hand-sampling problems Casteel 1972, Chaplin 1971, Clason and Prummel 1977 and Payne 1972a, 1972b). All the faunal material was analyzed at the Hunter College Bio-archaeological Laboratory in

New York City, New York, USA, under the supervision of Prof. Tom McGovern, and at the Brooklyn College Zooarchaeological Laboratory in Brooklyn, New York, USA, under the supervision of Dr. Sophia Perdikaris. Both these laboratories have comparative collections and comparative manuals that aided in the primary identification and data recording. Recording procedures followed a standardized data entry form created by the North Atlantic Biological Organization (NABONE-Version 9). This data analysis packet includes data codes, an Access® data base and Excel® spreadsheets. In this chapter specimen counts have been presented as the number of individual specimens (NISP) (Grayson 1984). Only those test-pits that produced bone material will be discussed, and their description will be partly based on information from the report by Jørn Henriksen (Henriksen 2002).

5.3. Results

5.3.1. Gammelvær, Loppa Municipality, Finnmark County

The Gammelvær site (test pit sample 1-6) is located on the outer coast at the mouth of Ullsfjord in the municipality of Loppa. The archaeological surface survey documented three structures: two multi-room houses (cluster form) and one Saami communal house. TP 1 was located in the northwest room of multi-room house No. 1, see Figure 21. Two stratigraphic units (SU) were recorded at a depth of 30 to 35 centimeters. SU 1 was described as a gray humus sandy layer with pieces of charcoal and much stone. SU 2 was a dark compact humus layer with immeasurable charcoal. This unit was interpreted as a floor. Only a single calcinated indeterminate bone was retrieved, from SU 2, see Table 9 SU 2 was radio-carbon dated from birch (*Betula L.*)

charcoal (Wk 10180, BP 411 ± 55, two sigma calibrated range 1410 - 1640 A.D.; Table 8).

TP 2 was located in multi-room house No. 2, in the southwest corner of the structure (Figure 22). A total of five stratigraphic units were recorded within a total depth of 33 cm. SU 1 was a mixture of fine turf, humus and gravel with the bottom of the layer revealing a mixture of charcoal and brown sandy soil. SU 2 was a mixture of brown sandy soil, charcoal and fine gravel. SU 3 was a layer of mottled gray fine sand. A possible ash layer appeared at the bottom of SU 3, distinguished by its strong orange color. SU 4 was a fine dark-brown silty soil layer with a thin layer of burnt bone and charcoal fragments. This unit was interpreted as a floor layer. Five fragments of bone (all < 2 cm) were recovered from SU 2 (Table 10). Three of the five pieces were calcinated bone. Samples for dating were recovered from the assumed floor layer SU 4, which provided two radiocarbon dates: Wk 10181, BP 711 ± 66, 2 sigma calibrated range 1210 - 1410 A.D. and Wk 10182, BP 731 ± 38, 2 sigma calibrated range 1210 - 1390 A.D. from birch and birch bark respectively (Table 8).

TP 3 was located in the northernmost room of the communal house (no plan drawing available). This was a 0.40 x 0.60 meter unit with three stratigraphic layers recorded within a depth of 20 cm. SU 1 was described as a turf layer. SU 2 was a thick gray brown layer with burnt bone and was interpreted as representing the main period of occupation. SU 3 was a dark charcoal layer and represented the initial establishment of the structure. SU 1 and 2 produced bone material, mostly indeterminate calcinated bone (Table 11).

5.3.2. Neselva-Ávzejohka, Måsøy Municipality, Finnmark County

The Neselva-Ávzejohka site (test pit sample 7-13) is on the southern shore of inner Kobbefjord in Måsøy municipality. There were three documented multi-room houses in addition to several other later structures. The multi-room house located in Neselva south has a very large symmetrical form (Figure 23). Two test-pit samples were placed inside the structure. TP 7 was located in a room in the southwest corner of the structure. Two stratigraphic layers were recorded within a total depth of 20 cm. SU 1 was a dark earthy-charcoal layer with bits of grey gravel. SU 2 was a compact gravel layer with a mixture of dark earth and a concentration of charcoal indicating a floor layer. From SU 2 a single piece of indeterminate bone was recovered (Table 12) and a charcoal sample of birch from SU 2 was radiocarbon dated (Wk 10186, BP 526 ± 40, 2 sigma calibrated range 1300 - 1450 A.D.; Table 8).

TP 9 was from a hearth interpreted as being modern (Henriksen 2002:7). However, it provided identifiable bone material, namely a small sample of cod (*Gadus morhua L.*) and indeterminate fish bone, Table 12. Because of the lack of any indications of burning this material is most likely have been deposited after the use of the hearth.

TP 10 and 11 were placed within multi-room house No. 2 just north of Neselva. This was a cluster-form house with an annexed boat-house or *naust* (Figure 24). TP 10 was located in the southernmost room of the structure and was composed of 5 cultural layers which reached a depth of 50 cm (Henriksen 2002:7). SU 1 was a greasy black compact humus layer with concentrations of charcoal indicating a possible hearth. SU 2 was recorded as flagstones, which were interpreted as being the floor of a second house structure (Henriksen 2002:7). Underneath the flagstones lay wood timbers that had been worked (SU 3). SU 4 was a brown sandy soil layer mixed with wood fragments, gravel and small stones with some charcoal. SU 5 was a dark gray humus layer with specks of charcoal and burnt bone. Units 3 to 5 were interpreted as being part of the original multi-room house No. 1 (Henriksen 2002:7). SU 2 was the only layer that produced a sample of bone, i.e. a single bone (Table 13). Two charcoal samples (birch) from SU 4 provided ^{14}C dates (Wk 10188, BP 292 ± 46, 2 sigma calibrated range 1470 - 1800 A.D. and Wk 10189, BP 414 ± 64, 2 sigma calibrated range 1410 - 1640 A.D.; Table 8).

TP 11 was located in a boat house (*naust*) connected to multi-room house No. 2, (Figure 24). Coastal erosion had removed nearly half of the structure. The test-pit had five stratigraphic layers reaching a total depth of 50 cm. SU 1 was a turf layer. SU 2 was a dark-brown sandy layer with charcoal. SU 3 was a black sandy layer. SU 4 was a light brown organic layer overlying a sterile shell-sand layer (SU 5). Although SU 1 was part of the turf layer it provided a fair amount of bone material of fish and a few samples of domesticates (Table 12). Although not dated, these samples were assumed to be modern. In addition, a sample of *Bivalvia* and *Gastropoda* was recovered. In regard to the *Mollusca* it was difficult to conclude if these were evidence of food waste, utilized for bait or a natural deposit due to coastal wave action. SU 2 was a sparse deposit consisting of only a handful of specimens (Table 12). The unit lacked any material that was suitable for dating.

TP 12 was excavated in a shallow deposition in multi-room house No. 3 (Figure 24). The bone material recovered from SU 1 was identified as sheep/goat (Table 12). Two charcoal samples (birch) were recovered from SU 2, providing a ^{14}C date (Wk 10305, BP 637 ± 67, 2 sigma calibrated range 1270 - 1430 A.D.; Table 8).

5.3.3. Værbukta, Måsøy Municipality, Finnmark County

The Værbukta site (test pit sample 14-18) is located at the mouth of Kobbefjord in the Måsøy municipality. Four structures were documented and test pitted (Henriksen 2002). The multi-room structure at Værbukta was a complex cluster form (Figure 25). Two test-pit samples were excavated, one inside the structure in the north central room (TP 14) and the other in the large midden located at the entrance of the structure (TP 15). The midden deposit had a 6.8 to 7.0 pH and was composed mostly of calcareous soils that provided an excellent environment for bone preservation. Despite the excellent preservation, the inclement weather conditions of the outer coast slowed down the excavation. Because of this situation the test-pit was re-sized to 0.50 x 0.50 meters so as to complete the survey on schedule. All of this material was excavated stratigraphically and wet-sieved through a 3 mm mesh. The test-pit reached a terminal depth of 1.3 meters with 9 stratigraphic layers recorded; approximately 13, 000 (NISP) pieces of bone were recovered from the first 5 layers (Table 13). The layer construction can be summarized as follows: SU 1: humus, SU 2: shellsand, some gravel, SU3: fine gray sand, SU 4: shellsand, SU5: black-gray charcoal and sand, SU 6: gray shellsand, SU 7: 5 cm thick fish bone deposit, SU 8: charcoal and burnt bone, SU 9: shellsand mixed with charcoal and bone. A single radiocarbon date from a piece of fish bone located at the bottom SU 9 provided a date (Wk 10322, BP 813 ± 64, 2 sigma calibrated range 1450 - 1680 A.D.; Table 8).

The analysis of the bone material revealed that from all layers the majority of the general taxa was fish, ca. 90 %. The most abundant species represented was cod (*Gadus morhua L.*), which comprised approximately ca. 32 % of the sample (Table 13). There was also an unusually high occurrence of well preserved otoliths (N = 111), mostly from cod. SU 1 was represented by marine fish as well as by a few samples of domestic species-*Bovidae* and pig (*Sus scrofa*)-and wild terrestrial mammals- reindeer (*Rangifer tarandus*) mammals. Modification of bone from this unit involved some of the material being chopped (N = 10) and chewed (N = 9), specifically vertebrae of *Gadidae*. The older units share a similar faunal diversity similar to that observed in SU 1, with a heavy emphasis on marine fish. Butchery marks were present on a few examples. SU 3 had evidence of *Gadidae* vertebrae being chopped. S.U. 4 had one chopped vertebrae of a cusk (*Brosme brosme*) with several elements of knife-marked cleithrum and certohyal from Gadidae. Observed in SU 5 were two saithe (*Pollachius virens*) post-temporal bones with knife marks (refer to Figures 16 and 17 for orientation).

5.3.4. Skonsvika, Berlevåg Municipality Finnmark County

The Skonsvika site (test pit sample 19-23) is located on the outer coast of the Varanger Peninsula in the municipality of Berlevåg; two multi-room houses were documented. Multi-room house No. 1 was a large cluster form (18 to 20 rooms) and was the larger of the two (Figure 26). Multi-room house No. 2 was also a cluster form of about 5 rooms (Figure 27). Three test-pits (TP 19, 20 and 23) were excavated within multi-room house No. 1. TP 19 was located in the southernmost room of the structure, in the eastern half of the room. Part of this unit was obstructed by a large stone so only one quadrant (quadrant C, i.e. 0.50 x 0.50 cm) of the entire unit could be excavated. Despite this obstruction, five stratigraphic layers were recorded to a depth of 70 cm. In general the stratigraphic units were fairly homogeneous and are as summarized as follows: SU 1: dark-brown sandy layer with lenses of shellsand, SU 2: fine gray sand, SU 3: brown soil layer with lenses of sand and fine gravel, SU 4: brown soil layer mixed with sand and some large bits of gravel, SU 5: brown soil layer with lenses of sand and fine gravel; at the bottom of this unit was a stone and burnt wood which was probably the floor. Below this layer a partially articulated lamb was recovered.

The faunal material was primarily concentrated in SU 5 and was quite diverse (Table 14). Signs of butchery and/or some style of bone working were observed in SU 5. Specifically, a single indeterminate seal tibia was recovered with cut marks and an indeterminate *Bivalvia* shell which was chopped and had knife marks on its ventral surface. There were also a few specimens of worked whale bone with knife marks. One radiocarbon date was run on an indeterminate terrestrial mammal bone (Wk 10323, BP 643 ± 47, 2 sigma calibrated range 1270 - 1410 A.D.; Table 8).

TP 20 was situated in a room located in the eastern half of the structure (Figure 26). Four stratigraphic layers were excavated to a cumulative depth of 55 cm. The units are as follows: SU 1: brown sand, SU 2: brown sand with fine gravel, SU 3: light brown sand with shellsand and gravel, SU 4: dark brown sand mixed with ash. At the bottom of SU 4 was poorly preserved wood interpreted as the floor (Henriksen 2002:13). All stratigraphic units produced some samples of bone material (Table 14). An AMS date on birch charcoal provided a radio carbon date (Wk 10309, BP 685 ± 65 BP, 2 sigma calibrated range 1280 - 1410 A.D.; Table 8).

TP 23 was located in the area believed to be the entrance passage of the structure (Figure 26); the unit was 0.50 x 0.50 meters. Five stratigraphic layers were excavated, which exhibited the same stratigraphic sequences as in TP 19. A single fish bone from haddock (*Melanogrammus aeglifinus*) was recovered from SU 5 (Table 14).

5.3.5. Kongshavn, Berlevåg Municipality Finnmark County

The Kongshavn site (test pit sample 24-26) is situated on an exposed point in the Berlevåg Municipality. This is a very large cluster form structure with 18 or 19 rooms. Two test-pits, TP 24 and 25, were excavated (Figure 28). TP 24 was placed in the center of a room on the western side of the structure. Five stratigraphic units were recorded with a cumulative depth of 80 cm and they are described as follows: SU 1: was a gravel and charcoal layer which contained much modern material, SU 2: was a dark gravel layer with large stones and some wood debris, SU 3: was a humus layer with fire-cracked rock and pumice, SU 4: was a flagstone layer intermixed with dark sandy soil containing charcoal and bone, SU 5: lay under the flagstones and was a culture layer which laid on top of another layer of flagstones, intermixed with charcoal and gravel. Finally, underneath there was sterile beach gravel. SU 4 and 5 were interpreted as floor layers indicative of the re-use of the room. The stratigraphic units above these floor layers produced very little bone (Table 15). Bone material was recovered from SU 5 but there were no indications of butchery or cooking (Table 15). An indeterminate terrestrial mammal bone recovered from SU 5 was AMS dated (Wk 10324, BP 585 ± 58, 2 sigma calibrated range 1290 - 1440 A.D.; Table 8).

TP 25 was excavated in one of the northernmost rooms (Figure 28). A total of six layers were documented within a depth of 90 cm. The upper stratigraphic layers were: SU 1: turf, SU 2: beach gravel, SU 3: was a silty brown sand layer, SU 4: was a greasy black-brown layer with flagstones and wood. This layer, SU 4, was interpreted as a possible floor layer. SU 5 marked the floor layer, with wood planks and flagstones lying over sterile beach gravel. SU 6 was underneath the floor and was sterile sand. All layers were fairly limited in species richness (Table 15). There were a few examples of butchery in SU 4, 5 and 6. In SU 4 and 6 halibut vertebrae had knife and chop marks, while other indicators of butchery were observed on indeterminate fish, i.e. ribs, and cut marks occurred on the rib of an indeterminate medium sized mammal. A sample of birch bark from S.U. 5 provided a radiocarbon date (Wk 10193, BP 380 ± 43, 2 sigma calibrated range 1440 - 1640 A.D.; Table 8).

5.3.6. Kjølnes, Berlevåg Municipality Finnmark County

The Kjølnes site (test pit sample 27) is a single symmetrical multi-room house located west of Kongshavn near the Kjølnes lighthouse. A test-pit was placed in the largest room at the southern end of the structure (Figure 29). Four stratigraphic units were recorded to within a total depth of 50 cm. The two upper layers are believed to be from the 18th and 19th centuries. SU 1 was a thick turf layer filled with modern waste and charcoal. SU 2 was a dark gray sandy layer with flagstones. In SU 3 numerous fire cracked rocks were recorded. In the NE corner of the unit were as the possible remains of a hearth, interpreted from a concentration of burnt bone and charcoal, in association with some rocks and flagstones (Henriksen 2002:17). Below this layer was sterile shellsand (SU 4) and a possible post-hole (Henriksen 2002:17). Faunal material was recovered from all stratigraphic units, with S.U. 3 having the largest sample, but no indications of butchery or burning were identified (Table 16). An AMS date for SU 3 was run on birch and European aspen (*Populus tremula*) charcoal: (Wk 10313, BP 697 ± 132, 2 sigma calibrated range 1030 - 1450 A.D.; Table 8).

5.3.7. Laukvik, Berlevåg Municipality Finnmark County

The Laukvik site (test pit sample 29-33) is a large complex site located on a small point west of Nålneset in the Berlevåg Municipality. The site is made up of possibly four multi-room houses of the cluster form (Figure 30). Excavation of the test pits took place in houses No. 1 and 3. House No. 1 is a five room structure built mostly with stones. A later structure (house No. 2) is believed either to have been built over house No. 1's northern passageway, or sections of house No. 1 may have been removed (Figure 30) (Henriksen 2002:18).

Connected to the more southerly side of this long passage were three rooms; behind these rooms was a larger room where TP 29 was placed. The test pit reached a depth of 60 cm and four stratigraphic units were recorded. The removal of the turf layer (SU 1) revealed a dark-greasy brown soil layer with bits of gravel (SU 2). Below this unit a wood floor or collapsed wall was encountered (SU 3). This was followed by a dark-greasy soil layer (SU 4). The unit terminated at a light-greasy brown soil layer (SU 5).

SU 1 contained a fairly rich and diverse bone sample, (Table 17), mostly of marine fish with cod being the most abundant species. The only domestic taxon present was pig. Although the skeletal representation of pig is small, there are indications that whole pigs were possibly brought on-site, given the presence of a skull fragment and elements from the lower appendages. Also recovered from this unit was the anterior portion of a maxilla from a walrus (*Odobenus rosmarus*), which lacked evidence of being butchered. Signs of burning were minimal and evidence of butchery was somewhat limited. There were a few examples of whale bones worked with knife marks.

SU 2 lacks the diversity of SU 1 but it is almost as rich in bone counts, with cod being the dominant species. There were no indications of burning or butchery. No bone material was recovered from any lower units with the exception of a medium terrestrial mammal bone from SU 3 and 4 used for radio-carbon dating (Wk 10325, BP 386 ± 45, 2 sigma calibrated range 1430 - 1640 A.D.; Table 8).

TP 30 was located in a room connected to the long northern passageway (Figure 30). Five stratigraphic units were documented within a total depth of 60 cm. Including the turf, SU 1 was a brown-sandy soil with patches of sand. Below this unit was a dark brown sandy soil with bits of charcoal (SU 2), beneath which lay a flagstone and wood-planked floor (SU 3). SU 4 was a dark cultural layer with charcoal and fire-cracked rock. Recovered in this layer was a side-plate and another accessory associated with a "rolling bone", or *rullevabein*, which was attached to the gunwales of a boat to guide fishing lines. The final unit, SU 5, consisted of fire-cracked rock and burnt wood. This unit lay on top of sterile beach sand and gravel. The flagstones and the planks of SU 3 were interpreted as an occupation floor on top of 20 to 30 cm of cultural deposits.

In general, the species richness and diversity was fairly similar throughout all of the units, i.e. dominated by marine fish, with the presence of some terrestrial and marine mammals. Signs of burning were absent. However, butchery was present in all units except SU 1, and it was very prominent in SU 4. Some specimens of mammal bone, e.g. pig lumbar vertebrae, showed signs of possibly being sawn. Worked bone was also observed, most notably on whale. Other forms of butchery were chopped bone or bone with cut marks resulting from the back and forth movement of a knife-blade. For example, the anterior portion of a dentary ofhaddock was chopped at approximately a 45 degree angle, and the sub-opercle of a Gadidae species had cut-marks from a knife-blade across its lateral surface. In SU 5 there were two examples of sliced fish ribs. A charcoal sample of birch from SU 5 was radiocarbon dated (Wk 10194, BP 396 ± 37, 2 sigma calibrated range 1430 - 1640 A. D; Table 8).

TP 31 was excavated in the westernmost room of cluster-form house No. 3 (Figure 30). TP 31 had eight stratigraphic layers within a depth of 55 cm. SU 1 was a gray sandy layer followed by a mixed layer of sand and humus (SU 2). Once SU 2 was removed another gray sandy layer appeared (SU 3). SU 4 was a brown-sandy humus mixture. Below this unit was a compact humus layer (SU 5). SU 6 comprised of burnt wood and whale bone followed by a unit (SU 7) containing a wooden floor associated with whale bone. The whale bone was part of the house construction. Below SU 7 was a unit composed of sand and humus mixed with charcoal (SU 8). The majority of the bone material comes from SU 3 (Table 17). The collection is not very rich but a few specimens of domesticates (sheep/goat) were identified. An AMS date on birch charcoal from SU 6/7 provided a date (Wk 10304, BP 339 ± 58, 2 sigma calibrated range 1440 - 1660 A.D.; Table 8).

5.3.8. Vadsøya, Vadsø Municipality Finnmark County

Vadsøya (test pit sample 35-37) is an island located east of the town of Vadsø. The site was first investigated and documented by Povl Simonsen in the 1980s (see Niemi 1983, Simonsen 1981, 1991). The site comprises of possibly 26 multi-room structures. The 2001 excavation focused on structure 126 from Simonsen's structure group XXIII (Figure 32). A 0.5 x 0.5 meter test pit (TP 35) was placed in the westernmost room of the symmetrical house form. Three stratigraphic layers were documented within a cumulative depth of 35 cm. SU 1 was a turf layer, which was followed by a dark humus layer with charcoal and bone (SU 2). The removal of SU 2 revealed a unit of flagstones (SU 3) resting on top of shell sand and a mixture of charcoal, bone and ash. S.U. 3 was interpreted as the original floor. A sample of birch charcoal from SU 3 was dated (Wk 10195, BP 322 ± 47, 2 sigma calibrated range 1450-1660 A.D.; Table 8).

The recovery efforts resulted in bone being retrieved from SU 1 and 2 (Table 18). Marine fish were present and domesticates (sheep/goat and pig) as well as reindeer were also represented. Evidence of burnt bone was sparse. Signs of butchery were observed only in SU 1. The anterior portion of the dentary of a cod was sliced at approximately a 45 degree angle, and the sub-opercle of an unidentified *Gadidae* species was also sliced (see Figures 16 and 17 for orientation).

5.4. Discussion

Although the data collection techniques and sample sizes limit the reliability of this preliminary study, the overall collection can be discussed. As would be expected for coastal sites fish were the most numerous taxa represented. Fish richness, however, varied from site to site, comprising anywhere from 50 % to 90 % of a collection. Other taxa were less abundant. Collectively, all mammals (domestic, wild and marine) were well represented at Skonsvika (20 %) and Vadsøyå (33 %). At the remaining sites non-fish bones were typically under 10 %. These two sites also appear to be the most diverse in terms of the number of taxa represented, but the limited excavations restrict the functional interpretation of the sites. It is clear however that some sites, or at least some areas of the sites, were probably more heavily used than other areas.

Butchery is an important factor to consider and its importance will be made more clear in subsequent chapters. At Vadsøyå (TP 35) a dentary from a cod was sliced at approximately 45 degree angle leaving only the anterior portion to be recovered (see Figure 20 for example). Also sliced was the sub-opercle of an unidentified *Gadidae* species. The same butchery observed at Vadsøyå (TP 35) was also recorded at Laukvika (TP 30) where a dentary of a haddock had been chopped at approximately 45 degree angle. Also at Laukvika, the sub-opercle of a *Gadidae* species had cut-marks from a knife-blade across its lateral surface. At Kongshavn (TP 25) several vertebrae from halibut had knife and chop marks. In contrast, at Vaerbukta (TP 15) *Gadidae* vertebrae were chopped and chewed, and several elements of knife-marked cleithrum and certohyal from *Gadidae* were recovered along with two saithe (*Pollachius virens*) post-temporal bones with knife marks.

The results from the 2001 test-pitting and analysis led to the decision to focus the following years' excavations in the Berlevåg municipality. Although the observations on fish butchery did not play a role in this decision-making the style of cut-marks turned out to be of considerable significance. The next chapter provides an analysis of the larger samples from the intense excavations of 2002 to 2004.

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Chapter 6. Site context

In the following the archaeological context of the material used in the presented research will be discussed in detail. This material originates from three sites: Kongshavn, Skonsvika and Nordmansett. In this chapter their analytical units and the chronological phasing of those units will be defined, along with a detailed presentation of the sites‘ archaeological context.

6.1. Overview of sites

The sites used in this analysis are all located along the coast of Finnmark within the Berlevåg municipality (see Figure 1). All of the sites provided faunal material for analysis. Kongshavn has faunal material from stratified deposits located within and outside the structure. Skonsvika has faunal material from stratified deposits located within the confines of the site but in a location believed to be outdoors. And finally, Nordmannsett‘s faunal deposits were recovered from indoors.

6.2. Defining faunal context

In general, the faunal remains from the multi-room sites derive from secure cultural deposits both inside and outside the structures. These are spatially distinct areas separated by physical barriers such as walls and pits as well as strata. Briefly, the Kongshavn material originates from 6 rooms or ″living areas″ and a midden deposit. These deposits are all stratified but have been sub-divided based on chronological division into temporal analytical units (AU). The faunal remains from Skonsvika are derived from a stratified midden deposits and dug pits which conform to the archaeological phasing of the site which are also placed into AU. In contrast, the material from Nordmannsett does not derive from a midden deposit but from a stratified deposit located within the interior of the structure.

6.2.1. Middens

In this presentation all material recovered from a midden will be defined as a deposit of household waste. The use of the term household waste is defined broadly and includes any by-product waste involved in culinary practices, cleaning episodes, and/or activities, whether domestic or commercial, associated with the household. Typically these kinds of cultural deposits are located outside a structure, i.e. either as a primary or secondary deposit. In order to have more comparability between and within the sites the midden deposits are further characterized as an accretion deposit neither originating from a floor layer or a short-term specialized deposit.

6.2.2. Living areas

A living area is a place of residence enclosed by walls. Within its enclosed walls meals might be prepared and consumed, the daily household chores and small scale craft production would be attended to, and residents would sleep as well as socialize. In comparison to middens these are also accretion deposits either directly or indirectly associated with a floor layer. These deposits reflect the activities that have taken place within the enclosed walls for a period of time, which depending upon episodes of floor cleaning and intensity of the activities can vary in thickness. These types of deposits only pertain to Kongshavn and Nordmansett.

6.2.3. Pits

At Skonsvika several pits were excavated. The pits are located in the same outdoor activity area as the midden. Like the midden, the chronology of the pits is tied into the phasing of the site, thus some of the pits are contemporaneous. The pits have been interpreted as multi-functional from smoking (meats) to storage (of procured meats). Pits appear to be functionally exclusive although there are possibly one or two pits that were both used for smoking and storage.

6.3. Chronological phasing

The following will discuss the approaches used to aggregate the data in order to fit it into a comprehensible chronology for easy comparability. Aggregation centered around two types of data units: the stratigraphic unit (SU) and the analytical unit (AU). The stratigraphic unit is the cultural/natural strata from which the material originated. The analytical unit is the aggregation of stratigraphic units based on pre-established criteria. In this research analytical units were formed by the following criteria: time distinction and spatial and deposition distinctions.

Analytical units formed by time distinct material had been used at Kongshavn and Skonsvika. At Kongshavn all of the deposits were divided chronologically between the Late Medieval and the Early Modern periods. Temporal differences were established by stratigraphic, material culture and radiocarbon dating. At Skonsvika all of the deposits were sub-divided into phases based on the life history of the site during the LM. It was practical to aggregate units this way in order to make comparisons between and within the sites. Such an approach allowed for a better understanding of the large scale changes that occurred over time.

Analytical units formed by spatial and depositional distinction were used at Kongshavn and Skonsvika. In Kongshavn living areas and middens were defined as separate units. Spatially, these are separate units with living areas located indoors and midden deposits located outdoors. In a living space the mundane activities of everyday result in the accumulations of matter on the floor. Occastionally overtime these inadvertent depositions can build-up and reveal very task-specific activities to that space. In contrast, a midden which is a deliberate deposit and originates from a variety of primary sources has the potential of reflecting the activities taking place at the whole site. At Skonsvika the midden and the pits were defined as separate analytical units. Although both units share the same space their original function differed. However, with the everntual disuse of pits they became incorporated into the midden making depositional distinctions harder to make. The aggregation of these units permitted distinctions to be made within the sites as far as the use of space and how activities indoors may or may not be different from those outside or how function of features may differ.

Finally, due to the sparse nature of a few of the stratigraphic units, in terms of bone frequencies, lumping was a logical alternative. As individual layers some of the stratigraphic units were too small to have significance in a zoo-archaeological discussion, however aggregated together these proved to be useful. Lumping was applied to the previously defined units. Coupled with the above criteria, which established a sensible way to define analytical units, lumping provided the robusticity to make those units statistically valid.

6.4. Kongshavn faunal context

6.4.1. Overview

The Kongshavn site is located in Berlevåg municipality on the Kjølnes promontory (Figure 28). The following information has been provided by B. Olsen and J. Henriksen and their documentation of the Kongshavn excavation from 2002 to 2004

(Henriksen In Press). The site is situated on a prehistoric shoreline surrounded by rock outcrops and has access to a small cove. The surface survey revealed that the Kongshavn site was a cluster of 20 rooms most of which were interconnected. The area of the site is 43 m x 26 m. In the SW portion of the site there are several large rooms with very large stone walls which are well defined and observable on the surface. The NW portion of the site is fairly even and lacks the definition of the SW. Surrounding the site to the north are several structures dating to the 19th and early 20th centuries, associated with the fishing and stockfish production of that period. The following will discuss the excavation strategy, the potential problems associated with that strategy as well as describe the origin and archaeological context of the faunal material used in this dissertation.

The excavation strategy was designed in the spring of 2002. It was decided that a narrow trench would extend across a large portion of the site. The purpose of the trench was to cross cut as many of the rooms as possible to gather as much information regarding the relative chronology, construction details and functional differences between the rooms. The trench was placed in a NNE to SSW orientation extending for a total length of 30 m with a width of 2 m. Originating in the NE corner of Room 0 the trench ran across five other rooms with its point of termination outside the external wall of the site.

The following is a justification for the above exploration strategy in the NW portion of the site. First, there was the practical placement of the trench to consider. In the SW of the site there were massive stone walls which had the potential of making it difficult to place a trench properly. In addition, because this part of the site had clearly visible and well defined features it was possible from surface inspection alone to gather adequate information on the building lay-out. Also, it was because of this high degree of exposure that the SW portion was believed to be more disturbed and less rich in archaeological information. In comparison, the northern portion presented itself as more practical in terms of placement of a trench due to the low relief of the area. Also, it was because of its undisturbed appearance that it was assumed that this area would be rich with information. However, once digging commenced and the turf was removed it became clear why the northern portion of the site was less defined and rather flat compared to the southern portion. The reason was that large stones had been used as fill within the rooms to even out the surface. It is believed that this was related to the 19th and 20th century fish processing activities when the pre-existing high walls were collapsed to create a more functional surface possibly used for drying racks.

This created a huge challenge for the excavation and documentation strategy. Primarily, it was difficult to identify any continuous natural and cultural layers between rooms since all were interrupted by walls or damaged by wall collapse. As a result of this situation each room became an isolated spatial unit. Within each spatial unit artifacts were provenienced and all layers were drawn and photographed. The same recovery procedures were applied to the faunal remains with the addition of sieving.

The analyzed material at Kongshavn (33, 808 TNF; 16, 983 NISP) originated from accumulated deposits within the six ″living areas″ and midden deposit at the site. Together these deposits span the complete 30 meters of the trench. Although the material was recovered along the entire trench it was the more northerly portion of the trench, Rooms 4, 5 and the exterior midden, which had the greatest concentration of bone material. As mentioned in Chapter 3 the material was excavated stratigraphically. These stratigraphic units were later aggregated into larger analytical units for easier comparability. The overall preservation of the material was good given the dramatic depositional history of the site. Based upon observations during the excavation it is clear that the collapsing of the site occurred well after the cultural layers were sealed.

Based on the excavation strategy potential problems were expected with regard to the recovery of the faunal material. One, was the limitation of the trench which only captured a small percentage of the site, less than 10 %. Second, was the possibility of missing the middens entirely, but fortunately this was not an issue. Third, the recovery strategy of faunal material was limited to rich layers of bone material, which could have resulted in less dense but significant layers being inadvertently over looked. However, the layers used in this dissertation were sieved 100 %. Fourth, Kongshavn‘s unique taphonomic history raised concerns about the high level of fragmentation and the potential for over-representation of taxa. However, as mentioned previously this was most likely not an issue given that the units used in this research were from layers already covered by natural sedimentation and roof collapse.

6.4.2. Specifics

The data originates from the six ″living areas″ within the site as well as a midden deposit. Each of these areas will be described as a separate unit. Within the “living areas” the diversity is much more variable between the rooms. This noted difference can be interpreted as revealing distinct behavioral, and possibly functional, differences between and within the rooms. The following is a synopsis based on the archaeological interpretation by Jørn Henriksen.

Room 0 was located at 101/100 x and 97/96 y. The stratigraphic units were 1, 2, 3 and 4. SU 1 was a turf layer. SU 2 was interpreted as a floor with slab stones intermixed with light grey gravel and small stones. On the slab stones was a concentration of charred stone. SU 3 was a fine black organic soil intermixed with charcoal and fire-cracked stone. SU 4 was interpreted as an earlier floor made of slab stones. Recovered from this layer were fire-cracked stones, charcoal and bones. Below this layer was sterile fine gravel soil.

Room 1 was located at 101/100 x and 100-105 y. The stratigraphic units were 1 through 7. SU 1 was a turf layer composed of a mixture of sand and gravel. SU 2 was composed of roof collapse and black organic soil with bits of charcoal. SU 3 was a complex cultural layer of black organic soil mixed with charcoal and fire cracked stones. In the upper half of the unit there were slab stones, which indicate a re-use of the room. Below these slab stones was an elaborate corner fireplace. In addition, running along the edges of the stone walls were upright planks which were remnants of the interior wall planking. SU 4 was a cultural layer of decomposed wood above SU 5, which was a slab stone floor. SU 6 was another slab stone floor and in between its stones there was a mixture of bone, charcoal and fire cracked stone. The interpretation of Room 1 is that SU 3 – 6 are connected to the Late Medieval occupation. The artifacts recovered from this room include a line sinker, steatite vessel fragments and ceramic sherds. Micro-morphological analysis has interpreted that the second phase of this room involved the keeping of livestock.

Room 2 was located at 100/101 x and 107-110 y. The stratigraphic units were 1 through 6 with SU 3 through 6 producing most of the bone material. SU 1 was composed of stone and gravel mixed in with medieval artifacts and fire-cracked stone which filled in the structure. SU 2 was a thick layer of burned wood and fire-cracked stone. SU 3 was a black organic layer intermixed with charcoal. Recorded in this layer was a massive corner fireplace and one posthole with part of the post preserved. SU 4 was associated with the fireplace and consisted of charcoal and ash. SU 5 was the floor layer of compact soil intermixed with charcoal and ash. SU 6 was the floor base composed of a compact soil intermixed with charcoal and ash.

The following is the archaeological interpretation of Room 2. The main layers of occupation were SU 3 – 6. Based on the evidence from SU 2 it is clear that this room burned down. After the destruction of the room it was filled-in with debris from the Late Meddle ages. Most notable were the numerous baking plates (*bakstehelle*) and medieval finger rings. Later, the room had been deliberately altered but the reasoning for this is not clear.

Room 3 was located at 100/101 x and 109-113 y. Stratagraphic units 4a through 5 (100 x and 111-113 y) were a midden deposit used in this dissertation. SU 1 was a heavily disturbed mixture of turf, boulders and soil. SU 2a was a heavily disturbed layer of dark humus believed to be a cultural layer, possibly a floor layer based on remains of wood. SU 2b was a heavily disturbed layer composed of a mixture of bone, fire-cracked rocks, and charcoal. SU 3 was a mixture of gravel, humus and fire-cracked stone. There was a mixture of finds from the medieval and the post-medieval periods. SU 4a was a dark sand layer intermixed with gravel. Within the layer there is a concentration of fire-cracked rock located at ca. 100.5 – 101.5 x 111.5 – 115.7 y. SU 4b was a compact brown humus layer with wood planks. SU 5 was interpreted as the bottom layer composed of compact charcoal. Located in the northern portion of this room were features which have been interpreted as a possible stone pathway or foundation connected to Room 4.

Interpretation of this room is complex. The upper layers (SU 1 - 3) are heavily disturbed. The disturbance is primarily associated with the late 19th century fishing activities near-by, which are noted in SU 1 - 2a. SU 2b is interpreted as a midden based on artifacts recovered such as post-reformation ceramics. However, the lack of certain artifacts, specifically clay-pipe stems, places the deposit somewhat later than 1550 A.D., but earlier than 1630/1650 A.D. when clay-pipes become ubiquitous. SU 3 was an early modern deposit and is associated with the post-medieval re-occupation of the site and construction of a house. As a result of the building effort earlier deposits were disturbed resulting in the mixing of medieval and post-medieval material. As mentioned, the construction of this house is associated with the re-occupation of the site in the 16th to mid-17th century, which possibly connects the site with the larger fishing communities located along the Varanger peninsula. All layers below this activity (SU 4a -5) are of a medieval date, associated with a large concentration of fire-cracked stone and a potential passage. Based on these features, in addition to other evidence like the bone material, the interpretation of this room is that it was an outdoor activity area.

Room 4 was located at 100/101 x and 114-117 y. The stratigraphic units used in this dissertation were SU 3 -7. SU 1 was the turf layer mixed with boulders and modern trash. SU 2 was a dark brown humus layer with some modern trash from the previous unit. There are some slab stones present but these had been disturbed. SU 3 was a cultural layer composed of dark brown humus layer underneath the slab stones intermixed with pieces of wood. SU 3b (101 x 113-117y) was a wall described as a grayish humus soil with bits of gravel intermixed with stones and animal bones. Both SU 3 and 3b were interpreted as midden deposits. SU 2b was a dark brown humus layer connected to SU 2 and is beneath SU 3b. SU 4 is a slabstone floor intermixed with dark organic soil above the slab stones with traces of wood. SU 4b was mostly coral sand located outside the concentration of slab stones with patches of humus. SU 5 was a brown sandy soil in between the slab stone floor. SU 5b was coral sand outside the concentration of slab stones with patches of humus. SU 6 was a brown sandy soil beneath the slab stone floor. SU 7 was a brown organic layer intermixed with charcoal, ash and animal bone. One feature associated with this layer was a pit dug into the sterile coral sand. The pit was lined with stone slabs. SU 8 was sterile coral sand under the floor.

The following is a brief interpretation of Room 4. It is believed that layers SU 2 - 3 represent activities from the Early Modern period based on the material recovered. SU 4 and the later units represent the Late Medieval period. The slab stone floor (SU 4) was similar to the one excavated in Room 1 but not as even. Based on the recovery of wood planks over the slab stones it is believed that this was used as a dwelling of some kind.

Room 5 and its outer wall are located at 100/101 x and 117-126 y. Excavators separated this part of the site into two units of analysis: the northern outer wall and the room proper. This decision was based on the fact that the wall was so heavily disturbed by modern material that it lacks any relation to the stratigraphy of the room. SU 1 begins below the turf layer and is described as a cultural layer of coarse gravel sand, pebbles and fire-cracked stone. Bone material is also recovered. SU 2 was a cultural layer of coarse gravel sand, pebbles and fire-cracked stone with fine sand and traces of ash and charcoal. This unit also produced bone material. SU 3 was a cultural layer of coarse gravel sand, pebbles and fire-cracked stone with fine sand and traces of ash and charcoal. This unit also produced bone material. Here a piece of reindeer antler was radio carbon dated (Wk 12174, BP 618 ± 46, two sigma calibrated range 1290 - 1410AD). SU 4 is fine brown sand with fire cracked rock and charcoal over coral sand. Dug into the coral sand directly below the fire cracked rock and charcoal was a fireplace/cooking pit dated to the Viking period by birch charcoal (genus *Betula*) (Wk 14675, BP 1104 ± 40, 860-1020 A.D.; Figure 3).

Within Room 5 proper the stratigraphic units here are SU 1 – 9/ SU 6 100 x and 118.5-122.0 y. Room 5 proper can be separated into two analytical units: modern and medieval. Units 1 -3 are modern while 4 -9 are medieval. The material presented in this dissertation comes from both of these analytical units. SU 1 is the first sub-turf layer which included large boulders believed to have been deposited in the early 20th century and is also composed of partly decomposed turf. SU 2 is a layer of partially decomposed turf. SU 3 was a heavily disturbed cultural and floor layer of black humus, slab stones, and charcoal. SU 4 was a layer of coarse grey gravel and sand with fire-cracked stones and charcoal. SU 4b was a mixture of coarse light-grey sand and coral sand with stones. SU 5 was a cultural layer composed of dark organic soil mixed with humus, coral sand, decomposed wood, and whalebone. Associated with this layer was a well constructed hearth radio carbon dated by birch charcoal (genus *Betula*) (Wk 14676, BP 670 ± 43, two sigma calibrated range 1270-1400 A.D.; Figure 3). SU 6 was a compact dark organic floor layer associated with remnants of wooden wall panels and posts. SU 6b was a midden deposit intermixed with coral sand. SU 7 was a compact dark, organic layer interpreted as the bottom of the floor. The features associated with this layer are a slab stone platform under the hearth, and remnants of wooden planks underneath the panel walls. SU 8 was an ash layer below the fire-place. SU 9 is interpreted as the foundation of the floor based on the evidence of a natural ditch filled with stone, and a post-hole dug into sterile coral sand.

6.5. Skonsvika faunal context

6.5.1. Overview

The Skonsvika site is located in the Berlevåg municipality situated in a well protected bay on the Svartnes promontory. Much of the following is based upon the archaeological documentation by P.Urbańczyk, K. Skrzyńska, and K. Misiewicz which took place over three field seasons: 2002-2004. Skonsvika is a large cluster form multi-room house site with a possible wall enclosure (Figure 26). The house is roughly 5 to 7 meters above sea level. The preliminary surface survey documented 18 to 20 depressions. At its widest point the site is roughly 40 meters (E-W) by 35 meters (N-S). The following will discuss the excavation strategy, the potential problems associated with that strategy as well as describe the origin and archaeological context of the faunal material used in this dissertation.

A strategy of excavation of Skonsvika, similar to Kongshavn, was devised in 2002 and resulted in the decision to cut a large trench across the entire site. This decision was reached based on the desire to acquire as much information as possible given the limited resources and time. Thus, a 40 meter by 2 meter trench running N-S was placed cross-cutting the entire site. To get at relative chronology and construction details this trench covered the entire length of the site and included several surface features believed to be rooms and walls.

The excavation followed a strict stratigraphic methodology with each layer being recorded and removed separately. Soon after the removal of the turf and several layers (S.U. 1-3) it became clear that the entire site was covered by a series of aeolian deposits, which were separated by periodic organic soil formation. These latter soil formations formed during relatively short periods at the site. Aggregated together these natural layers made up an approximately 0.5 m thick series of alternating light and dark sandy soil types. When this has been established a more rigorous approach was adopted to remove these non-cultural layers. Once more solid layering had been exposed the intended recording practice was resumed, which was a standard single-context excavation and documentation. The documentation relied upon digitized recording for high-precision documentation. The archaeological accumulations, were thick making it unrealistic to sieve the entire site or every layer for that matter in the available time. Therefore, it was decided to sieve only layers of a midden-type with a dense concentration of faunal material.

The faunal material from Skonsvika (23, 831 TNF; 11, 114 NISP) comes from a large midden deposit. The area of excavation from which the material used in this research was recovered was from 114 to 121 N. In total the entire excavation resulted in 80 plus single-context layers and 4 phases with context layers 12, 14 and 46 being the main sources of bone material. The main focus of recovery was in an area around a large outdoor oven (Oven 1). This oven was surrounded by a series of 9 pits, which were filled with ash and bone. The overall preservation was good owing to the intermittent layers of wind-blown shell sand which sealed the analyzed midden layers and provided a neutral to slightly alkaline pH level conducive to good bone preservation. Given the rapid deposition history of the deposits in favorable soil conditions the material recovered was highly diverse with a very low taphonomic foot print and was in taphonomic terms very homogenous.

The preceeding shows an excavation strategy can have a negative influence on the recovery of faunal material. One, is the limited extent of the trench. Although practical for purposes of understanding chronology and building tradition it limited the sample size of the faunal material. There was also the possibility of missing the middens entirely. Second, the recovery of faunal material was limited to layers that were deemed organically rich a subjective judgement. As a result the site was not 100 % sieved. However, the layers that were considered rich in bone material were sieved 100 %.

6.5.2. Specifics

In the following phasing and stratigraphic of the site will be discussed. The site was divided into 4 phases each with its own unique features and qualities.

Phase 1 is regarded as representing the earliest activities on the site. The main locus of this early activity was in the central portion of the trench, between 114 and 121 N. Located in this area were two features, pits 8 and 9, both dug into the natural gravel surface and therefore considered the earliest phase of the site. Pit 8 was irregularly shaped (0. 58 m x 0. 44 m) with a depth of about 0. 36 m. The bottom of the pit is flat. The fill of the pit, SU 61, was made of an organic greyish brown soil with fish bones and pieces of wood. This pit was truncated by three stake-holes. Pit 9 (120 N/98 E – 121 N/98 E) was almost oval in shape (0.78 m x 0.64 m) with a depth of 0.84 m. This was a flat-bottom pit the primary fill of which is composed of dark grayish-black sand mixed with very fine silt and decomposed charcoal with fish bones and fish scales, about 2 cm thick (SU 68).

Artifacts recovered from these features were small in number. Several iron nails and iron objects that could not be identified were excavated from Pit 8 along with a round bone object. From Pit 9 an ambiguous piece of bone was recovered along with a stone sinker, possibly of soap stone. Unfortunately, dating of this material was not possible..

The first phase is regarded as evience that people had started to utilize the site. Although it is believed that the visits were seasonal it has been suggested that preparations were underway at this point for a more permanent residence. The function of the pits is not clear. Pit 8's primary function was possibly a posthole firming up a large wooden post and then later changed to rubbish deposit while Pit 9 was a storage pit, reserved for food like dried or smoked fish or some other storage function. The following will discuss the specifics of the site in regard to the phasing and stratigraphy. The site was divided into 4 phases each with its own unique features and qualities.

Phase 2 is interpreted as the emerging permanent settlement at Skonsvika. The extent of phase 2 is similar to the previous phase with the main focus of activity between 114 to 121 N. There are several features associated with this phase: pits, an oven and wooden stakes and stake-holes. Those features where faunal material was recovered will be discussed in greater detail.

Pit 4 (113. 70 N to 114. 50 N) was an irregular shaped circular pit with a diameter of ca. 0.7 m and a depth of 0.83 m. Several layers were excavated inside this pit. The bottom layer (SU 64) was an organic dark grayish-brown soil, interpreted as decomposed wood mixed with fish bones. The upper layers are part of the third phase of the site and are composed of midden SU 34, 46.

Pit 5 was an irregularly shaped depression, 2.1 m long and varying in width from 0.36 to 1.0 m with a depth of 0.28 m. Layer 55 was the fill, a firm dark grayish-brown organic soil comprising the remains of decomposed planks.

Pit 7 was circular with a diameter of ca. 1.2 m. On top of the fill was a cluster of loose stones resting on a thin layer of decomposed wood with organic dark grayish brown soil underneath. This pit had vertical walls extending to a depth of 0.82 m. Originally it had been filled by a firm, dark grayish-brown soil containing much decomposed wood and charcoal (SU 63). The bottom of the pit and the upper parts of the sides were covered with a thin layer of yellow ash containing remains of fish (SU 63a). This ash has been interpreted as the result of smoking for curring meat.

Oven 5 is a central feature of phase 2. This was large oven at 1.6 m in length. Only a portion of it was excavated due to the limitations of the excavation trench but what was exposed revealed a heavily constructed feature with multiple walls of stones of varied sizes covered with shell sand. The shell sand has been interpreted as possibly having a functional purpose as an insulator. Excavated from within the interior of the oven was a ca. 6 cm thick layer of yellow ash (SU 57).

Also recorded were three stake-holes with stakes. These stakes may have supported the post from Pit 8. These were ca. 0.2 – 0.3 m in diameter and ranged in depth from 0.22 to 0.35 m. The fill (SU 58, 59 and 60) of these posts was all similar: a firm, brownish-black silty soil with bits of decomposed wood.

As in the previous phase the frequency of artifacts from Phase 2 was small. Pit 7 had a fair amount of artifacts made of bone and antler, including a hoe-like tool made of whale bone, a knife handle and an ornate bag lock made of antler. Recovered also was sherds of German stoneware. An antler knife handle and several unidentifiable iron objects were recovered from Pit 4. Within the oven iron nails were recovered. Typological dating of some of the artifacts provides an approximate date to the ca. 13th – 14th centuries.

The archaeological interpretation is based on the analysis of P. Urbańczyk and K. Skrzyńska. Some of the features connected to Phase 2 had been destroyed by later activity. For example, the floor layer (SU 57) associated with the oven had been removed and was believed to have been used as leveling material in Phase 3. It was unclear if Oven 5 was a free-standing open-air structure or part of a building. Therefore, it was assumed that the house structure was destroyed with the materials used for later construction. South of the oven features were recorded which mark the formation of a courtyard and out-door activity area.

Pits 4 and 5 had held wood covered containers for food or household products. Pit 5 was shallow and had a wooden barrel or bracket at the bottom. Pit 7 was interpreted as a smoking pit and is believed to have been used later as a storage or rubbish pit. This pit was the only pit that produced bone material for analysis. As mentioned SU 63a and 64 both produced bone material. These were spatially distinct layers but temporally they are related to this phasing of the site.

Phase 3 at Skonsvika is considered as the apex of the site. It is during this phase that the spatial organization becomes more defined between a division of built spaces and open-air activity areas. Also, it is during phase 3 that the heavily utilized activity area was enclosed by a wall made of stone. The structures consisted of joined rooms connected by intersecting doorways and corridors. From this it has been suggested that during this phase the site was enclosed and that within the enclosure there were numerous structures and a large open-air activity area. To gain access to the site there was a main entrance corridor to the west. Archaeological interpretation divided this phase into three separate sub-phases (Phase 3 a,b,c) based on changes in internal organization and utilization of space over time.

The following will briefly discuss the sub-phases of Phase 3. During Phase 3a there was a heavily constructed turf walled building. P. Urbańczyk and K. Skrzyńska call this room the ″winter room″. In addition to the "winter room" several pits were associated with the phase: Pits 4(6), 2 and 3. During phase 3b an extra room was added to the ″winter room″ known as the ″summer room″. This room was made of lighter construction material, mostly wood, but it is possible that there was heavier material on the outer walls because the existing wood paneling was rather thin. Within the center of the room a large oven (Oven 2) was constructed. The construction of this room in the southern portion of the site also resulted in the extension of the activity area further south. Phase 3b also saw the construction of an oven (Oven 1) and a new pit (Pit 7). Phase 3c mostly represents a continuation of the pre-existing spatial organization with some modification. For example, in the yard Oven 1 is extended SW with the construction of a stone platform.

The artifacts recovered from the above structures will be briefly discussed. The greatest frequency of finds was recovered from within the "winter room" (SU 47). These artifacts varied from several pieces of unidentified bronze fragments to hand-crafted items such as bone gaming pieces to likely imported items of decorative bronze. The floor layer (SU 18) of the winter room contained fragments of iron and boat nails and a stone sinker for a fishing line or net. Also, a large number of cut animal bones were recovered from this floor.

Many artifacts of diverse types were recovered from the summer room. SU 54 produced a fine bone handle and a piece of “Baltic” type pottery dated between the 11th and 14th centuries. A variety of artifacts was recovered from SU 51 including an iron knife blade, strike-a-light, baking plate and an iron object. On the original floor layer (SU 49/29) a stone sinker and a piece of a bone comb were recovered. The floor layer (SU 22) above the original floor produced several boat nails, pieces of iron, a bronze needle, a stone sinker and a baking plate. Finally, recovered from the upper floor layer (SU 10) was a large quern stone-like object, although it is believed that this was not a useable quern stone because of the porosity and the irregularity of the stone. The finds from both the “winter” and “summer” rooms point to the late medieval period.

The interpretation of the above areas suggests a difference in function between the rooms. The “summer room” finds are more suggestive of a living space. Also, the construction of a large central fireplace indicates more of a living space quality to the “summer room”. In contrast, the multiple entrances of the “winter room” indicate that this had a transit function where people passed through to other rooms and was thus not a proper living space. The interpretation of this room is that it resembles more of a workshop and/or storage area.

The house yard area was also divided into sub-phases and follows the same chronology as described for the structures. There were indications that some pits from Phase 2 were still in use during Phase 3. For example, Pit 4 was used as a storage pit during both Phases 2 and 3. Construction of newer pits did take place during Phase 3a with the construction of Pits 2 and 3. During Phase 3b Pit 1 was built. As mentioned previously, Oven 1 was constructed in association with SU 46, the earliest midden layer recorded at the site during Phase 3b. SU 46, which covers the entire yard area, is a slightly firm dark grey soil containing strongly decomposed pieces of wood and large amounts of bones. SU 46 filled and evened out the depression of Pits 2,3, and 4 and was localized around the oven (Oven 1). Outside the pits the thickness of SU 46 was quite regular between 3-5 cm. SU 35 was the next midden layer which was the same context/matrix as 46, however these two layers were separated by a natural sand deposit SU 37. North half of SU 35 was SU 34, which covered an area north of the oven and had built up against the southern wall of summer room (9 cm thick) and is composed of firm, very organic silt sand and bones. Above SU 35 and 34 was SU 14 which had also built-up against the southern wall of the summer room as a very thick midden deposit of ca. 0.12 m. This is a more mixed layer of firm dark organic silt and fine sand containing numerous grains of gravel.

The formation processes of the courtyard is as follows. Phase 3a was a very short period indicated by the fact that none of the pits (1,2,3,4) are in spatial conflict with the summer room or Oven 1 both of which emerge in Phase 3b. During most of phase 3 the area between the summer room and the smoking pits is characterized by accumulation of highly organic midden layers (SU 46, 35, 34 and 14). In the northern portion of the yard the midden material built up against the southern wall of the “summer room”. Oven 1 was the primary structure of this area, however the midden formation relates to the other structures and the house area as well. The final activities of Phase 3 are when the pits go out of use and become over laid by younger deposits.

Phase 4 is the final phase of the site and represents a short abandonment period. The two main rooms excavated were abandoned but activity around the oven (Oven 1) continued. Phase 4 was divided into two sub-phases: 4a represents the last activities connected to the use of Oven 1 (and simultaneously the period of the house collapse) and 4b the time when the site was completely abandoned and all of the structures were covered by deposits caused by natural processes.

Phase 4a saw two rooms abandoned and partly destroyed. After the “winter room” collapsed a pit hearth was built on top of its northern wall. This is believed to be associated with the continued use of the activity area and Oven 1. Oven 1 as mentioned was still in use during this phase with SU 11 and 8 excavated from its interior specifically associated with it. Surrounding the oven, in the area between the former summer room and the smoking-pit depressions new midden layers were formed (SU 12, 9 and 6). Of these SU 12 was most substantial, 0.2 and 0.5 m thick, consisting of a heterogeneous deposit of firm dark slate sand intersected by shell sand mixed with organic silt, gravel, pieces of decomposed wood and large amounts of fish bones.

The finds recovered from this phase were few in number. Many of the finds were iron nails and bits and pieces of iron (SU 56). Some finds were found associated with Oven 2 (SU 21) including fish hooks and boat nails. Within the now abandoned summer room a small iron ring and more nails were recovered (SU 10). However, the area with the greatest collection of finds was around Oven 1 within the midden deposit. SU 12 produced an assortment of nails, boat nails, unidentified pieces of iron and large amounts of cut bone. SU 9 produced a number of artifacts associated with activity around the oven including numerous baking plate fragments, a strike-a-light, knife handles, sherds of pottery and artifacts made out of antler. The final layer of Phase 4a, SU 6, produced a strike-a-light and a bronze belt clasp. The belt clasp was of the "lyre" style clasp which is associated with north and northwest Rus' where lyre-shaped were popular between the 12th and first half of the 14th century.

There are two possible interpretations of phase 4a. Either this period represents sporadic use of the site post-settlement or the site was still partly inhabited. Either scenario is possible. What is known is that the activity area was still in use during this phase.

Phase 4b is the final phase of the site (SU 7, 5, 4, 3, 2, and 1). SU 7, 5, and 4 are connected with the medieval phase of the site. SU 7 was primarily made up of collapsed roof and turf walls and covers the destroyed structures on site. Above SU 7 was SU 5 which is the final layer connected to the destruction of the medieval household. The final layer of this medieval phase was SU 4. This layer contained a fair amount of animal bones indicating that the activity area was still in use. The final layers, SU 3, 2, and 1 were all natural. SU 3 and 2 were wind deposits while S.U. 1 was topsoil.

6.6. Nordmansett faunal context

6.6.1. Overview

The site of Nordmansett is located in the Berlevåg municipality approximately 8 km east (as the crow flies) of the village of Berlevåg. The site is situated in a small protected harbor by the same name and consists of a symmetrical house form with four rooms leading off the main corridor with a fifth room located at the terminal apex of the corridor, Figure 31. Attached to the house structure was another room with a separate entrance. Overall the site measures roughly 12 m x 12 m. The main entrance of the structure faced the east. The following will discuss the excavation strategy; the potential problems associated with that strategy as well as describe the origin and archaeological context of the faunal material used in this dissertation.

The excavation strategy at Nordmansett involved the placement of a single trench. The primary goal of this excavation was to acquire better dating material than recovered previously from the 2001 excavation. The trench was 5 meters long (113 N 96 E) and cut across the main corridor and two of the front rooms. As the excavation proceeded the trench was extended another 1 m x 2 m W. This was a single-context excavation with all stratigraphic units recorded and documented by digital photography. Given the lack of time for this excavation none of the layers were sieved. Therefore the main method of collection of data was by hand.

The context of the faunal material for Nordmansett (141 TNF; 40 NISP) comes from the front room of the structure, see Figure 31. There were no features associated with this area to indicate the function of this area. The primary sources of bone material are SU 8 and 9.

The above illustrates potential problems with the data used in this dissertation. The main issue is the lack of screening of the material. The second issue was the narrowness of the trench. Both of these issues put limitations on the inferences that can be made from this material.

6.6.2. Specifics

At Nordmansett a total of 9 stratigraphic units was recorded. The most recent layer (SU 2) was composed of sand and charcoal and a few animal bones. Below this unit was a brownish sandy layer (SU 3). SU 4 was described as a red-brownish turf mixed with shell/slate sand. Below this layer was a gray-brownish sand (SU 5). Stratigraphic units 6-8 are described as secondary fill from the front room. SU 9 was the original floor which consisted of very dark brown organic soil, at a final depth of ca. 80 cm below surface. This sunken feature had what appeared to be thin wood paneled walls. After the use of this area ceased the shell-sand from walls slid in and the walls collapsed.

In the following the finds and interpretation of the area of excavation is discussed. From SU 2 clay pipe stems and an object made of whale bone were recovered. The clay pipe stems provide a *terminus ante quem* of the Early Modern period. SU 3,4 and 5 produced no artifacts but there was a few bits of bone from SU 5. SU 6-8 produced an assortment of bones and boat nails. SU 9 was the original floor layer under which an iron chest corner fitting and a small chest lock fitting of an Early Modern type were recovered. This layer also produced bone. Both SU 8 and 9 produced the largest amount of bone material (124 TNF). Given the limitations of this excavation it is difficult to present a conclusive interpretation of the function of this room. However, the bone evidence does reveal similarities in butchery practices as observed elsewhere which will be discussed later.

Chapter 7. Analysis of the Faunal Assemblage from Berlevåg Municipality Finnmark County Norway

7.1. Introduction

The following section will examine the faunal material recovered from the sites excavated on the Varanger Peninsula in the Berlevåg municipality focusing on the sites of Kongshavn, Skonsvika and Nordmensett. To date this project has identified approximately 80, 000 fragments of bone which will be presented in the following.

7.2. Analysis of Late Medieval Faunal Collections from Kongshavn

7.2.1. Kongshavn Room 0 "living area"

Only a portion of Room 0 was excavated. There were four stratagraphic units recorded in this room: SU 1, 2 , 3 and 4. The bone material was recovered from SU 3 which was a fine black organic (fatty) soil intermixed with charcoal and fire-cracked stone. Below this unit was SU 4 which was interpreted as a floor layer of slab stones, fire cracked rock and charcoal.

Total Number of Fragments

The fragment counts for room 0 can be found in Table 22 at 345 TNF. Fish dominate all taxonomic categories with about 62 % of the collection or 214 TNF. There is a large percentage of indeterminate bone recovered from the room that comprises about 30 % of the faunal remains (108 TNF). The other taxonomic categories are not significantly represented (23 TNF).

Number of Individual Specimens

Specimen counts reveal a low species diversity in room 0 at 39 NISP. Four species of fish were identified, see Table 23. None of these produced a robust sample to warrant further analysis (total 38 NISP). A single reindeer bone was identified as a first phalange.

As previously mentioned, a large percentage of indeterminate material was recovered. Combining this material with the rest of the faunal deposit the overall fragmentation of the deposit reveals that a significant proportion of the bone material is under 2 cm maximum length, with no bone fragments larger than 5 centimeters (Table 21). However, it should be mentioned that this analysis did not take into account fragmentation at the element or species level as advised by Outram (2005) and Outram (2001), which discuss a methodological approach for dealing with indeterminate bone (see also Outram 1999). The analysis also revealed that 10 % of the collection was burned. All of this burned bone was calcinated; with the exception of one identified fish vertebra the remaining material was indeterminate.

The negative evidence is also important. Indicators of butchery or human/animal agency on bone are absent.

Summary

Room 0 is a small and low diversity deposit. The high frequency of small fragments can be interpreted as evidence of attrition through natural taphonomic processes and density-mediated destruction with a degree of burning aiding in the attrition of the deposit.

The provenience of the archaeological material during the excavation could provide some indication as to the concentration of activities. Two localities within the room were recorded as primary sources of bone, although not the sole source, since much of the material was recovered during sieving. At 101.65 X 97.11 Y, S.U.3 there was a mixture of fish and mammal bone with only two occurrences of modification by burning and a rather heterogeneous level of fragmentation. The other locality at 101.75 X 97.28, S.U. 3, produced mainly fish bone with no indications of modification. Unfortunately, taken as a whole this evidence is too vague to provide any indication of specific activities or behaviors.

7.2.2. Kongshavn Room 1 “living area”

The interpretation of Room 1 is that SU 3 – 7 are connected to the Late Medieval occupation. This room is characterized by the well designed slabstone floor and corner fireplace. The bone material presented below originated from SU 3 – SU 7.

Total Number of Fragments

The total number of fragments from Room 1 is 1,489 TNF. Fish taxa made up approximately 66 % of this assemblage (Table 22). Mollusca are well represented in the deposit, the majority of which are fragmented shell. There is a high frequency of indeterminate bone and indeterminate mammal bone.

Number of Individual Specimens

Specimen counts provide a detailed picture of the diversity of this deposit (Table 23). The fish species are diverse but were dominated by haddock, cod and halibut. A variety of domesticated species, like cattle, sheep/goat and pig, are also present (Table 23), but their numbers are too low for detailed analysis. Wild species such as reindeer and fox are also present. The bird evidence suggests that local shore-birds, e.g.

ducks (Anitidae) and sea gulls (Laridae), were present, but their use as a food resource or for any other utilitarian purpose would be speculative.

As far as bone modification is concerned, burning, gnawing and butchery are present. Burning is relatively limited; there are several examples of calcinated bone present but not in significant amounts. There is an example of a scorched bone from the articulated axial skeleton of a haddock, which was recovered in an area of high concentration of charcoal. Gnawing has been identified on several bones from several taxa (Table 27). The modifying agent is difficult to pinpoint but dental patterning indicates that a percentage is from canine agents. In regard to the gnawing on fish, much of this appears as crushed vertebrae although whether this is human or canine in origin is difficult to say. In regard to large fish like halibut it is most likely a canine agent. The gnawing of a reindeer cervical vertebrae and an unidentified rib were attributed to a canine.

Butchery has been well recorded in this room (Table 28). The majority of the butchery occurs on fish species, which will be discussed later, but there are two Cetecea bones that appear to have been worked. Numerous pieces of indeterminate bone show signs of various degrees of butchery from slicing, chopping and, punctures to knife marks.

Fisheries analysis

As mentioned the fish taxa are quite diverse. Based on NISP counts haddock is the most frequent species in the entire deposit at 214 NISP followed by cod and halibut which combined are approximately 34% of the deposit. Because of the high frequency of these species further analysis can be done (Tables 24-26; Figures 33-35).

The skeletal-part distribution of cod demonstrates a lack of cranial elements, particularly from the lateral skull bones (Table 24). There is also a low presence of elements from the caudal skeleton. The haddock skeletal distribution reveals a low presence of cranial elements, like the lateral skull bones, but a large representation of the trunk portion (vertebral column and caudal vertebrae) (Table 25). Halibut‘s skeletal part distribution demonstrates a similar skeletal profile as seen in haddock, but there is a greater presence of lateral skull elements (Table 26).

Butchery marks were observed on all three species of fish (Table 28). The butchery marks on cod appear only in the lower stratigraphic units (SU 7 and 6), and they involve the slicing of the cleithrum. It is also worth mentioning that the cleithra identified as Gadidae from these units were also sliced. Haddock also has butchery occurring on the cleithrum, but the mechanical processes observed both on haddock and cod/Gadidae are very different. This also occurs in SU 7 but there are also samples from upper stratigraphic units (SU 3). There is one example of a caudal vertebra of a halibut, being sliced through, recovered from SU 7.

Summary

The fish remains from Room 1 clearly demonstrate that in most, but not all, cases processed fish was deposited within the room. This interpretation is based on the documented occurrence of clear osteological signatures that differentiate a processing site from a habitation site by an over-abundance of cranial elements and a near lack of post-cranial elements in the former while the reverse signature would be observable in the latter. This is clearly apparent with the haddock and halibut remains, which show an over abundance of post-cranial elements. These remains are interpreted as a deposit of discarded food waste with the cranial portion being cut off and discarded elsewhere, either on site some place or another site or at sea, and with the tail section brought to the discard location. The butchery observed on haddock could be the result of processing. Cod is a bit trickier with its low frequency of cranial and post-cranial elements but high frequency of appendicular elements. It is in this region that a lot of butchery marks have been observed so some kind of special style of butchery has taken place with the assumption that this is for immediate consumption. For the most part the other taxa present represent food items as well but given the low frequencies no detailed analysis can be provided.

7.2.3. Kongshavn Room 2 "living area"

Room 2 stratigraphic units were 1 through 6 with SU 3 through 6 producing the bone material used in this dissertation. In this room there was a compact dirt floor mixed with charcoal and ash and a large corner fireplace.

Total Number of Fragments

The total number of fragments of bone from Room 2 is 2,487. The general taxonomic groups reveal a heavy concentration on fish supplemented by birds, land and sea mammals (Table 30), however, there is also a noticeably large presence of sea mammals and birds.

Number of Individual Specimens

The individual species present are dominated by fish (Table 31), of which halibut is the most dominant, with about 35 % of the collection, while cod and haddock combined represent ca. 50 %. Domesticated mammals recovered include cattle, sheep/goats and pigs, but their numbers are too small to warrent deeper analysis. However, it can be mentioned that none of these specimens showed signs of butchery. The marine mammals were aggregated into Phocidea (n = 25) or Cetecea categories due to the lack of specific diagnostics. There was nevertheless a high frequency of seals. These were most likely whole individuals brought into this area for butchery and consumption although butchery marks were low in frequency. Birds are primarily shore/sea bird species with the addition of grouse and two samples identified to the genus level of Buteo as a bird of prey. Mollusca were recovered from the room but are too low in number to draw any inferences from.

It is also important to have some idea of the bone modification (Table 35). Butchery marks were observed in all of the stratigraphic units within the room, but the frequencies are not high. There is one example of worked whale bone but the majority of the observed whale bone that was modified had butchery marks (n = 4). Other species with signs of butchery marks were reindeer (n = 2) and unidentified seal (n = 2).

Evidence of gnawing was observed (Table 36), the most likely agents being rodents, humans and carnivores. However, based upon numerous observations much of the evidence points towards canines as being the primary agent of destruction (n = 28). There is a large sample of halibut bones, mostly vertebrae, that have been chewed and crushed, most likely by canines (n = 13). This conclusion is based on the large size of the vertebrae and the dental pattern imprint left on the bones. Some bones showed signs of stomach etching most likely from canines as well. Evidence of possible human agency is the crushing of smaller vertebrae.

Fisheries Analysis

Because of the dominance of fish in the collection a more detailed analysis will be undertaken. As seen in Table 31 the fish species are fairly diverse (n = 6) with no single species dominating. Halibut is the most numerous (n = 440) species followed by cod (n = 381) and haddock (n = 242), respectively. These three species will be further analyzed.

The analysis of skeletal-part distribution takes into account the similarities and differences between the observed compared to the expected values (Tables 32-34 and Figures 36-38). When compared to the expected value it would appear that cod is well represented at the site with slight differences between observed and expected frequencies in certain skeletal element groups like the caudal skeleton, lateral skull bones and vertebral column. In the case of haddock, the observed element frequencies are also in good agreement with the expected values except in the case of the very large representation of the pectoral girdle. There are two possible explainations of this: one is the greater likelihood of preservation the robust cleithrum and the other is the utility of this bone.   With halibut there is an over representation of caudal vertebrae.

Butchery marks are present on these three species of fish (Table 35). Cod has butchery in the appendicular region, specifically on the cleithrum, which is represented by slicing butchery marks. This occurs mostly in the lower stratigraphic units, SU 6 and 5. There are also a few observations of butchery marks on Gadidae cleithra which can be assumed to be cod as well. Also worth mentioning is the same kind of butchery mark observed on a saithe cleithrum. In the upper stratigraphic units, SU 4 and 3, the supracleithrum of cod, also of the appendicular region, displays either shallow knife marks or deeper cuts, or whittle marks, on its anterior side (see Figure 18). In haddock there is a noticeable steady slicing of the cleithrum, and in a few cases also the supracleithrum, which occurs throughout the room‘s stratigraphic units. However, it should be mentioned that these butchery marks are clearly very different than those observed on cod. The butchery marks observed for halibut occur both in the earliest and latest stratigraphic units within room 2. The butchery marks observed primarily occur in the appendicular and post-cranial region, with one exception of a sliced dentary from SU 3.

Summary

Based upon the above it would appear that this room might have functioned as some kind of food preparation and/or an eating area. Fish skeletal element representation of cod and haddock suggests possible food preparation based on the near identical element frequency compared to the expected values. If, cod and haddock were being processed elsewhere with the decapitated heads left behind and the tails, or post-cranial portions, brought back to the site for consumption then there would be a very large difference between the observed and the expected values in regard to the representation of the vertebral column. However, there is a noticeably high frequency of haddock cleithrum which is difficult to explain. It is possible that the cleithrum is representative of the actual post-cranial remains brought back to site. This is supported by the slicing butchery marks across the appendicular region, particularly the cleithrum, which point towards the processing of fish most likely for immediate consumption. It should be noted that the slicing butchery marks on cod and haddock were not identical. The style of butchery observed on cod has not been observed anywhere as a method of drying fish by salt or air. The presence of a large number of halibut caudal skeletons, also with butchery marks, suggests that the skeletal portions were brought into the room in an already processed state.

The frequency of seals also suggests consumption, although there is not much in the way of butchery marks.

Adding to the evidence that the room had some function as a food preparation and/or consumption area is the canine modification evidence. This is based on the observation of gnawed bone reflecting what is known as “kennel behavior”. As mentioned before halibut had a large frequency of heavily damaged bone suggesting that canines were present. Also present were coprolites. Whether these were of human or some other animal is not known but it is speculated that these were from canines due to the occurrence of stomach etched bone fragments.

7.2.4. Kongshavn Room 3 “living area”

The stratigraphic layers for Room 3 are 1 through 5 with the material used in this dissertation coming from SU 4a through 5. SU 4a through 5 are medieval in date. The interpretation of this room is that it was an outdoor activity area

Total Number of Fragments

The total number of fragments from Room 3 is 1,742 heavily dominated by fish at ca. 92 % (Table 38), with the proportion of the remaining taxa being quite small at ca. 7 %, of which domesticates and birds appear to most significant.

Number of Individual Specimens

Species diversity in Room 3 is fairly limited at 13 species (Table 39). The most prominent species are cod, halibut and haddock, respectively. The domesticates represented are sheep/goat and pig. Based upon skeletal part frequencies the domesticates recovered from this room represent whole individuals. No signs of butchery were observed on any of the domesticates. Several canine individuals were recovered primarily from the earliest stratigraphic unit (SU 6). These were found throughout the stratigraphic unit and were not aggregated in one specific area within the room. Based on skeletal part frequencies it appears that whole canines made their way into the deposit. The remaining species on Table 39 offer an insight into what was in the local area and possibly brought back to the site. For example, the few remains of whale show signs of being butchered (n = 3), although whether for consumption or some other purpose is not clear. Again, reindeer and a few local shore birds, like sea gulls, are present but their frequencies are too low to justify an in-depth discussion.

Fisheries analysis

The overall diversity of the fish taxa is relatively low at 5 species. As mentioned before three species are the most dominant: cod, haddock and halibut. Cod is the most frequent (ca. 64 %) followed by halibut (ca. 22 %).

Turning to skeletal part distribution, it is clear that whole cod were being brought into this area and probably processed (Table 40; Figures 39-41). The overall distribution of elements points to a low frequency of elements from the caudal skeleton as well as the appendicular region and a very high frequency of elements from the vertebral column (Table 40 and Figure 41). Closer analysis of the vertebral series shows a frequency distribution similar to what is expected at a processing site (see Table 6). Taking the analysis one step further there is a noticeable and familiar frequency distribution that is fairly similar to what is expected at a processing site.

With regard to haddock there appears to be almost two behaviors occurring simultaneously. Table 41 and Figure 39 show a relatively well represented haddock skeleton with noticeably high frequencies of elements from the lateral bone series and the pectoral region and low frequencies from trunk elements (vertebral column and caudal skeleton). Upon closer analysis of the vertebral series (Table 41 and Figure 41) the observed values of caudal vertebrae are quite high which is in-line with expected values at a habitation site, but there is also a difference in the frequencies of the precaudal vertebrae which contradicts those expectations. Table 41 and Figure 40 detail the high frequency of cleithra (appendicular region), but the overall frequencies of elements does not point to either discard behavior associated with a pure processing or a pure habitation site, but rather a mixture of both.

The skeletal distribution of halibut reveals a split distribution pattern (Table 42 and Figure 39). As seen in the table and figure there is a high frequency of elements from the cranial region (later skull bones) and the trunk (the caudal skeleton) with a noticeable low frequency from the appendicular region (pectoral and pelvic bones). A closer examination of the vertebral series reveals the high frequency of caudal vertebrae and lower occurrence of either thoracic or precaudal vertebrae (Table 42 and Figure 41). Table 42 and Figure 40 supports the above observations of a low presence of elements from the appendicular region. Somewhat similar to haddock, the skeletal distribution observed has clearly neither a processing nor a habitation signature but represents a mixture of both discard behaviors.

Butchery marks are frequent within the fish taxa (Table 43). Cod has signs of heavy butchery marks within the lower stratigraphic units (SU 6), primarily slicing of the dentary, premaxilla, the cleithrum and subopercular (see Figure 20). Slicing of the cleithrum was also observed in SU 6 for Gadidae. Above this stratigraphic unit the slicing of the dentary and premaxillary are also observed. It is possible that this style of butchery by slicing the lateral skull bones aided in hook removal but there could also have been another reason for this, although unclear at this point. If processing for air-drying or salt-drying occurred it was on a small scale, most likely for household consumption. Butchery of the cleithrum and subopercular, however, could also indicate possible food preparation. The only observed butchery on haddock appears on a caudal vertebra from SU 6 that had been sliced, with no indications of the cleithrum being butchered. The butchery marks observed on halibut involve the slicing of the maxilla, interhaemal spine and cleithrum, which is similar to cod. In the terminal layer of this room (SU 6) there is one example of a posttemporal with a knife scratch.

Summary

Summarizing this room‘s taxa and function will have to rely on the interpretation of the fish data. With regard to cod, it was possibly processed in this room. As mentioned the slicing butchery marks focus primarily on the lateral skulls bones which may reflect a new style of processing. The discard behavior for both haddock and halibut is not clearly defined and it can only be assumed that both processing and consumption were taking place in this room.

This analysis seems to be reflecting the complex nature of this room. Here multiple tasks were performed during the room‘s existence, from processing to storage and possible food preparation and consumption.

7.2.5. Kongshavn Room 4 “living area”

Room 4 stratigraphic units are represented by SU 4 -7. These units are from the medieval period with SU 4 representing a slab stone floor. The faunal material was recovered from the floor area and below it, just above the sterile matrix (SU 8). The entire room is interpreted as a dwelling area.

Total Number of Individual Fragments

The general taxonomy of room 4 reveals great richness of faunal material (2,335 TNF), although fish taxa dominate at ca. 84 % (Table 46). Both the domestic and wild terrestrial mammals are frequent, as are sea mammals at a total of 1.97 %. Birds are fairly well represented in comparison to the non-fish taxa at 1.76 %. Mollusca are also present but their presence is not so significant at 0.43 %.

Number of Individual Specimens

The number of individual specimens reflects the concentration of fish supplemented by other species. As mentioned the most dominant taxonomic group is fish, specifically cod, haddock and halibut in order frequency (Table 47). Unfortunately the material used in this presentation has been only partly analyzed, because of time constrants. Thus much of what is being discussed here is tentative with the exception of material from SU 4 which was fully analysed.

Based upon an overview of the skeletal representation of reindeer it is possible that whole animals were brought back to the site and butchered there. Much of the recovered material however was antler (n = 17 of 26) which showed signs of being modified. Domesticates, like sheep/goat, were also present on site but most likely as whole individuals. The seal remains identified represent indeterminate seal ribs, which are also high meat utility elements. The remaining sea mammal data have been categorized into generic taxonomic classes due to the lack of diagnostic markers.

There is some evidence of gnawing and burning. Gnaw marks are primarily attributed to canines.   There is one example of a haddock cleithrum being gnawed by a canine. Also, there is evidence of canine gnaw marks on halibut vertebrae (n = 9) and a heavily chewed long bone from a sheep/goat. Burning evidence is very limited with only one example of a calcinated piece of bone.

There is evidence of butchery other than fish (n = 16) (Table 51). Butchery marks, in the form of knife marks, were observed on indeterminate bone of Cetecea and a Phocidea rib. Also, as mentioned previously, a large number of butchered reindeer antler were recovered.

Fisheries Analysis

The fish data from Room 4 are fairly diverse and rich (Table 47). As mentioned before, cod, halibut and haddock are the most frequent species found in the deposit. And although cod is the most frequent taxa it‘s presence in the deposit is not overwhelmingly dominant, with just over 40 %. The skeletal distribution of haddock and halibut will be presented but due to a lack of representation those observations will not be discussed.

The skeletal distribution of cod is dissimilar to either the expected values of a processing or habitation site (Table 48; Figures 42-44). Rather, the distribution is very consistent with the presence of nearly whole fish. There is a low presence of elements from a portion of the trunk (caudal vertebrae) while the vertebral column is over-represented, and it is clear that within certain parts of the cranial region there is an overabundance of elements (Table 48 and Figure 42). Closer analysis of the vertebral series demonstrates this as well (Table 48 and Figure 44). Also, Table 48 and Figure 43 show that the frequency of elements from the cranial and appendicular region is almost identical to the expected values of a whole individual. Thus, it appears there has been little transformation of cod in Room 4.

Butchery is a fairly significant aspect (n = 11) of this assemblage (Table 51). Observed butchery marks on cod occur on the cleithrum and subopercular, which have been sliced. This style of butchery also occurs on the cleithrum of Gadidae. Slicing of caudal vertebrae from halibut was observed.

Summary

The characteristics of the faunal deposit from Room 4 are informative and possibly reveal the multi-function aspect of the room. In the case of cod it appears as though whole fish were brought back to the site, most likely for consumption. This might not have been the case for haddock and halibut. The remains of the domesticated mammals reveal a provisioning nature to the room as well.

One of the more interesting aspects of the Room 4 deposit is the butchery marks (Table 51). As described previously, the butchery marks observed on cod appear in other areas of the site as well. This style of butchery has been associated with immediate consumption. The large quantities of worked antler from reindeer illustrate the use of reindeer for non-subsistence purposes, possibly craft production of some kind.

7.2.6. Kongshavn Room 5 midden A

Excavated from room 5 were two middens from the late Medieval phase of the site, one of which was a single event deposit (Midden A) the other an accretion midden (Midden B). These two will be treated separately. Midden A is a compact layer of bone approximately 15 centimeters thick (SU 6) located in the western portion of the room, coordinates 100/101 x 118.5-120 y. Even though the deposit was large and dense it appeared not to extend further into the unexcavated portion of the trench; in fact it appeared to truncate the floor area in a purposeful fashion. Because of the lack of any observable depositional pauses in the form of aeolian deposits, for example, this deposit has been interpreted as a single event. In association with this deposit was a fireplace and several large pieces of whale bone. The presence of whale bone of such dimensions, ca. 0.5 x 0.5 m, may indicate a structural component to the room or an adjacent room rather than a deposited food item.

Total Number of Fragments Identified

The total number of fragments identified comprises the generic level of identification (Table 54). Fish comprises roughly 90 % of the identified taxa out of a total 9, 668 TNF. Aggregated together, all other taxonomic categories comprise less than 10 % of the total number of fragments. However, wild terrestrial mammals (0.17 %) and sea mammals (0.85 %) are relatively abundant. Most surprising and noteworthy is the absence of birds.

Number of Identified Specimens Counts

A closer examination of the species present in Table 55 demonstrates the importance of marine fish as a primary taxa of economic importance. Cod is the most abundant marine fish, comprising approximately 73 % of the total NISP. Other marine fish such as haddock and halibut are both represented, but noticeably not as frequently as cod. Of lesser economic importance are several other species, most significant because of its current economic importance is herring, which has not been observed in any other deposits. The presence of herring indicates possibly other fishing methods employed, like nets. There were a few examples of domesticated species (n = 4) which point to the importation of foodstuffs.

A possible secondary source of economic importance is whale, much of the whale bones recovered are small fragments (ca. 50 % less than 2 cm), although they do have signs of butchery (n = 23). Specifically, much of the whale bone has been chopped, with signs of knife-marks, sawn and worked. The worked whale bone has been manipulated in a variety of ways from sanded, to planed (indicated by the bone shaving), to having bone edges squared. Regardless of this evidence, it is still difficult to asses the actual food utility, or other utilitarian value, of whale.

Although the reindeer bone is not frequent and is most likely statistically unrepresentative, it was examined in detailed (Table 56; Figures 45 and 46). With respect to the food utility indices (FUI) (Metcalfe and Jones 1988, Woollett 2003) with the underlying assumption that these are kill and/or butchery sites there is a strongly negative relationship between % MAU and % MUI (Figure 45). This indicates a strategy of removing all the high-valued meat-rich elements. As there is no high correlation between bone density and body-part representation (Figure 46), density-mediated attrition was not a factor in the character of the assemblage. This is supported by the observation that many of the elements represented at the site have a medium to high density value. Thus, high-valued meat-rich bones were removed from this locality, leaving behind dense, but meat-poor bone, or the butchery took place elsewhere with the unwanted bits being discarded in this area.

The sample of reindeer bone is small but that does not negate the importance of the observed butchery marks. Indications of butchery were observed on at least half of the skeletal elements (Table 60). Observations were made of knife marks on the proximal and distal ends of skeletal elements, specifically on ribs and phalanges. Knife marks also appear on the lateral mid-shaft of a metatarsal bone. On a lumbar vertebra, a combination of scratches from a knife and heavy blows were observed. More chopping was observed on a metacarpal bone, which was intentionally split down the middle, possibly as an extraction technique to get at the nutritionally rich marrow. Recovered antler also showed signs of being chopped.

Evidence of either burning or gnawing was not significant in this collection. The evidence of gnawing is observed on two fish vertebrae but lacks any definitive agent (Table 61)

Fisheries Analysis

Since marine fish have a prominent role in this deposit a special analysis is required. The total sum of all identified fish fragments is 8, 704 with marine fish species comprising about 98 %. The collection was heavily dominated by cod which comprised about 72 % of the identified species. However, haddock and halibut are well represented as well and will also be discussed in detail.

The skeletal distribution of cod (Table 57 and Figure 47), shows a well represented cranial and appendicular region, but elements are noticeably lacking from the trunk portion. Specifically, this is noted in the vertebral column and caudal skeleton. Upon closer examination of the cod's vertebral series it is clear that caudal and precaudal vertebrae are lacking, but in contrast thoracic vertebrae are over-represented (Table 57 and Figure 49). Table 57 and Figure 48 are consistent with observations presented in the previous sets of tables and figures, that there is a noticeable difference in the representation of elements from the cranial region and a portion of the appendicular region. Therefore, based on these observed distributions of cod and comparing them to the expected values of a processing site it is quite clear that cod was being processed here for long term storage.

The skeletal distribution of haddock appears to represent the deposition of near-complete individuals (Tables 58 and Figures 47-49). Again, this conclusion is based on a comparison of the observed distributions to the expected values of a whole Gadidae.

With regard to halibut, the skeletal distribution is not as clear. There is a significant over-representation of the trunk portion of halibut, specifically the caudal skeleton, and what appears to be a low representation of the cranial region and appendicular region (Table 58 and Figure 47). The distribution of the vertebral series shows this as well (Table 58 and Figure 49), but more clearly it shows the high frequency of caudal vertebrae. It appears as whole individuals were being deposited at the site (Table 58 and Figure 47), but that much of what was deposited originated from the post-cranial skeleton.

Osteological measurements to reconstruct fish size were made only on cod (Figure 50). Three elements are presented as the data source for total length reconstruction: the premaxilla, the dentary and the maxilla. Although frequencies differ, the general pattern of dispersion is consistent with what has been observed so far. Generally, there is a high frequency of cod in the 600 to 700 mm length range with a decrease in the 800 to 900 mm range, then an increase in the 900 to 1000 mm length range. The majority of individuals are in the 600 to 800 mm size range, which implies that although these cod were on the small end of the size scale they were still in the effective, but not optimal, size range to air-dry.

One of the more striking aspects of the analysis has been the identification of butchery-marks. The majority of butchery-marks was observed on cod, which came in a variety of forms: deep knife incisions, or slices; knife scratches, and heavy blows possibly made by a heavy bladed implement, like a cleaver (Table 60). For cod, butchery-marks were most significant on the supracleithrum in the form of slice marks, or ″whittle-marks″ (n = 47), see Figure 19. Both haddock and halibut have butchery-marks, but not to the same degree as observed on cod. Most of the elements identified as haddock and halibut appear to have been sliced by a knife, although halibut also had a fair amount of vertebrae severely damaged by heavy blows. There was also a large number of indeterminate fish ribs (n = 20) and bone (n = 18) that had been sliced as well.

Summary

Several inferences can be drawn from Midden A. It appears as though cod was processed specifically for long term storage. Based on skeletal part distribution it appears as though much of the cranial portion and parts of the upper vertebral column were deposited here while the absent lower portion was deposited elsewhere. Haddock, on the other hand, appears to have been deposited as whole fish. Halibut is more of a mix of whole individuals and post-cranial remains, which may have to do with size dependent processing in which larger fish were beheaded at sea. It is clear that whole reindeer were brought to the site and butchered. In regard to the domesticated mammals these too were possibly whole animals but it is difficult to determine that based on the sample size. The large presence of fragmented whale bone might indicate its importance as a food source, or boiling for oil.

7.2.7. Kongshavn Room 5 midden B

Another midden deposit was identified in Room 5, known as midden B. This midden was separated from the previously discussed midden based on its accretion nature. Unlike the previous deposit, which was very contained, this deposit had accumulated throughout the entire room (100/101 x and 117/122 y) and was easily separated into several stratigraphic layers (S.U. 5-9) which together date to the late medieval phase.

Total Number of Fragments

The total number of fragments is 6, 376 (Table 63). As with the other deposit, fish comprise the majority of the fragments identified at ca. 92 % . Relatively speaking there is also a large concentration of wild terrestrial mammals (0.60 %), sea mammals (0.84 %) and birds (1.21 %) .

Number of Identified Specimens Counts

The species count (n = 23) reveals a high level of diversity not seen elsewhere (Table 64). Among the identified Gadidae species cod and haddock are the most abundant at ca. 44 % and 26 %, respectively. Halibut is the third most abundant fish, ca. 25 %. The remaining fish species identified range from 1.14 % to 0.03 %.

Besides reindeer at 1.08 % the sample of both domestic and wild land mammals recovered is not very large (Table 64). What can be surmised from their sparse representation is that domestics such as sheep/goat and pig as well as wild mammals like arctic fox were present on site but in what capacity cannot be determined. Reindeer skeletal element frequencies based on % MAU counts can be viewed in Table 65. The deposit is mostly made up of crania and other non-meat rich areas like the lower hind and fore limbs, and vertebrae. However, ribs which can be removed and dried are also present. With respect to the food utility index (FUI), this implies butchery and selection processes that resulted in the more meat-rich portions being deposited elsewhere (Figure 51).

The % MAU element representation data plotted against bone density indicates a lack of correlation, so that density mediated attrition was not a factor in skeletal-part representation (Figure 52). Consequently, there appear to be cultural reasons behind the differential distribution via transportation of selected elements.

The butchery-marks on reindeer indicate disarticulation, heavy butchery and possible craft production (Table 69). Specifically, proximal ends of ribs and other jointed areas show signs of obvious cutting with knives, while other elements have been chopped, including antler which also shows signs of being worked.

Turning to the sea mammals (Table 64), none of the seal specimens identified were successfully identified to species level. This was also the case with the whale bone, as the whales were primarily represented by fragments of unidentifiable bone elements. It is worth mentioning that some of the whale bone recovered showed various signs of modification, mostly chopping by heavy implements or working by tools. Some of the recovered worked whale bone were shaved bits, possibly a result of some kind of planning tool.

Birds were comprised of an assortment of species, mostly of the sea and shore bird variety (Table 64). Individuals from the Laridae family were the most frequent of all of the birds, but with respect to the collection as a whole they were not found in significant numbers. The remaining birds identified to species level were only present in trace amounts.

Fisheries Analysis

Despite the fact that the collection is dominated by three species of fish, the diversity of the taxa represented is relatively broad, (n = 8). As discussed earlier cod (ca. 43 %), haddock (ca. 26 %) and halibut (ca. 25 %) represent approximately 98 % of the fish assemblage. Although cod is the most abundant, the deposit does not have a single dominant species and is thus best characterized as multi-species, Table 64.

The distribution of elements from the three dominant marine fish species will be discussed. When the entire cod skeleton is examined there is only slight divergence between the observed and the expected (whole Gadidae) element frequencies (Table 66; Figure 53). Specifically, there is a low frequency of caudal elements (Table 66). Analysis of the vertebral series of cod shows an over-representation of thoracic vertebrae and only a slight variance from the expected values of precaudal and caudal vertebrae (Table 66 and Figure 55). Table 66 and Figure 54 show a slight under-representation of a portion of the appendicular region, specifically the cleithrum. When a further comparison is made to the expected values of either a processing or a habitation site neither one is in total agreement with the observed, but neither are there grounds for an alternate suggestion and it can only be concluded that whole cod were brought and discarded here.

The skeletal distribution of haddock is evenly represented (Table 67 and Figure 53). The analysis of the vertebral series depicts a high frequency of caudal vertebrae with a slight under-representation of the thoracic and precaudal vertebrae (Table 67 and Figure 55). The over-representation of the post-cranial region is observed with a high frequency of cleithra. However, when compared to expected values from either processing or habitation sites none of these observations are convincing enough to conclusively determine the discard practices other than to say that whole haddock was discarded here.

The skeletal distribution of halibut depicts a gross over-representation of post-cranial elements (Table 68 and Figure 53), which is also supported by the analysis of the vertebral series (Table 68 and Figure 55). Neither the expected values of processing or habitation sites are consistent with the observed elemental distribution for halibut. However, the over-abundance of post-cranial elements suggests that processing and head removal took place elsewhere.

The presence of butchery-marks was significant in this deposit (Table 69). The most frequent butchery-mark was whittling of the supracleithrum of cod. The second most frequent butchery-mark was the heavy slicing observed on the cleithrum from cod.

This style of butchery is also observed on cleithrum fragments identified only to family level (Gadidae), but it can be assumed these are cod as well. Butchery of the cleithrum was also observed in haddock, but this was typically chopped and was different from what was observed in cod because it appeared as though retrieval of the dense portion of the haddock cleithrum was the main objective. The butchery-marks observed on halibut elements consisted mainly of the angled cutting of vertebrae.

The osteological measurements focused exclusively on cod (Figure 56). The central tendency lay between 700 to 1000 mm in total length, thus suggesting that these cod could have been air dried effectively.

Summary

Midden B was dominated by fish remains, but had a multi-species composition, with no single dominant taxa. Reindeer was possibly butchered at this locality, with the meatier portions being deposited elsewhere. The remains of cod may represent both processing for long term storage (based on the analysis of the skeletal-part distribution), while the butchery marks on the cleithrum suggest food preparation. For haddock it appears that whole individuals were deposited on site, but it is probable that a few processed individuals were discarded here as well. Halibut may represent a different form of processing and transport due to size, wherein small halibut are brought back to the site while whole and larger fish were processed at sea. To conclude, both middens B and A display similar faunal characteristics despite their different depositional histories.

7.2.8. Kongshavn exterior midden

A midden deposit was located on the exterior of the north wall of Room 5, at 100/101 x to 123/124/125 y. It was excavated in three stratigraphic units (SU 1,2, and 3) but for analytical purposes it was aggregated into one as it was an accretion midden that could be treated as a single depositional unit.

Total Number of Fragments

Similar to the previous midden deposits the TNF (8, 982) reveals an overwhelming dominance of fish taxa at ca 83 % (Table 71). The second most dominant category is the large assortment of unidentifiable bone fragments at ca. 13 %, however, domesticated mammals (0.32 %), sea mammals (0.26 %) and mollusca (1.20 %) are relatively frequent as well.

Number of Individual Specimens

Table 72 reveals the taxonomic diversity of the midden, n = 20. However, cod is overwhelmingly the dominant species with roughly 95 % of those individuals identified to species level. The other fish species identified were much fewer in number and ranged from 1.54 % to 0.18 % of NISP.

With regard to terrestrial mammals, this midden was unusual for its relatively high representation of domesticates; pig (0.55 %) are the most dominant terrestrial mammal (Table 73). For the analysis of pig skeletal element distribution the modified general utility index (MGUI) was employed (Figure 57). There is a noticeable lack of meat-rich elements. The correlation coefficient between MGUI and element frequency was negative but not significant. The correlation of bone density and elements present was negative as well (Figure 58). Thus, it appears that neither density-mediated attrition nor selective transport were significant in the formation of the deposit.

Other terrestrial mammal species present were just trace remains which varied from rodents to large land mammals (Table 72). One significant find was the presence of a femur from a polar bear. No butchery-marks were observed on the specimen. Suggestions about its presence in the deposit would be purely speculative at this point.

Like the terrestrial mammals, the sea-mammals were sparsely represented with only three individuals identified to species level. The shaft from a femur of a grey seal was recovered and showed signs of knife marks (Table 75). The other specimens were the mandible and post canine tooth of a harbour seal. The unidentifiable whale bone recovered, only showed a few isolated cases of butchery in the form of knife and chop marks.

The collection of birds recovered was small in number although the level of species identification is quite high. All of the birds identified were sea-birds. There were no signs of any kind of butchery or preference of more selective elements, like meat-rich elements.

Fisheries Analysis

This analysis will focus on cod only because of its overabundance in the deposit. Although the deposit was taxonomically diverse the relative frequency of the other species was low. In general, this deposit was quite different from the others in its almost complete concentration on cod, thus, it is a good example of a mono-species deposit.

The following will focus on the skeletal element distribution frequencies from cod. In comparison to the expected values of a whole Gadidae, the elemental distribution of cod is slightly under- or over-represented in some regions of the skeleton. There is a noticeable lack of elements from a portion of the post-cranial region, specifically the caudal skeleton (Table 74; Figure 59). Turning to a closer examination of the vertebral series skeleton Table 74 and Figure 61 illustrate that there is a low representation of caudal and precaudal vertebrae and a over-representation of thoracic elements. Finally, Table 74 and Figure 60 support the above observations of a low to non-existent trunk representation, while both the premaxilla and posttemporal are well-represented and the cleithrum is noticeably lacking from the appendicular region. In comparison to the expected values of a processing site the observed elemental frequencies of cod suggest that it was being processed on site.

Butchery is found exclusively on cod (Table 75). The most common style of butchery was sliced elements, specifically the posttemporal and postcleithrum, n = 11 and n = 8 respectively. There were also a few examples of sliced premaxillary, n = 5, and a large number of posttemporals with scratches possibly made from a knife, n = 10. Evidence of butchery on the posttemporal can be seen as direct evidence of decapitation. An example of such a butchery mark has been observed at the Sami site of Šaggušnjar'ga (Odner 1989, AD 1585 +/- 65) in Varanger Finnmark. Interestingly, similar cut marks on post-temporals have also been observed in Viking Age and medieval Scotland (James Barrett personal communication). The interpretation of these cut marks is that they are the result of decapitation (James Barrett personal communication).

Figure 62 displays the total length measurements for cod, which mostly range between 600 to 1200 mm. Not only is this a broad size variation but these ranges fit squarely in the middle of the potential to air dry cod.

Summary

This midden represents a deposit devoted to specialized fishing. The overwhelming amounts of cod and the obvious signs of butchery are unique. Based upon the analysis of the skeletal part distribution in which the meat bearing parts are lacking it is clear that cod was being processed and what has been recovered is the by-product of that processing. It seems that this is most likely processing for long term storage, although it is unclear whether this is for household use or possibly some off-site market. In the larger context of the site it appears as though this specialized fishery was just one of many activities taking place there.

The presence of pig indicates that some of the meat for those occupying the site was imported. Although lacking any signs of butchery marks, the deposit has not under gone selective transport and was not subject to a great degree of density-mediated attrition, so it is likely that whole pig was kept on site and was consumed.

7.3. Skonsvika Data

Skonsvika is a four-phase site. Its faunal material is from an external midden deposit associated with an activity area. The initial, or pioneering, phase is characterized by the early construction and planning of the site during seasonal visits. The second phase exhibits a greater permanence of habitation at the site and area, with the construction of some of the first dwellings. The third phase is the main use-period of the multi room complex. The forth phase, directly tagged on to the end of the third phase, represents the abandonment and slow destruction of the site.

7.3.1. Phase 1: Pioneering, seasonal use

Pits 8 and 9 are associated with the earliest phase of the site. As mentioned previously the function of the pits is not clear; pit 8's primary function was possibly as a posthole firming up a large wooden post, then later changed to rubbish deposit, while pit 9 was a storage pit, reserved for food like dried or smoked fish.

Total Number of Fragments

Pits 8 and 9 had fairly similar amounts of TNF at 192 and 144, respectively (Table 128). Approximately 80 % of the faunal deposits from both features was comprised of fish. Other taxonomic groups show trace frequencies while evidence of mollusca is lacking from both pits.

Number of Individual Specimens

The archaeofauna collections from Pits 8 and 9 are similar in that both are low in species diversity and rich in numbers (Table 129). Pit 8 was dominated by haddock and cod, which together made-up approximately 75 % of the collection (Table 129). Halibut was the third most abundant species, at ca. 13 %. There are trace amounts of sheep/goat and reindeer, ca. 2 and 1 % respectively. Pit 9 was dominated by cod at approximately 47 %. Other species of importance are haddock, cusk (*Brosme brosme*) and halibut, ca. 14, 8 and 7 %, respectively. There are a few examples of terrestrial and marine mammals present, ca. 8 and 5 %, respectively. The most interesting finding was a humerus from a Falconidae, however the overall presence of bird was small at n = 5.

Butchery-marks were observed on a few specimens. The modified bone from Pit 8 comprised two examples from the cleithrum of haddock which showed signs of butchery, one with a slice mark cutting through the bone and the other with obvious scratch marks from a knife. Both cut-marks occurred in the same general area on the more dense ventral portion of the cleithrum. Other butchery involved an innominate from a sheep/goat that showed signs of heavy blows, possibly from an axe, and the proximal end of a seal rib that had been sliced through. The butchery from Pit 9 was represented by a sliced cleithrum from a gadoid, although different that seen on the haddock cleithra, and several knife cuts on a cod supracleithrum.

7.3.2. Phase 2: First construction for permanent use

Pit 7 is associated with the second phase of the site as a part of the more formalized and emerging settlement. Pit 7 was originally filled by a firm, dark grayish-brown soil containing frequent decomposed wood and charcoal (S.U. 63). The bottom of the pit and the upper parts of the walls were covered with a thin layer of yellow ash containing remains of fish (S.U. 63a). Pit 7 was used as a smoking pit and is believed to have been used as a storage or rubbish pit.

Total Number of Fragments

Pit 7 is a fairly diverse and rich deposit (3, 040 TNF), the richness due to the abundance of fish, which constitutes 88 % of the collection (Table 105). The other taxonomic groups are lower in frequency, ca. 3 %, but there is a high frequency of sea mammals and mollusca and a presence of domesticates.

Number of Individual Specimens

Specimen counts reveal the diversity of the deposit (n = 19), (Table 106). Haddock is the most abundant taxon at 46 %, followed by cod and halibut with 34 % and 14 %, respectively. Terrestrial mammals are fairly diverse (n = 5), with a high percentage of domesticates such as sheep/goat (0.52 %). There is a large presence of sea mammals which heavily leans towards Cetacea, ca. 1.60 %. Various species of shore and sea birds are also present such as eider duck (*Somateria mollissima*) (0.22 %), Cepphus species like guillemots (0.14 %) and Herring gull (*Larus argentatus*) (0.14 %).

Butchery and gnawing was also observed (Tables 110 and 111). The whale bone shows signs of butchery and being worked (n = 7). Most of the worked whale bone appears to be planned or sanded. Gnawing, specifically by canine agents, was noticed on several pieces of stomach etched bone (n = 4), including a carpal from a sheep/goat, which had bits of coprolites still attached.

Fisheries Analysis

The size of the deposit permits a detailed analysis of the fish data. The collection is heavily dominated by cod, haddock and halibut, which collectively make up about 95 % of the collection.

The distribution of skeletal elements allows for the identification and understanding of the possible cultural and taphonomic processes involved in the creation of the deposit. With respect to cod, there is no large and profound difference between observed and expected frequencies in relation to the whole Gadidae (Table 107; Figures 80-82).

Haddock, on the other hand, had no dramatic underrepresentation of elements from the trunk portion of the body, instead, the greatest difference from the expected whole Gadidae was observed at the transitional area of head and trunk in the appendicular region, with an overrepresentation of the pectoral girdle (Table 108; Figures 80-82). However, the observed frequencies fit neither the expected values for a processing nor a habitation site.

Halibut is represented fairly evenly with the exception of a high frequency of caudal vertebrae (Tables 109; Figures 80-82). The frequencies of the vertebral series do reflect those expected at a habitation site but the remaining data does not. Therefore based on size, it appears that halibut might have been processed differently resulting in the selective transport of the trunk portion.

Butchery marks were observed on all three species (Table 110). Cod has butchery on the pectoral girdle bone series (appendicular) with the supracleithrum having the distinctive whittle mark and knife marks (n = 3). There were also a couple of knife marks observed on caudal vertebrae (n = 2). Haddock also exhibited butchery marks in the pectoral girdle area, with slicing and knife marks observed on the cleithrum (n = 6). A few caudal vertebrae showed signs of chop and slice marks (n = 3). Halibut had cut marks only on the vertebral series, specifically the precaudal vertebrae, which were typically sliced (n = 3). In the Gadidae category (most likely cod), a high frequency of slicing butchery marks was observed on the cleithrum (n = 48).

Other transformational data are evident by the presence of gnawing (Table 111). There are numerous examples of halibut vertebrae showing clear signs of being crushed by chewing (n = 14). The primary agent of the chewing has not been determined, but because the vertebrae are quite large, ca. > 2 cm in diameter, canines can be assumed to be the primary agent. There are a few examples of cod and haddock vertebrae being chewed as well. These are smaller vertebrae, ca. < 1 to < 2 cm in diameter, for which either humans or canines could be the agents of destruction.

Summary

Much of the material represents discard from food preparation, consumption and possibly craft production. Evidence for food waste is based on the butchery marks from the fish, indicating food preparation. Specific food preparation evidence lies with the butchery marks observed on Gadidae and the butchery of the cleithrum. The assumption is that this is evidence of culinary practices. The butchery on halibut also points to possible evidence of size-reduction processing. Craft production or working of bone is obvious for whale bone. One noteworthy observation is the evidence for the importation of domestic animals possible for food and secondary products.

7.3.3. Phase 3: Site "climax"

There are multiple stratigraphic units associated with this phase. The stratigraphic units from the midden are: 46, 34, 35, and 14. Also associated with this phase are several pits: 1, 2, 3, and 4.

Stratigraphic Unit 46

Stratigraphic unit 46 is the earliest midden layer from the site. The layer is associated with the second phase of the site and extends over the entire exterior activity area from the northern edge of the “smoking pit depression” in the south to the wooden wall of the summer room in the north. It is also the earliest layer associated with the midden accumulation around Oven 1, and is followed by SU 35. Pits 2, 3 and 4 are associated with this stratigraphic unit.

Total Number of Fragments

The total number of fragments of SU 46 is 4, 172 (Table 96). Approximately 88 % of the collection is comprised of fish remains. Mollusca are the second most frequent taxonomic group at ca. 2 %.

Number of Individual Species

The analysis revealed the strong presence of only a few key species, while other taxa are of lesser frequency, (Table 97). Specifically, cod, haddock and halibut are the most dominate species at ca. 47, 36 and 10 % respectively, collectively comprising ca. 94 % of the collection. Noticeably absent from the collection are domestic species. Collectively sea mammals comprise almost 1 % of the collection. The only sign of butchery was observed on the mandible of a grey seal (*Halichoerus gryphus*) which had been sliced. Wild terrestrial mammals are comprised of various species ranging from rodentia (0.31 %), mustelidae (0.13 %), canidae (0.04 %) to reindeer (0.85 %), with the latter being the most frequent of this taxonomic group.

The sample size for reindeer is sufficient for further analysis. However, the analysis of the relationship between the representation of reindeer bone elements and the food utility and bone density indices showed no significant relationships (Table 98; Figures 74 and 75). There were signs of butchery marks on the reindeer bones (Table 102). Several indications of worked antler in the form of shavings were observed. A few bone elements showed signs of knife scratches on articular surfaces, e.g., proximal ribs and scapula. In total, at least half of the reindeer bones had some kind of cut mark.

Fisheries Analysis

The fish assemblage is fairly diverse, with no single species dominant (Table 97) but with the majority of the material representing cod, haddock and halibut. The following analysis will consider the frequency of skeletal part representation based upon several methods as well as provide a descriptive account of the butchery marks present. The three previously mentioned fish species are the focus of attention, although total size reconstruction will only include cod.

The observed values of the full skeletal distribution from all three species show clear differences in the frequency of elements. The full skeletal distribution of cod is similar to the expected value of a processing site (Table 99; Figures 76-78). Closer examination of the trunk portion of the body, reveals that the axial skeleton of cod is well represented in comparison to the expected values of a whole Gadidae, however with somewhat under-represented precaudal vertebrae (Figure 78). However, Figure 77 details a low frequency of cleithra, which almost mirrors that of a processing site.

Haddock demonstrates a clear over abundance of elements from the pectoral girdle bone series and upper vertebral column with an under-representation of caudal vertebrae (Table 100; Figures 76-78). The examination of the axial skeleton demonstrates a frequency that is not that different from the expected values of a whole Gadidae; however, the high frequency of cleithra in Figure 78 suggests a distribution similar to a habitation site, but this is most likely a result of some other factor. It is clear though that whole haddock are being deposited.

For halibut, cranial elements from the olfactory, occipital, otic, investings regions are under-represented, but caudal vertebrae are over-represented (Table 101; Figure 76). The observed values shown in Figures 75 and 76 are somewhat mixed between the expected values for a habitation and a processing site. Such a pattern might indicate a difference of treatment based on size, with larger individuals being processed before being discarded on-site.

Butchery marks were present throughout the fish taxa (Table 102). Haddock has a high frequency of cut-marks observed on the cleithrum in the pectoral girdle (n = 13). These are specifically slice marks, with two observations of scratches made by a knife on two other individual cleithra. Within this bone series one supracleithrum had a cut mark by a knife. Cod had several cut marks associated with the pectoral girdle, specifically slice marks made on the cleithrum (n = 5), as well as other elements in this bone series, such as the postcleithum (n = 2) and supracleithrum (n = 5). There were also several observations of a whittle marks made on the supracleithrum (n = 4), in addition to one knife mark. Some of the identified cod vertebrae also show signs of butchery, specifically knife cut-marks or slicing (n = 5). Butchery on Gadidae, which can be assumed to be cod, was also noted. Specifically on the cleithrum (n = 17) which was sliced. Butchery marks on halibut are only observed on the lower vertebral column, specifically the caudal vertebrae, where various styles of cut marks were observed (n = 8). Butchery was also observed on saithe (*Pollachius virens*) (n = 1) and fish (n = 20) with the majority of the latter‘s butchery on the ribs (n = 12).

Total length reconstruction of cod is based on the measurements of the lateral skull elements, the premaxilla and dentary (Figure 79). Although their individual frequencies are different the parallel distribution of the two elements demonstrates that their range of total length centers primarily between 700 mm to 1000 mm.

A large number of fish bones had signs of having been chewed (n = 43), mostly the centrum of the vertebrae being crushed by an unknown agent (Table 103). Halibut had the highest frequency of crushed vertebrae (n = 33).

Summary

This deposit, the earliest midden on the site, reflects mostly a subsistence economy, but some of the data suggests non-subsistence related activity. As mentioned earlier there is a noticeable absence of any domesticates. Reindeer was obviously butchered on-site for both meat and possibly for secondary material for craft production. The presence of sea mammals also suggests exploitation of the surrounding area. Unfortunately, there is a lack of skeletal evidence of canine and Mustelidae whose presence could possibly represent non-subsistence related exploitation. There is no suggestion of procuring fish for long term storage and skeletal part frequencies and observed cut-marks point to immediate consumption. Both cod and haddock have numerous observations of butchery-marks on the cleithrum; although, these are mechanically very different, as explained earlier, it points to a clear focus on the appendicular region but whole fish are being brought back and deposited on site. In regard to halibut, it is being partly processed elsewhere and then brought to the site. Thus, there is an obvious and clear difference in processing of different fish species. However, the slicing of vertebrae are common butchery marks observed on all three species. In the case of halibut one explanation may have to do with the cutting-up of more manageable pieces of meat for consumption. Finally, the numerous crushed pieces of fish vertebrae is direct evidence of consumption. However, the main agent of destruction is unknown.

Pits 2 and 3

Pits 2 and 3 are associated with the third phase of the site, which as mentioned is interpreted as the height of the site's use and occupation. The fill of pit 2 was comprised of several stratigraphic units: SU 46, 35, 14 and 12 with SU 46 and SU 14 producing bone. The function of the pit is interpreted as a storage container possibly for food, liquids or household utensils.

Pit 3 was comprised of several layers. The upper most layer consisted of big stones and gravely soil (SU 20) followed by capping midden material (SUs 14 and 46). The pit is interpreted as being used for smoking.

Total Number of Fragments

The subsequent discussion will present the data from Pits 2 (SU 46) and 3 (SU 46) (Table 1113). The TNF of Pit 2 is about twice as high as Pit 3 at 959 and 480, respectively. The major taxonomic group present in both features is fish with ca. 80 % in Pit 3 and ca. 66 % in Pit 2. Pits 2 and 3 had trace remains of other taxonomic groups at ca. 6 % and 4 % respectively. Both also had a high percentage of indeterminate bone with Pit 2 at ca. 28 % and Pit 3 at ca. 15 %.

Number of Individual Specimens

Specimen counts from pits 2 and 3 are shown in Table 114. Pit 2 is fairly rich, but not diverse in taxa, n = 10. Fish, specifically cod and haddock, are the dominant species in this feature at ca. 46 % and 35 %, respectively. The remaining taxa are present only in trace amounts ranging from ca. 8 % to 0.3 %. In contrast, pit 3 is a diverse sample with n = 15. Fish are the dominant taxa, and the four species most abundant are: cod (ca. 21 %), halibut (ca. 36 %), saithe (ca. 13 %), and cusk (ca. 15 %). Other species in this deposit are found only in trace amounts representation ranging from ca. 3 % to ca. 1%.

Evidence of bone modification has been observed from indications of butchery and gnawing (Tables 117, 118 and 120, 121). In regard to butchery, Pit 3 has a few examples of slicing on unidentifiable fish bone (n = 3), as well as on a caudal vertebra from a halibut. Pit 3 had several examples of crushed centrums from halibut vertebrae (n = 13). Some of these were large vertebrae, > 2 cm in diameter, and show clear indications of canine agency (n = 4). Butchery from Pit 2 was observed on several specimens of fish and a couple of examples of worked antler from reindeer. The gnawing from Pit 2 is more diverse, with two examples of crushed halibut caudal vertebrae (n = 6). A couple of mammal bones show signs of stomach etching (n = 2), most likely from having passed through a canine. The fish vertebrae (cod and haddock) that have been crushed by chewing are possible results of canine agency, however, given that the diameters of centra from the cod or haddock vertebrae used here were less than 1 cm it is possible that humans were an agent as well.

Fisheries analysis

Frequencies were only high enough in Pit 2 to carry out more detailed analysis. The species most highly represented at Pit 2 were cod and haddock. With regard to body part representation there is no indication that any large scale selective processing or transport has taken place with cod (Table 115 and Figure 83). However, compared to the expected values of a processing site the observed values for cod possibly indicate an overrepresentation of premaxilla and underrepresentation of cleithra, which could be interepreted as evidence of small scale processing taking place (Table 115 and Figure

84). For haddock the body part representation is fairly consistent with the expected values of whole Gadidae (Table 116 and Figure 83); however, there is an overrepresentation of caudal vertebrae and cleithra which is similar to the expected values at a habitation site (Table 116). Therefore, it is possible that some processing took place elsewhere and that the trunk portion was discarded here.

Modification of the bone material is evident (Tables 117 and 120). Butchery marks were observed on both cod and haddock. Cod displayed whittling and slicing butchery marks on two surpacleithra, while haddock had one cleithrum with a knife mark. The cleithra identified to Gadidae displayed slicing on several individuals (n = 7).

Summary

The faunal data point to a high concentration of discard from subsistence practices. The Pit 2 data indicates that whole fish were brought to the site and consumed there, and processes of possibly catching and consuming produced specific butchery-marks. It is also evident that both human agents and canines assisted in the transformation of the deposits. These small deposits point to the use of local resources; there is no evidence of importation of domesticates to the site.

Stratagraphic Unit 14

S.U. 14 is the top of a large midden deposit associated with an outdoor activity area. Comprising this midden deposit are units 14, 34, 35 and 46. Like the other units 14 formed at the high point of activity at the site in Phase 3. Of the four stratigraphic units S.U. 14 is the thickest and is in close proximity to the large open hearth. The layer was mixed, composed of firm, very dark organic silt, fine sand containing numerous grains of gravel, patches of decomposed wood, fish-bones concentrations and large pieces of charcoal. Also associated with this layer were Pits 2 and 3.

Total Number of Fragments

Fish make up roughly 85 % of the collection (Table 86). Domesticates are practically non-existent (0.02 %), with most of the mammals being represented by wild terrestrial mammals (1.35 %). Sea mammals, birds and mollusca are moderately represented in the deposit at ca. 1 % each.

Number of Individual Specimens

The overall species diversity of this deposit is quite high (Table 87). Cod, haddock and halibut are the most dominant species at 25, 30 and 15 % respectively. In comparison, collectively the terrestrial mammals comprise 3 % of the collection while the other species are much less abundant.

Relative to the entire collection the representation of reindeer is significant at 2.12 %. The relationship between the FUI and representation of elements indicates a mildly significant negative relationship between the two (Table 88 and Figures 68 and 69), meaning that the elements were not selected based on food utility. There is no significant correlation between bone element representation and bone density. With regard to general butchery marks on reindeer, there are many chop and knife marks on some long bones and numerous antler elements showed signs of being worked (Table 93). Indications of gnawing, possibly by a canine, were observed on a proximal ulna and a couple of stomach etched elements (Table 94).

The elements that have been identified within the Canidae group have been aggregated for analytical purposes, (Table 89), but because the sample size is not large the discussion will be more descriptive than analytical. The majority of the elements represented in this collection come from the lower extremities many of which were articulated specimens. Why this is the case is not entirely clear. No signs of butchery were found on any of the specimens.

Other connections to the sea are represented by the small sample of birds (0.42 %) and mollusca (2.17 %). The bird sample is only represented by shore and sea-birds such as Laridae and Anitidae. Mollusca are represented by four species, but it is uncertain whether they represent bait, or food, or neither.

The presence of butchery and gnawing is observed on other taxa (Tables 93 and 94). A single otter mandible is worth mentioning. Although no other specimens of otter were recovered in this layer it is still significant. The specimen recovered had numerous signs of knife scratches along the horizontal ramus, which are not typical to skinning so these knife marks maybe associated with some other activity not determined at this point. Also, several pieces of whale bone showed signs of being chopped and worked. In one example shavings were recovered, indicating the use of some kind of special tool. Gnawing possibly by canines was further noted on several indeterminate bone pieces (n = 7) which showed signs of either tooth marks or stomach etching.

Fisheries Analysis

The fish taxa from S.U. 14 represent a very diverse and rich assemblage. The focus of this discussion is the same demersal fish: cod, haddock and halibut, which make-up the bulk of the fish taxa and demonstrate the diverse nature of the deposit.

The complete elemental distribution of cod is illustrated in Table 90 and Figures 70-72. Based upon observations it appears as though the trunk portion, specifically the caudal skeleton, is underrepresented and that there is a slight overrepresentation of lateral skull bones, such as premaxilla. However, this distribution pattern represents neither the frequencies expected at a processing or habitation site and is more likely the result of whole fish being brought back to the site for immediate consumption.

The skeletal distribution of haddock is similar to that of cod (Table 91 and Figure 70), although the appendicular region is better represented in haddock (Table 91 and Figure 70). This is also observable in the spread of the vertebrae series (see Table 91 and Figure 72). Again, like cod the observed values are more in line with expected values of whole fish rather than values expected at a processing or habitation site.

The vertebral and caudal elements of halibut are highly overrepresented (Table 92; Figure 70) and it appears as though whole or near whole individuals were discarded. Most likely the extreme difference in skeletal distribution represents size selectivity with smaller individuals being brought back whole to the site while large individuals were partially butchered elsewhere.

Butchery marks are present although not prominent in this collection (Table 93). Cod shows the greatest frequency of butchery marks on the cleithrum, specifically, slicing (n = 7). Sometimes one individual would be sliced twice, resulting in only the central portion of the cleithrum being present. In other cases only the ventral or dorsal ends were recovered. This same style of butchery was observed on specimens identified only to family level (Gadidae) (n = 12), which are most likely cod as well. The supracleithrum also showed signs of whittle marks (n = 4). Haddock also had its cleithrum sliced, but not in the same style as cod. It would appear as though the large dense bone piece was intentionally removed. In halibut most of the butchery marks appear on various vertebrae. For example, the caudal vertebrae have been sliced through while a few examples show signs of being scratched by a knife. Indeterminate fish bone (n = 41) showed various signs of butchery, particularly the slicing of ribs (n = 4).

Gnawing was present on both cod and halibut (Table 94). Most of the caudal vertebrae of both cod and halibut were crushed (n = 27) by an unknown agent. There was one dentary from a cod that showed indications of being chewed by a canine.

The total length reconstruction of cod is based on a small sample size (n = 43) (Figure 73). Most of the fish lie in the 600 to 1000 millimeter range. Again, this is within the suitable size range to air-dry cod.

Summary

This collection represents mostly a subsistence economy, with the exception of the canines, which were most likely deposited on site as a byproduct of sporadic skinning. Reindeer and fish all represent food items. Although in reindeer the relationship between the food indices and density indices for those elements was a negative (i.e. bone elements were not selected for high meat value) the presence of butchery marks on the reindeer bones indicates that they were butchered for consumption. In the case of fish, although the collection is large it still most likely represents fish caught, butchered and consumed locally.

Pits 2 and 3

The upper layers of Pits 2 and 3 were composed of S.U. 14. The faunal material from this layer will be presented in the following.

Total Number of Fragments

The TNF counts of Pits 2 and 3 are extremely different (Table 123), with the former having a TNF of 12 and the latter 420. Pit 2 is only represented by fish taxa, while the fish taxa in Pit 3 represent ca. 80 % of the collection. The other taxonomic groups range from ca. 8 % to 0.24 %.

Number of Individual Specimens

The overall diversity of the pits is mixed (Table 124). Pit 2 is only represented by one species, halibut (n = 12) while Pit 3 is more diverse.

In Pit 3 fish taxa comprise about 84 % of the collection (Table 124). Cod, haddock and halibut are the most abundant species at about 28 %, 41 % and 12 %, respectively. Other species of fish are represented but their presence is not as abundant.

The abundance of non-fish species in Pit 3 varies. Terrestrial mammals, like reindeer (n = 3) and arctic fox (n = 1), are represented in the deposit although their abundance is small. Whale is well represented in the collection at about 7 %. Mollusca are represented by four species, whose collective abundance is similar to whales at ca. 7 %.

Butchery and gnawing marks are present but their presence is not significant (Table 125 and 126). Four examples of slicing were observed on cod, haddock and two indeterminate fish bones. Butchery was also observed on reindeer cervical vertebrae which were chopped. Pit 2 had one example of a sliced caudal vertebra from a halibut. The only indication of gnawing was on a crushed caudal vertebra from a haddock.

Summary

Given the limitations of the sample size from both pits the conclusions will be brief. Pit 2 (SU 14) contained only halibut remains which were too small to say anything other than noting the presence of halibut. Pit 3 (SU 14) had a diverse collection of locally acquired resources.

7.3.4. Phase 4: Abandonment

Stratigraphic unit 12 is one of three layers representing the abandonment phase of the site located in the outdoor activity area. SU 12 is the earliest and largest midden layer associated with this phase. The other layers associated with this phase are SU 9 and 6, which will not be discussed here.

Total Number of Fragments

A TNF 8,938 were recovered from SU 12, of which roughly 13 % was unidentifiable (Table 77). A large percentage of the identifiable material, approximately 78 % of the fragments, was fish. Most surprising was the high level of mollusca at about 5 % of TNF, about a quarter of which was comprised of whole valves or umbos. The other taxonomic categories are less than 1 %.

Number of Individual Specimens

A summary of the number of individuals identified is presented in Table 78. Fish continue to have a dominating presence, especially the species within the Gadidae family. Haddock and cod are the most abundant species, the former with a slightly larger percentage of 34 % as opposed to 33 % of haddock. Halibut is the third most abundant species at 18 %. The remaining species identified were only in trace quantities. Nonetheless, the collection is fairly diverse (n = 32).

Relative to the percentage of fish present all other taxa are represented in small percentages, such as the terrestrial mammals (ca. 2 %) (Table 78). The domesticates present were sheeep/goat (ca. 0.3 %) and pig (0.1 %). In the case of sheep/goat whole animals were most likely present on site, based on the skeletal parts represented. Some of the sheep/goats appear to have been young, based upon two signs of immaturity: the lack of epiphyseal fusion in some of the long bones and the appearance of woven-fibered tissue of the periosteal cortex on some of the bone elements. With regard to pig, the sample size is very small so it is not clear if whole individuals were present. However, one individual appears to be young based on the presence of woven-fibered tissue on the third phalanx. Some digestive wear appears on a detached distal epiphyses from a fibula.

Although the collection of reindeer elements represented less than 1 % of the entire identified deposit the analysis still proved to be statistically viable (Table 79). The relationship between the animal units (MAU) represented and their FUI and bone density proved to be statistically insignificant (Figures 63 and 64). There was no significant relationship between element representation, food utility and density. Butchery was minimal and was only observed on a few pieces of antler which likely represent material that had been worked.

Carnivores are present at various levels of identification (Table 130). For the purposes of this analysis those elements identified will be aggregated (n = 17). There was one fully articulated individual identified as a red fox. This individual was in direct association with Oven 1.

Sea mammals are represented by seals and whale (Table 78) the latter represented by bone fragments with a small percentage showing signs of being modified either by chopping or deep knife cuts (n = 51) (Table 83). Butchery of whale bone took the form of slicing and/or chopping (n = 5). The seals are represented by a variety of elements but the sample size was insufficient to do a full analysis (n = 6). There was one large seal identified which might be a bearded seal but this is not certain. There were no signs of butchery observed.

A variety of bird species, both shore and sea birds, was recovered (Table 78). Although not great in number (n = 26), the collection is quite diverse in terms of species (n = 10). There was one butchery mark on an indeterminate bird femur.

Invertebrates play a larger role in the composition of this deposit than in previous deposits (Table 78). Specifically, only counting umbos species like mussels (*Mytilus edulis*) and periwinkles (*Littorina littorea*) are fairly abundant in comparison to some of the other species in the collection, ca. 4 % and ca. 1 %, respectively.

Gnawing on mammal bone points to possible canine agents (Table 84). Specifically, several pieces of bone show signs of stomach acid etching most likely from canines (n = 4).

Fisheries Analysis

The following analysis will concentrate on the most abundant fish species. Haddock, by a slim percentage, is the most dominant species at 34 % while cod and halibut are 33 % and 18 %, respectively. Together these three species comprise about 85 % of the entire collection and are diverse (n = 10). Due to a limited sample size, reconstruction of total length will not be presented.

However, a discussion of the distribution of elements is possible. Overall, cod elemental distribution is more similar to the expected values of whole Gadidae than for processed fish (Tables 80; Figures 65-67).

The skeletal distribution of haddock is similar to cod, with the exception of a high frequency of the pectoral girdle, most likely the cleithrum (Table 81; Figures 65 and 66).

The distribution of halibut elements shows a dramatic difference from the other fish taxa, in the form of a significant over-representation of elements from the trunk portion, specifically the vertebral column and caudal skeleton (Table 82; Figure 65). In Table 82 and Figure 66 there is an obvious high percentage of cranial elements relative to appendicular elements. Based on its elemental distribution it appears that halibut was selectively transported to the site.

Cut-marks have been observed on all three major species of fish (Table 83). Most of the butchery marks on cod are in the form of slicing marks with no particular element having a high frequency of cut marks. Also, if Gadidae (most likely cod) are included (n = 9) the slicing of the cleithrum is particularly significant. Haddock has both elements that have been sliced and elements with marks made by a knife (n = 3). The majority of the butchery marks on halibut occur on the caudal vertebrae or unidentifiable vertebrae which are either sliced or chopped (n = 14).

Gnaw marks were significant for the fish taxa as well (Table 84). Cod had two examples of crushed caudal vertebrae while halibut had n = 13 examples of crushed vertebrae. In cases of large halibut vertebrae the suspicion is canine agents.

Summary

In summary, the material from SU 12 indicates a non-specialized subsistence. The presence of various wild and domesticated mammals reflect provisions brought to the site. In the case of reindeer and sheep/goat these were brought to the site as whole animals. However, because of the lack limited number of pig bones it is impossible to conclude whether these animals were brought to the site whole or in parts.

Mollusca present an intriguing problem. The question is whether their presence represents food, or their use as bait. It is difficult to determine, but their presence is noticeable.

Cod and haddock appear to have been processed and consumed on site. The element distribution of halibut, which mostly consisted of elements from the tail section, could reflect the processing of halibut elsewhere with some individuals, probably small individuals, being brought back whole to the site. The butchery of halibut also indicates the possibility it was chopped up into more manageable pieces.

Chapter 8. Early Modern Period (Post-1550 to 1800 A.D.)

8.1. Kongshavn

At Kongshavn the Early Modern material is concentrated in the upper stratigraphic units of rooms 4 and 5. The archaeological interpretation of these rooms is that they were abandoned at some point during the Late Medieval Period and then reoccupied later on in the Early Modern Period.

8.1.1. Room 5

SUs 2 and 3 are dated to the Early Modern Period. This material is primarily fill from the re-occupation of the site.

Total Number of Fragments

The total number of fragments (TNF) is robust at 3,243, (Table 131). Fish are the most dominant taxonomic group at ca. 83 %. Birds and indeterminate bone have a fairly large representation at ca. 3 % and 11 %, respectively. The other taxonomic groups are represented to a limited degree and range from ca. 1 % to 0.03 %, (Table 131). An interesting observation is the greater abundance of domesticates versus wild terrestrial mammals.

Number of Individual Specimens

The collection has a fairly diverse spectrum of species, (Table 132). Cod is the most dominant species at 63 % followed by halibut (ca. 13 %) and haddock (ca. 14 %).

The domesticates recovered are cow (ca. 0.07 %) and pig (ca. 0.8 %). The latter is represented by a large enough sample to assume that whole animals were brought to the site. Butchery was observed on a fragmented portion of a pig skull, which showed indications that it had been chopped and butchered with a knife. A single femur from a cow was recovered; this had no signs of butchery.

The sea mammals recovered were only identified to the family level as Phocidae and Cetacea, ca. 0.3 % to 3 % respectively. Although no butchery marks were observed on any of the seal bones there was one puncture mark noted from a possible canine. Several (n = 22) pieces of whale bone recovered from SU 2 showed signs of being butchered or worked, in the form of flakes or shavings.

The bird species represent an assortment of local shore and sea birds. Most of the species present are gull-species (n = 22). There is no indication from butchery marks or skeletal distribution that any of these species represent food resources.

Invertebrates observed in the deposit were mostly periwinkles (n = 17). These might have served as food or bait.

Fisheries analysis

The fish taxa are low in species diversity (n = 6), being dominated by cod at over 50 %. The other two most prominent species of fish recovered were halibut (ca. 14 %) and haddock (ca. 13 %).

The skeletal element distribution of cod shows a high frequency of lateral skull bones and a low frequency of caudal vertebrae from the trunk portion, (Table 133 and Figure 86). Closer examination (Table 133 and Figure 87) shows that relative to the expected proportions (of whole Gadidae) there is a slight underrepresentation in elements from the trunk portion as well as elements from the appendicular region, like the cleithrum, and an over abundance of lateral skull bones. When these observed values are compared to the expected values for a processing or habitation site Figure # closely corresponds with a processing site. Therefore, what is most likely occurring is a higher than usual proportion of head to trunk portions being deposited, most likely as a result of processing, but based on the elemental distribution this was not air-dried fish and most likely represents salt-dried fish.

Haddock skeletal elemental distribution is fairly uniform and consistent with the expected proportions for whole Gadidae, (Table 134 and Figure 86), although there is a noticeably high frequency of cleithra from the appendicular region (Table 134 and Figure 87). Relative to the expected proportions, however, the vertebral series of haddock shows a high frequency of caudal vertebrae from the trunk portion (Table 134 and Figure 88). In comparison, the observed values of haddock are similar to the expected values of a habitation site, which a small portion of processed haddock (with head removed) being deposited.

The skeletal distribution of halibut shows a higher than expected frequency of elements from the trunk portion (Table 135 and Figure 86). Table 135 and Figure 88 depicting the vertebral series partly support this observation and indicates that there is a noticeable frequency difference relative to the expected values. Table 135 and Figure 87 show a high frequency of bones from the lateral skull series and a low frequency of cleithra from the appendicular region. However, the observed values appear to represent both expected values from either a processing or habitation site, thus indicating possible selective transport.

Butchery marks are very prominent in this collection (Table 136). Specifically, cod has a high frequency of cut marks located on the lateral skull bones (premaxilla, maxilla, and dentary) at n = 72. These cut marks are described as slicing typically at a 45 degree angle. This slicing style is also observed on several other bones but not in the high frequency as seen on the lateral skull bones. Slicing butchery marks were also observed (n = 4) on those individuals identified to the family level of Gadidae, which are most likely cod. Other cut marks observed on cod were knife marks (n = 14) and two observations of what appear to be a partial cut and then snapping of the bone, which were observed on two premaxilla. A few of the lateral skull bones from halibut also had the same style of slicing cut marks (n = 4). Butchery marks were also observed on the cranial and trunk portions of the body (n = 5). Haddock had only one example of a cut mark on a cleithrum. There were also a high frequency of indeterminate fish ribs sliced (N = 36).

Summary

The Early Modern archaeo-fauna from Room 5 most likely represents a subsistence economy. The domesticates reflect food provisioning, which was supplemented by local resources like seals and possibly whale and birds; in the case of whales these maybe stranded individuals. Fish also represent food provisioning but the butchery observed, i.e. the slicing marks focused on the lateral skull bones, is different than anything observed thus far.

The butchery marks are the most striking evidence from this room (and from Room 4 see below). This butchery pattern may have far reaching implications, primarily because it is possibly an ethnically associated practice along the coast of Finnmark. Recent preliminary research into the presence of similar butchery marks at other multi-room house sites has revealed the presence of similar cut marks at the sites of Vadsøya (Simonsen 1981) and at the Saami site of Šaggušnjar'ga both, located in Varanger Fjord. Similar cut marks have also been observed by the author at two other multi-room sites: Luakvika and Nordmensett. One example was recorded from the upper layer (SU 12) at Skonsvika as well. James Barrett notes the presence of fish butchery in Viking Age and medieval Scottish sites where he interprets cuts to the lateral skull bones (dentary, premaxilla, maxilla, palatine) as the product of hook removal, or tongue removal based upon the orientation of the cut (James Barrett personal communication). Both of these explanations are possibly applicable to the younger layers at Kongshavn. Although the Kongshavn material is described similarly as the cut marks from Scotland the author has not personally observed the Scottish examples so it would be premature to conclude that these are similar practices. It is possible that slicing of the lateral skull bones aided in the drying process of cod, which is a modern practice for drying redfish which is exported to the Japanese market (Erin Hansen personal communication). It could also be a specific ethnic practice known as the Russian cut (Bjørnar Olsen personal communication). This style of cutting is known among some fishers in the north who describe this style of butchery as a Russian practice. In addition, this style of butchery has been observed at several other sites in Finnmark dated to the Early Modern period (Olsen and Urbańzyck In Press).

8.1.2. Room 4

The Early Modern period in room 4 can be aggregated into one analytical unit based on two stratigraphic units (SU 3 and 3B). The full archaeological interpretation of this room is incomplete at this point so little information was available for integration into this analysis.

Total Number of Fragments

Together the stratigraphic units making up the Early Modern Period produced a TNF of 870 (Table 139). The vast majority of this bone material is represented by fish at 92 %. The second most well represented taxonomic group is indeterminate bone at ca. 6 %. The other taxonomic groups vary in frequency from ca. 2 % to 0.23 %.

Number of Individual Specimens

The species diversity of Room 4 is very low (Table 140). Cod is the most prominent species at 76 % followed by haddock (ca. 6 %) and halibut (ca. 13 %). Sheep/goat is present at ca. 0.6 %. Cetacea are represented by numerous fragments at ca. 4.7 %. Only one bone of a whale had a knife mark.

Fisheries analysis

As mentioned, the faunal data, as a whole have a very low species diversity (n = 6), and the same holds true for the fish taxa (n = 4). Cod comprises about 76 % of the collection.

The skeletal distribution of cod is fairly straight forward (Table 141 and Figures 89-91). Besides an over-representation of elements from the cranial portion of cod, specifically the lateral skull bones and the opercular series, and a under-representation of elements from the trunk portion, namely the caudal skeleton, little has changed from the observed values with regard to the expected values of a whole Gadidae.

Butchery is a noticeable component of this deposit, Table 142. Cod has the most frequent occurrence of butchery marks (n = 18) and these occur on the dentary and premaxilla of the lateral skull bone series. The style of butchery is to that observed in the Early Modern deposits of Room 5. Halibut, although not discussed here in detail, also had a similar style of butchery practice on several lateral skull bones (n = 3). Also, mentionable are several occurrences of indeterminate fish ribs being sliced (n = 35).

Summary

Given the low level of species diversity and NISP counts conclusions regarding this deposit are necessarily tentative. Domesticates were brought to the site either as portions or whole animals. Whale bone is present but these could have been hunted or scavenged and used for a variety of functions other than as a food source. Fish most likely had a subsistence function, but cod is the only species that had a large enough sample size for analysis. Based upon the skeletal distribution of cod it appears that whole cod were most likely deposited here with the occasional discard of processed individuals, based on the large concentration of cranial elements and the low frequency of trunk elements. The near equal proportion of appendicular elements (posttemporal and cleithrum) supports conclusion. Although, the butchery on cod and halibut (and indeterminate fish) is similar to what was observed in Room 5, the skeletal distributions are different. Therefore, it is possible that Room 4 was simply a dumping area for the processing that occured in Room 5, given that the size of the two datasets is markedly different.

8.2. Nordmannsett

The site of Nordmansett was a 5 meter long test trench with a total of 9 stratigraphic units recorded. The majority of the animals remains came from SU 8 and 9 but for this dissertation all layers with be presented. SU 9 was the original floor.

Total Number of Fragments

The limited scope of the Nordmensett excavation and the area of excavation resulted in a fairly low number of fragments (141 TNF), Table 144. The most abundant taxonomic group was fish, at roughly 76 % of the collection. Apart from the indeterminate bone (ca. 17.7 %), the rest of the collection occurs in trace amounts (ca. 6.4 %).

Number of Individual Specimens

Species diversity is low in this deposit (Table 145). Cod is the most abundant species at 70 % followed by haddock and halibut, which are equally represented at 7.5 % each. Other species are land mammals, (Table 145), including domesticates like pig (7.5 %) and reindeer (7.5 %).

The butchery marks observed were primarily on the fish remains (Table 146), however, an example of reindeer antler shows indications of being worked. The cut marks observed on cod (n = 4) were of the slicing style and were located primarily on the lateral skull bones. Halibut also had a butchery style of slicing located on the lateral skull bones. There were also a few (n = 6) slice marks on unidentifiable fish elements.

Summary

The Nordmennset data is a small faunal collection from a non-midden deposit, therefore conclusions are limited. No final conclusion can really be reached regarding the function of this site. However, what can be drawn from the data is what was present at the site, specifically the presence of domesticates and reindeer. The style of butchery observed on cod and halibut is similar to that observed elsewhere along the Finnmark coast and potentially links the Nordmannset site to these sites.

Chapter 9. Summary and Conclusions

Defined in the introduction to this dissertation were two sets of questions. The first set of questions were specific and focused on the possible economic strategy of the multi-room houses. This questioning also asked if these particular economic strategies and practices, akin to those strategies such as butchery practices, implicate a specific ethnic group? By answering these questions the functional purpose of these sites would be answered along with the economic network these structures were orientated towards. The second set of questions were generalized and were concerned with the placement of the multi-room house sites in a broader context of medieval/early modern economies of Finnmark as well as the cultural history of the North Atlantic. To answer these questions of economic orientation, function and ethnicity, and to be conjointly applied to their theoretical underpinning, faunal data was used. For this data to be useful for the purposes of this dissertation the data had to be transformed into taxonomic abundances by determining the relative frequency of species, elemental studies were applied to certain species to determine utilization and butchery patterns were analyzed for possible evidence of processing style with implication of indentifying potential ethnic agents.

9.1. Summary of Main Findings

The zooarchaeological data presented herein are represented by three sites, Skonsvika, Kongshavn and Nordmennsett, and cover the Late Medieval Period to the Early Modern Period. The depositional contexts include activity areas and middens from rooms within the structures, as well as from middens external to the structures.

The medieval material at the Kongshavn site included material originating from both the interior and exterior of the structures. The material from the interior portions of the site produced various results that ranged from providing little indication of specific activities or behaviors (e.g. Room 0) to providing evidence of specific behavioral activities and functions, including consumption and craft production. Room 1 demonstrated that in most, but not all cases, processed fish was deposited within the room; some of the remains are interpreted as a deposit of discarded food waste. Room 2 exhibited similar characteristics to Room 1 and appears to have functioned as some kind of food preparation and/or eating area. The Room 3 analysis seems to reflect the long-term use of this room. Here, multiple tasks were performed over the room's life span, from processing to storage, and possibly food preparation and consumption. Room 4 appeared to have a multi-functional profile with a variety of behaviors present: consumption, provisioning, and possibly craft production of some kind. In summary, the rooms reflect the functionally non-specific nature of the site, with no one activity being more prominent than another.

The material from the Room 5 middens and the middens outside of the structure are markedly different. In Room 5 Midden A, all of the faunal material appears to be reflective of immediate consumption, with the exception of cod, which appears to have been processed for long term storage. However, the large presence of fragmented whale bone might indicate its importance as a food source, or boiling for oil. Midden B was quite similar to Midden A and shows no indications of a break in behavior. The exterior midden represents a deposit indicative of specialized cod fishing. It seems that this is most likely processing for long term storage, although it is unclear whether this is for household use or possibly some off-site market. Placed into the larger context of the site it appears as though this specialized fishery was just one of many activities taking place and that it lacks the faunal signatures expected of a commercial fishing site, such as a large accumulation of bone material.

The Skonsvika material was derived from an external midden that was divided into four temporal phases. Phase 1, the pioneering phase of the site, was associated with seasonal occupation. The faunal analysis was based on a small sample of material recovered from two pits (Pits 8 and 9) which indicated consumption of both wild and domestic taxa. Phase 2, which saw the construction of the first permanent structures on the site, was represented by material from food preparation, consumption and possibly craft production. Phase 3 was the apex of the site occupation, which provided the largest sample of the faunal material. This material mostly reflects a subsistence economy, but some of the data suggest the presence of non-subsistence related activity, as observed in the canine fauna, which were a byproduct of sporadic skinning. Phase 4 represents the abandonment of the site. The material indicates a non-specialized subsistence with the presence of various wild and domesticated mammals that reflect provisions brought to the site. In summary, in terms of the faunal data the Skonsvika site represents a semi-specialized site where a subsistence economy was prevalent.

The Early Modern Period material was recovered from the Kongshavn and Nordmansett site. The archaeo-fauna from Kongshavn Room 5 most likely represents a subsistence level economy supplemented with provisioning from domesticates. The fish fauna also represent food provisioning but the butchery observed, the slicing marks focused on the lateral skull bones, is different from than anything observed in the Late Medieval material. Assessment of the Room 4 material was limited by its small sample size, but it seems to represent a subsistence type of economy. It is also possible that much of the Room 4 material originated from activities in Room 5, given the similarities in butchery marks. The Nordmansett data are a small faunal collection from a non-midden deposit, therefore conclusions are limited. However, an observation which possibly links this site with the later material at Kongshavn was the presence of the same style of butchery marks.

9.2. Theoretical Summary

The theoretical angle of this dissertation relies heavily upon the understandings of Pierre Bourdieu's idea of practice and how it relates to ethnicity. As mentioned in Chapter 2 ways of doing things is a socialization process that forms the practices of everyday life. Within any action of doing there are discernable patterns. These patterns reflect the shared commonalities and expressions of social experiences, both past and present, that are articulated in the production of regular actions. These practices range in form and style from the position a knife is held in the hand of a butcher and its resulting butchery signature from anything observed in Finnmark, North Norway and the North Atlantic.

Variations in the butchery patterns were evaluated with respect to different types of processing behavior that might indicate differences in production goals (subsistence use, storage, commercial fishery) as well as possible ethnic differences in butchery practices (cut-marks). Although the majority of contextual units had cut-marks present the uniformity of these practices from both the Skonsvika and Kongshavn site was striking with the majority related to subsistence and storage use, although the originator of these marks is still unidentified. Also, there were clear differences observed between the late medieval and early modern periods, which in regard to the latter cannot be accounted for in terms of production goals. Instead, the possibility is that all of these cut-marks are related to different ethnic practices by individuals "enskilled" with a way of doing things in particular manner.

To understand the above one must follow the logic that a standardized method in the modification of one type of commodity signals culturally specific markings of unchanged and unchallenged practices which associate a commodity with a particular culture and/or ethnicity. The recognition of ethnicity is derived from commonalities of habitus which are often strong psychological attachments associated with ethnic identity and ethnic symbolism. Ethnic identity and symbolism are generated by the function of the habitus which inscribes individuals with a sense of identity, or their social self (Jones 1992), which in a pluralistic setting maintains cultural boundaries (Pyszczyk 1989).

9.3. The Research Questions of the region and super-region

To answer the research questions inferences will be drawn from the zoo-archaeological data presented within this dissertation. To complete a full synthesis of the research various supportive lines of data will be presented as they pertain to the specifics of function and ethnicity.

Question 1: *What are the functions of the multi-room house sites: Kongshavn, Skonsvika and Nordmannsett?*

The Late Medieval Period bone material from the Kongshavn and the Skonsvika sites exhibited characteristics of a mixed economy in the form of a localized and imported subsistence economy which was supplemented by specialized fishing and fur trapping. The latter activities connect these sites with a larger economic trade network.

The presence of domesticates, i.e. cattle, sheep/goat and pig, reveals that animal husbandry, although small in scale, was taking place at both Kongshavn and Skonsvika. From the representation of skeletal elements it is certain that whole animals were kept on site rather than being brought in as butchered provisioned portions. This conclusion is also supported by the soil micromorphological analysis which revealed the presence of domestics on site (Kongshavn most notably) via the positive identification of coprolites from livestock (herbivores) (Adderly and Simpson In Press). As mentioned previously in Chapter 1.1 there was also botanical evidence that pasturage was developed at Skonsvika (Jensen In Press). Some of the domestic livestock, such as cattle and sheep/goat, possibly represents animals kept for secondary products, like milk. Fodder could have been supplied locally and if needed the feeding of offal and discard from the fish was possible.

The diet of those who inhabited the multi-room sites was not only comprised of domesticates but local wild fauna too. There were no convincing signs of specialized hunting practices or specialized transportation of hunted prey. When interpreting the reindeer data the most plausible explanation for both the Kongshavn and Skonsvika skeletal profile is that whole reindeer were brought to the site to be butchered and consumed there. At both sites there is an under representation of high-food value elements and a high frequency of low-food value parts indicating that intensive selection and butchery was taking place at both sites. It's probable that the former were heavily processed for bone marrow and bone grease, as observed in the numerous the bits of indeterminate bone splinters and spiral fractures (Outram 2001:402).In addition to subsistence some kind of small scale craft production was most likely taking place with the noticeable butchery and shavings from reindeer antler.

The seal data included a high frequency of seal ribs, which are high value meat elements (Nelson 1969, Mobjerg and Robert-Lamblin 1989 Diab 1998:12). Also, similar to the transportation practices involving reindeer it does appear based on skeletal part representations that whole seal were being brought back to the site. A similar interpretation was reached in the analysis of the faunal data from Norse Greenland which demonstrated that whole seals were being brought back to the sites as well (Degerbøl 1929, McGovern 1992, Enghoff 2003). Although contradictory to the reindeer skeletal profile the suggestion here is that seal was not as heavily processed as reindeer.

Whale has long been a valued food and utilitarian resource for northern communities (Szabo 2000:1). With regard to the Finnmark sites, there are several pieces of large bone that would fit into James Savelle's (1997) frame/bulk utility index for architecturally useful bone; these include ribs, some of which are heavily worked, vertebrae and a few un-speciated cranial pieces. Some of the larger pieces, although too small for aiding in the construction of the houses, still had utilitarian functions. Examples include some of the larger pieces used as chopping blocks or cutting boards (Monks 2001). Throughout the midden areas and in some of the rooms (Rooms 2, 4 and 5) at Kongshavn there is a fair number of fragmented whale bone. Much of it is in large fragments (i.e. greater than 5 cm), some of which had clear indications of being used as wedges to ensure stability in the stone walls while others have been burned to various degrees. The latter is suggestive of some kind of processing, either as fuel (oil extraction) or food (Mulville 2002). Since this former suggestion lacks sufficient numbers of discarded bone to be plausible, it is more likely that the burnt bone represents the discard from cooking episodes. In Monks (2002:149) there is a discussion of an oil utility index for whale which points out the presence of what he calls "bone chips". He surmises that the presence of such "chips" is a by-product of oil extraction due to culinary and nutritional necessity, such as fattening up soups or stews. In general, however, the archaeology of whaling is difficult (Johnson 2002:45 and McCarthy 1984) because whales will be butchered well away from site and because whale bone on site can come from any source, such as being hunted or scavenged from a random stranding.

With regard to the other Late Medieval midden deposits located at Kongshavn and the activity area at Skonsvika which are all fairly similar in terms of demonstrating an intense concentration of marine fish, specifically cod, haddock and halibut. However, this intensity does not reflect the specialization of industrial fishing as defined by Perdikaris (1998) and as seen in sites connected with the Hanseatic trade and other international trade networks (Perdikaris et al. 2002, Amundsen et al. 2005). Rather, based on the butchery patterns, i.e. skeletal-part distribution and cut-marks, these deposits represent subsistence practices.

Evidence of fur trapping/processing was observed from the work area at Skonsvika. Although not much archaeological work has been done on fur trapping/processing sites the literature that does exists provides some useful information to draw convincing inferences from (e.g. Veale 1966, Prummel 1978, Anderson 1981, Martin 1986, Winge 1998, 2001, Howard-Johnston 1998, Baxter and Hamilton-Dyer 2003). As suggested by this research osteological evidence of the trade, processing and use of furs can be found at trading posts where trappers and furriers would do some of the initial processing, at major centers of trade where tanners and fellmongers would reside and sell/export furs, and burial sites. For practical purposes it must be assumed that most of the butchery was taking place at the kill site where animals would be skinned away from base camps and trading centers, thus most, if not all, of the osteological material, like the skull and most of the post-cranial bones, would have been deposited elsewhere. Based on the conclusions reached by Baxter and Hamilton-Dyer (2003:92) of their analysis of the Millbridge site in Hertford U.K (10th to 12th century AD Saxo-Norman period) it is suggestive that the presence of the paws and claws, i.e. metapodials and phalanges, and the tail, i.e. caudal elements, implies the presence of processed pelts (see also Reichstein 1984, Hatting 1990 and Wigh 2001:120-123). The presence of these elements, and some whole individuals, at Skonsvika suggests the presence of pelts. The whole animals most likely were acquired in relatively close proximity to the site, so transportation costs were reasonable enough to have brought whole individuals to the site to undergo the first stages of the skinning process rather than butchered at the kill-site. In addition, the physical evidence in terms of processing may come from other sources of empirical data, like butchery marks. Wigh (1998) reports cut marks on skulls from the town of Sigtuna in Sweden near the trading town of Birka (see Trolle-Lassen 1986 for reference to cut-marks on the skull). The Roman period site in Eastbourne, Sussex had dog skulls with cut marks along the nasal bone (Serjeantson 1989). Similarly, the articulated arctic fox specimen recovered from Skonsvika that was associated with the outdoor oven had one knife mark across its nasal bone.

In addition, two dogs were recovered from the site. Dogs have been well documented as a hunting method used by Russian/Karelian trappers (Kovalev 2003). There are documented accounts from the 15th century that beaver were hunted with nets, baskets and dogs, it is believed that this method was practiced by medieval Karelians

(Talve 1997). Therefore, based on the presented evidence Skonsvika partially acted as a base camp/processing site for furriers/trappers; however, the evidence suggests that this kind of activity was most likely opportunistic and did not reflect of the sole purpose of the site.

The exterior midden at Konghavn in terms of species present and skeletal-part representation does fit into what has been observed throughout much of the North Atlantic, which are large midden deposits of discarded head-parts of codfish after processing for long-term storage (Barrett *et al*. 1999, Perdikaris and McGovern 2003). What differentiates this deposit from being considered a discard of industrialized activity is the low density of material. As mentioned previously in this chapter, in comparison to the other multi-room house deposits the exterior midden at Kongshavn stands out as being quite unique behaviorally and possibly reflects an attempt at making procured fish, most likely "stock fish" based upon the observed way of processing expected at Norse sites in north Norway (Perdikaris 1998). As equally, consideration must also be paid to the locality of the deposit, which is "outside" the house, this further strengthens the conclusion based on spatial differentiation (i.e. spatially separate activities) that this deposit behaviorally represents something different from the rest of the deposit at Kongshavn, and Skonsvika for that matter. The summation is that this deposit does represent an event of procuring cod for long term storage, whether this is for an international or more local/ethnically specific market, or for tax/tribute collection, is difficult to determine.

In general, both sites exhibit activities illustrative of a multi-functional work place, or work camp. The processing of cod and fur bearing mammals although present were just minor activities but they do connect the Kongshavn and Skonsvika with western and eastern trade networks, respectively. The presence of domesticates, obviously imported, implies that long-term provisioning was a necessity to the subsistence economy, which was also supplemented by a variety of local wild fauna. Turning to specifics, some of the rooms at Kongshavn reflect the multi-functional aspect of the site because their function changes over the lifespan of the site, these changes in function are difficult to quantify but they could be over a year or years. One speculation is that this change is either connected to more individuals residing on site therefore there would be a necessity for more room in terms of boarding and work space, or another speculation is that the function of the rooms change. In comparison to Kongshavn, Skonsvika's faunal material was much more static. Based on this observation the speculation is that the function of the site stayed relatively consistent over the years. This function had an industrial quality to it noted by the presence of numerous pits, ovens and the buildup of a large amount of combustible material. However, there is a sudden and abrupt ending to the sites use which is unexplainable at this point; whereas, in contrast Kongshavn remained in use well into the Early Modern Period.

The Early Modern Period material is represented by Kongshavn and Nordmannsett. Kongshavn is represented by the upper layers from Rooms 4 and 5, where this material has a provisioning nature to it with the majority of the assemblage reflective of the late medieval material. However, the butchery observed on cod, which will be discussed later, is unique and functionally does not fit into any known processing techniques. Therefore, at this moment Early Modern Kongshavn appears more to be at a subsistence level economy.

The sample from Nordmansett was small but some speculative remarks can be made. Like the later layers at Kongshavn, it is clear that some provisioning was taking place with the presence of domesticates and wild terrestrial mammals. Fishing was also an activity, this material will be discussed in detail in the proceeding section was similar to the material recovered from Early Modern Kongshavn. Therefore, the function of Nordmansett although on a smaller scale given the size of the site and the faunal sample was functionally and economically similar to early modern Kongshavn.

Question 2: If possible, can the ethnicity of the people inhabiting these sites be determined?

The task here is to determine if the faunal data has particular attributes to make conclusive statements about ethnicity. As a reminder, the analysis and interpretation of the artifacts from the late medieval suggests that the multi-room house sites were ethnically mixed. This analysis concluded that the majority of the artifacts recovered from Kongshavn were Norse, while a high frequency of Russia and/or Karelia artifacts were present at Skonsvika. The architectural data from both sites falls along similar ethnic lines of differentiation. At Kongshavn the corner fire-place in Room 1 was similar to ones found in urban centers, like Trondheim or Bergen. Likewise, the large ovens at Skonsvika were stylistically similar to Russian ovens. The faunal analysis will try to argue that certain economic practices, like fishing and fur-trapping as well as butchery practices have the potential to be qualitatively sound indicators of ethnicity.

To assist in this discussion numerous archaeo-fauna deposits throughout North Norway and parts of the North Atlantic will be referred to for ethnic comparatives, Table 148. Unfortunately, despite a lot of effort on behalf of the author it has been difficult to make solid contacts with Russian institutions which might have some archaeological information concerning multi-room house sites in Russia. As a result this discussion has no particular Russian archaeo-fauna deposits to refer to directly, therefore many of the statements made herein are tentative until Russian data can be added to the discussion.

Throughout much of the Norse dominated North Atlantic there was a tradition of fishing, specifically for cod, which by the Late Medieval and Early Modern Periods was generally associated with the commercial fish trade. As mentioned elsewhere (Chapter 4) this trade in dried fish resulted in certain characteristic traits observable in the archaeological record. As a reminder of the generalities, these faunal deposits were typically large, numbering in the tens to hundreds of thousands of identifiable pieces of bone, with diagnostic butchery patterns of decapitation and gutting. The exterior midden at Kongshavn is the only deposit throughout the collections presented which reflect a skeletal distribution similar to the butchery pattern of the dried fish trade. In comparison to the other multi-room house deposits the exterior midden at Kongshavn possibly reflects an attempt at making procured fish, most likely “stock fish”, but the cut-marks observed are not consistent with any known Norse/Norwegian sites in North Norway associated with the commercial fish trade (Perdikaris 1998). It is this attribute of the deposit which possible disqualifies it as being created by Norwegian fishermen. Although a deeper interpretation will be presented in the next section this variation in the processing technique reflects a different method by a non-Norwegian to process cod, possibly for the Norwegian trade network or Norwegian tax collector.

It was known that the trade in furs was a primary economic activity of Novgorod, a trade that was largely supplied by Karelian middlemen. The faunal evidence from Skonsvika revealed the presence of fur bearing mammals whose skeletal distribution was similar to that observed at sites where processing of furs was taking place. Although furs were being processed at Skonsvika, there is a lack of ethnically diagnostic markers by way of processing techniques or cut-marks that conclusively link the presence of fur-trapping with Russian/Karelian trappers. Hypothetically, however, because fur trapping was a well-known activity by Karelians and given that much of the material culture is Russian/Karelian it is justifiable to speculate that the trapping and processing was being carried out by Karelians.

Finally, there was a large body of evidence presented with regard to the cut-marks observed at all of the sites throughout both periods of occupation. To assist with the interpretation of the data and to potentially connect the observations with other observations made throughout the North Atlantic refer to Table 148. What is equally relevant to this discussion is the negative data regarding the lack of butchery marks from other contemporary archaeological sites in Finnmark and throughout the North Atlantic. Many of the Finnmark sites have been investigated by the author and lack any signs of cut-marks detailed herein. These sites are (refer to Table 148): the Norwegian fortress site of Vardøhus (Late Medieval), the Sami sites of Karlebotn (Odner 1989, Late Medieval) and Gæccevajnjarga (Odner 1989, Late Medieval), Nesseby, Finnmark, and the multi-room house sites of Forsøl (Bratrein n.d., Late Medieval), Hammerfest, Finnmark and Værbukta (Henriksen 2002, Wk 10322, BP 813 ± 62, two sigma calibrated range 1450-1680 A.D.), Måsøy Finnmark, and the Norwegian farm mound of Måsøy, Måsøy Finnmark. Added to this list of negative data are numerous sites from North Troms and Nordland which are completely absent of cut-marks, Table 148. In addition, there are the comparative sites throughout the North Atlantic, some of which, specifically a few of the Icelandic sites and one Shetland site, have been personally analyzed, or involved in managerial capacity, by the author.

Referring back to the exterior midden at Kongshavn which, as mentioned in the previous section, does have cut marks observed on the post-temporal, postcleithrum and premaxilla bone of cod. All three of these elements were sliced through the bone, in addition of the few examples of knife scratches observed on the post-temporal. Neither of these styles of cut-marks are known at Norse/Norwegian sites in north Norway, Table 148. However, an example of such a butchery mark on the post-temporal has been observed by the author at the Saami site of Šaggušnjar'ga (Odner 1989, AD 1585 +/- 65) located in Nesseby Municipality, Finnmark County (Table 148). Similar cut-marks on the post-temporal and the premaxilla have also been observed in Viking Age and medieval Scotland (James Barrett personal communication) (Table 148). The interpretation of the cut-marks on the post-temporal is that they are the result of decapitation (James Barrett personal communication). Based on this interpretation one could also surmise that the cut-marks on the post-cleithrum, a bone which articulates with the post-temporal, are associated with decapitation. The cut-marks to the premaxilla at the Scottish sites has been interpreted as evidence of hook removal (Barrett 1999:371). Having not personally observed the data from the Scotland sites it is difficult to refute or to agree with Barrett's observations, but based on what has been presented, and not presented, it is a fair assessment as mentioned previously that this deposit was created by a non-Norwegian.

Because of the similarity between the faunal deposits located in the rooms at Kongshavn and the activity area at Skonsvika they will be discussed simultaneously. The cut-marks observed on cod were primarily slicing marks across the appendicular region, particularly the cleithrum and subopercular. These cut-marks have been interpreted as evidence of processing fish for immediate consumption. The only example outside the multi-room houses, and one personally analyzed by the author, is from the Saami site of Šaggušnjar'ga (AD 1585 +/- 65) where a number of butchered suboperculars from cod were observed that were stylistically similar to those reported herein. What can be derived from this analysis is that the data is consistent between three sites, two of which are multi-room house sites. What links the Saami site to the multi-room house site at this point is not explainable but it is obvious that there is an exclusive linkage between the sites. The lack of a Russian/Karelian comparison is problematic but this does not rule them out as a contender owing to the fact this style of cut-marks do not appear in any known Norse site, and only one Saami site and no other, supports the speculation that this style of cut-mark with created by Russian/Karelian.

The butchery observed at the midden deposit in Room 5 was a mixture of sliced cleithrum and knife-marked supra-cleithrum, but the latter is the center of discussion here. Similar cut-marks on the surpa-cleithrum were also observed in the upper layers of Room 2 (SU 4 and 3). Outside of the multi-room houses only one example has been found at the iron age site of St. Boniface, Papa Westrey, Orkney where Ruby Cerón-Carrasco (1998) reports cut marks on the supra-cleithrum of cod in addition to those reported on the dentary, maxilla and vomer. But based on her descriptions and drawings the cut marks are without question stylistically dissimilar from those reported in this dissertation. This style of cut-mark has not been observed anywhere in Finnmark or elsewhere, but its association with a style of cut-mark already attributed to Russian/Karelians places it within the ethnic categorization.

Turning to the body part frequencies and cut-marks observed on halibut throughout the late medieval deposits from both sites there have not been any similar archaeological observations made elsewhere in north Norway or the North Atlantic. However, as noted in Íslenkir sjávarhættir III by Lúðvík Kristjánsson (1983) there are several Icelandic methods of halibut butchery which are detailed in numerous drawings. Some of these drawings, specifically on pages 276, 279, and 282, detail the removal of the appendicular region, or gill region, from halibut. Taken at face value these drawings and the observed elemental distribution presented earlier appear fairly similar. In addition, the cut-marks observed on the axial skeleton (trunk portion) and cranial region are convincingly similar to some of the drawings in Kristjánsson's book (1983: 275, 277). Therefore, it would not be a far stretch at this early point to tentatively propose that potentially the same butchery practices as detailed by Kristjánsson (1983) had been taking place in Finnmark. But, based on the author's own zoo-archaeological experience with Icelandic data, and the accounts of other researchers, no such cut-marks have been observed in Icelandic collections thus far. The author also feels that given the folk traditions of Norwegian fishermen, who have strict taboos surrounding halibut fishing, it is a fair assessment to state that the assemblages of halibut were not made Norwegians (Amundsen forthcoming). Nor is there any indication of halibut being butchered at any of the Saami sites analyzed; therefore, conclusions with regard to the halibut butchery tentatively point to Russian/Karelians. Although, the Icelandic connection is very convincing it would be difficult to argue that Icelanders were only present at Skonsvika and Kongshavn to butcher halibut.

Many of the cut-marks observed on haddock reported in this dissertation were found on the cleithra. Cutting off the haddock cleithrum has been consistently observed in other sites across the North Atlantic as well (McGovern et al. in press), but because of the ubiquitous nature of these butchery marks it is difficult to pinpoint potential ethnic provenience.

The cut-marks observed on cod from early modern Kongshavn, specifically from Rooms 4 and 5 (SU 2-3), and Nordmennsett, with one example from the later phase at Skonsvika (SU 12), represent a very different cut-mark observed in Finnmark. These were described as slicing of the lateral skull bones (dentary, premaxilla, maxilla and palatine). Similar cut-marks have also been observed at another multi-room site Luakvika, Berlevåg Municipality, Finnmark County (Wk 10325, BP 386 ± 45, two sigma calibrated range 1430-1640 A.D.) and at the sites of Vadsøya, Vadsø Municipality, Finnmark County (Simonsen 1981, Late Medieval to Early Modern) and, again, at the

Sami site of Šaggušnjar'ga (Odner 1989, AD 1585 +/- 65) also in the Varanger Fjord (Table 148). Again, James Barrett (personal communication) notes the presence of a similar butchery mark in Scotland from the Viking to the Medieval Periods evidence of hook removal, or tongue removal (James Barrett personal communication). Although the early modern Kongshavn material is descriptively similar to the cut marks from Viking Age/medieval Scotland this author has not personally observed the Scottish samples to draw a definitive conclusion about their stylistically similarities to the Kongshavn samples; therefore, based on what has been presented this data seems outside of everything discussed so far and could represent, as noted in some of the historical documentation, other Russian groups coming into Finnmark post-fur trade.

Finally, a few remarks in closing about the cut-marks discussed, their significance and their impact on the historical processes of Finnmark. What is known is that the cut-marks appear to be more concentrated in Finnmark and do not appear anywhere else throughout North Norway (Table 148). In fact, all of the styles of cut-marks described here, based on the limited excavations in western Finnmark, e.g. Værbukta, appear only in sites located in the eastern half of Finnmark and in a few sites in the North Atlantic, Table 148. However, the evidence from the North Atlantic would have to be analyzed by the author to determine the likeness to the Finnmark data. The eastern sites of Finnmark are ethnically mixed based on the artifactual and architectural data, but each site has a disposition to either Norse or Russian/Karelian. Similar to the artifactual and architectural evidence portions of the faunal data are ethnically distinct, but the majority of the subsistence evidence has been interpreted as being unanimously Russian/Karelian. The overall "mixed" ethnic flavor that permeates the sites might be attributed to the function/purpose of these sites and suggests that these are seasonal trading outposts where various ethnic groups would congregate to trade, most likely from early spring to late autumn. Despite this ethnic mixing and various levels of participation in different trade networks these outposts still retained the core ethnic markers of the primary occupants, Russian/Karelian traders, as observed in the cut-marks on the various fish. However, the Kongshavn data does present a problem to explain. It is possible that this site was a Norse trading post as well with Russian/Karelians working on site as labors such as cooks. As Lightfoot (1998:201) points out people consistently reproduce their structural principles through their daily lives, specifically food preparation as is the case here. It are these daily practices, like butchery patterns and the cut-marks left behind on bone, which are culturally specific habits which can be interpreted as ethnic markers because they are inherent to a particular group. Derived from these actions are the sub-conscious acts learning by doing, like processing fish, which is a very consistent activity, and because of its consistency it is observed within the archaeological record. Finally, based on Cohen's (1971:266-281) definition of a trade diaspora these sites do represent a Russian/Karelian diaspora, which in terms of significance to the historical processes of Finnmark present a culturally more "Eastern" landscape of eastern Finnmark than previous considered. It is most likely that the late medieval data represents the antecedents to the early modern economic distinction described by Lars Ivar Hansen that differentiates western and eastern Finnmark.

However, the above discussion does not explain why the Saami site of Šaggušnjar'ga had numerous styles of cut-marks present. This occurrence raises the question that maybe the cut-marks discussed are of Saami origin? It is possible that

Saami individuals could have resided at the multi-room house sites as hired laborers. But then this raises the question of why are these cut-marks not present at other Saami sites? One explanation is that Šaggušnjar'ga could have been visited by Russian/Karelians traders periodically as a central meeting place to trade with local Saami of the Varanger fjord.

Question 3: *Are there economic differences along the coast of Finnmark during the Late Medieval and Early Modern periods?*

With regard to the multi-room house structures it does appear that there is an economic difference between the Late Medieval and Early Modern Periods. This is supported by the abandonment of Skonsvika and the re-use of Kongshavn by the Early Modern Period. Together these data represent both an economic and political shift. It is by the Early Modern Period that the principality of Moscow had taken over Novgorod's trade networks and established new trade agreements with Norway limiting its presence along coastal Finnmark. However, as suggested earlier by the historical record, Russians (pre-Pomor) from the White Sea were coming to Finnmark and living for a year or two with their families (Hansen in press). It is more than likely that Kongshavn represents such a site of Russian occupation. In western Finnmark there was a greater involvement in the Norwegian dried fish trade. This is based on evidence from the farm mound at Måsøy and the multi-room house of Værbukta, both of which had very large midden deposits of fish. However, the extent of these economic differences between the Late Medieval and the Early Modern Periods is not clear at this point and will require more focused investigations on this issue.

Question 4: *What do the findings mean with regard to the North Atlantic region?*

That in addition to the Norse there were other cultural influences which helped shape the region. These other cultural influences were obviously on the eastern fringe of the North Atlantic but they still managed to participate, to some degree, and have an impact economically and politically. The findings here do away with the perspective that the North Atlantic region is a homogenous culture based solely on a trade network in dried fish trade. It is apparent, based on the data, that there were different ways to operate within the North Atlantic. The multi-room house data represents this difference.

9.4. Concluding remarks and directions for future research

To conclude, this research accomplished several things. As a component in the multi-room house project it added more information to an otherwise marginalized time period in North Norwegian archaeology. There was the addition of more fauna data to the North Norwegian and North Atlantic data base. Also, there was an opportunity to examine the problem of ethnic identity by presenting some unique data.

However, the following dissertation only offered a small detailed percentage of information regarding the culture history of Finnmark to answer questions beyond the scope of the doctoral requirements herein a larger assessment of excavation and potential sites for future research is warranted.

The general topic of this proposal is to investigate the development of a trade diaspora in North Norway's later historic period. If the multi-room house sites represent a true trade diaspora then there should be interconnected qualities located at all of the sites, such as the "ethnic" markers observed in the multi-room houses of eastern

Finnmark. Localities of research interest are specifically western Finnmark and north-west Russia. The significance of this research would be to establish the interconnectedness between the multi-room house sites and their association with the trade network across Finnmark and parts of northern Fennoscandia.

To restate what has been discussed elsewhere in this dissertation, the past thirty plus years the North Atlantic region has under gone a progressive and steady increase in archaeological and zoo-archaeological research, specifically within fisheries archaeology. Throughout the region numerous researchers have contributed an enormous amounts of work to this niche alone (e.g. Amorosi et al. 1996, Barrett et al. 1997, 1999, Bigelow 1984, 1985, Cérron-Carrasco 1994, Church et al. 2005, Dockrill et al. 2001, Edvardsson et al. 2004, Enghoff 2003, Jones 1991, Nicholson 1998, Ogilvie 1996, Perdikaris 1996, 1998; Perdikaris and McGovern 2004; Rackham 1996, Simpson et al. 2000, McGovern and Perdikaris 2002, 2003, Perdikaris et al. 2002, Edvarsson et al. 2003, McGovern et al. 2003, Brewington et al. 2004, Amundsen et al. 2004, Harrison et al. 2004, McGovern et al. 2004a, McGovern et al. 2004b, Krivogorskaya 2005); unfortunately, because of the limitation of space only a few of the many prominent researchers will be cited in the following. Sophia Perdikaris has been investigating one of the main research problems in post-Viking period North Atlantic which has been understanding the factors behind the shift from local subsistence economies into regional commercialized economies primarily in north Norway (see Perdikaris 1996, 1998a, 1998b, Peridikaris and McGovern 2004); while, James Barrett focused his investigations on the same topic in northern Scotland and the Orkneys (Barrett et al. 2004). Other prominent researchers on this topic include Wim Van Neer (Van Neer and Ervynck 2004) who primarily focused his research in the North Sea region and Inge Bødker Enghoff (1999) who concentrated on the Baltic region. Another topic of interest has been the connection between coastal sites and interior sites with the processing of marine fish for long-term storage (e.g. Heinrich 1994, Van Neer and Ervynck 1994, McGovern and Perdikaris 2002, 2003, Perdikaris et al. 2002, Edvarsson et al. 2003, McGovern et al. 2003, Brewington et al. 2004, Amundsen et al. 2004, Harrison et al. 2004, McGovern et al. 2004a, McGovern et al. 2004b, Krivogorskaya 2005).

The interconnecting theme binding all of this research has been the investigation into long-distance trade networks. However, not much attention has been devoted to the social phenomena of trade diasporas and use of zoo-archaeology. The pluralistic nature of Finnmark during the later historic period provides an ideal social situation for the development of a trade diasporas, as discussed in Chapter 2.

The following is the methodological protocol for investigating a trade diaspora over multiple field seasons. The first year and half of this investigation would re-focus on Skonsvika, primarily the activity area (court yard) and interior areas of the site. The goals would be to determine differential use of the site and ethnicity. Therefore, at Skonsvika excavation would focus on opening up a much larger area of excavation by focusing on the already partially excavated activity area. Because it is difficult to determine the entire extent of the deposit the following suggestion is based on an estimation of its size. The entire excavated area was approximately 40 x 2 meters. The first phase of the site was 26 x 2 meters with the activity area concentrated in the area of 114 to 121 N. To fully capture the deposit it would be advisable to extend the excavation both east and west with the east ward extension at approximately two and half meters and the western extension at five meters. Given the size of the unit it would most likely take three months, with the possible addition of another field season to excavate the entire unit. In addition, investigations into other areas of the site, namely interior portions of the site, would take the same amount of time provided that all of the excavations were conducted by 4 to 5 individuals.

The following years, specifically years 2 and 4, would address whether or not a similar functionality observed at Skonsvika is observed in western Finnmark. The sites at Neselva-Ávzejohka (1300 - 1450 A.D.), Måsøy Municipality, Finnmark County, are excellent possible contenders for further investigation based on the 2001 excavation which observed good organic preservation. These are very large structures, ca. 25 x 30 meters, so excavation should consider the protocol used at the Skonsvika site, i.e. a trench to investigate the interconnection of all of the rooms and then based on those results extend the trench further. Manpower would most likely rely on 5 to 9 individuals to do the excavations over several field seasons for two or three years.

Finally, examination into prospective sites in the White Sea region would be questionable and would rely heavily upon a hospitable political atmosphere, which can be variable but is possible. In addition, it would be in the best interest of future research to examine Russian Pomor fishing sites from the 17th-18th century that are located along the coast of Finnmark.

The expected results would hopefully establish a continuation of what was observed in eastern Finnmark, however with a possible local variation. Therefore, these results could support the notion of a trade diaspora established throughout Finnmark.

How this relates to the current research into fisheries archaeology is that it opens the discussion to examining the social impact of long-distance trade and early commercialization had on various cultural groups.

TABLES

Table 1 Bone material used in this research.

Site name	Year of excavation	Excavation type	Fauna TNF
Skonsvika	2001	test pitting	392
Kongshavn	2001	test pitting	296
Skonsvika	2002	full excavation	5,599
Kongshavn	2002	full excavation	19,873
Skonsvika	2003	full excavation	14,380
Kongshavn	2003	full excavation	1716
Skonsvika	2004	full excavation	3,867
Kongshavn	2004	full excavation	20,512
Nordmannsett	2004	test trench	143

Table 2 Processing Site Full Elemental Distribution of Cod.

	MAU	%MAU
Olfactory	1492.50	17.69
Occipital	373.50	4.43
Otic	467.50	5.54
Investing	233.50	2.77
Lateral	2011.40	23.83
Opercular	891.50	10.56
Mandicular	626.00	7.42
Hyoid Arch	861.00	10.20
Branchial Arch	8.50	0.10
Pectoral Girdle	701.00	8.31
Pelvic Girdle	0.00	0.00
Vertebral Column	695.00	8.24
Caudal Skeleton	77.79	0.92
Total	**8439.19**	**100.00**

Table 3 Habitation Site Full Elemental Distribtion of Cod.

	MAU	%MAU
Olfactory	0.00	0.00
Occipital	0.00	0.00
Otic	0.00	0.00
Investing	0.00	0.00
Lateral	2.00	2.76
Opercular	1.50	2.07
Mandicular	0.00	0.00
Hyoid Arch	0.50	0.69
Branchial Arch	0.00	0.00
Pectoral Girdle	57.00	78.56
Pelvic Girdle	1.00	1.38
Vertebral Column	0.05	0.07
Caudal Skeleton	10.50	14.47
Total	**72.55**	**100.00**

Table 4 Processing Site Partial Elemental Distribution of Cod.

	MAU	% MAU
Premaxilla	414.50	50.98
Posttemporal	322.50	39.67
Cleithrum	76.00	9.35
Total	**813.00**	**100.00**

Table 5 Habitation Site Partial Elemental Distribution of Cod.

	MAU	%MAU
Premaxilla	0.00	0.00
Posttemporal	2.00	5.33
Cleithrum	35.50	94.67
Total	**37.50**	**100.00**

Table 6 Processing Site Vertebral Series of Cod.

	MAU	% MAU
Thoracic	256.00	62.47
Precaudal	85.00	20.74
Caudal	68.79	16.79
Total	**409.79**	**100.00**

Table 7 Habitation Site Vertebral Series of Cod.

Habitation site Vertebral Series	MAU	%MAU
Thoracic	0.00	0.00
Precaudal	0.05	0.50
Caudal	10.50	99.50
Total	**10.55**	**100.00**

Table 8 2001 Radiocarbon dates.

Context	**Lab. Ref.**	**Locality**	**C-14 B.P.**	**C-14 Cal. 68.2% / 95.4%**
Testpit 1	Wk-10180	Gammelvær	411 + 55	1430 - 1520 / 1410 - 1640 A.D.
Testpit 2	Wk-10181	Gammelvær	711 + 66	1240 - 1390 / 1210 - 1410 A.D.
Testpit 2	Wk-10182	Gammelvær	731 + 38	1258 - 1298 / 1210 - 1390 A.D.
Testpit 7	Wk-10186	Neselv/Avzejohka S	526 + 40	1330 - 1440 / 1300 - 1450 A.D.
Testpit 8	Wk-10187	Neselv/Avzejohka S	574 + 38	1315 - 1415 / 1300 - 1430 A.D.
Testpit 10	Wk-10188	Neselv/Avzejohka N	292 + 46	1510 - 1660 / 1470 - 1800 A.D.

Testpit 10	Wk-10189	Neselv/Avzejohka N	414 + 64	1430 - 1630 / 1410 - 1640 A.D.
Testpit 12	Wk-10190	Neselv/Avzejohka N		Modern
Testpit 12	Wk-10304	Neselv/Avzejohka N	379 + 67	1440 - 1630 / 1420 - 1650 A.D.
Testpit 13	Wk-10305	Neselv/Avzejohka N	637 + 67	1295 - 1395 / 1270 - 1430 A.D.
Testpit 14	Wk-10306	Værbukta		Modern
Testpit 15	Wk-10322	Værbukta	813 + 62	1500 - 1640 / 1450 - 1680 A.D.
Testpit 20	Wk-10309	Skonsvika	685 + 65	1295 - 1395 / 1280 - 1410 A.D.
Testpit 22	Wk-10311	Skonsvika	676 + 60	1280 - 1400 / 1240 – 1410 A.D.
Testpit 19	Wk-10323	Skonsvika	643 + 47	1280 - 1390 / 1270 - 1410 A.D.
Testpit 24	Wk-10324	Kongshavn	585 + 58	1300 - 1410 / 1290 - 1440 A.D.
Testpit 25	Wk-10193	Kongshavn	380 + 43	1440 - 1630 / 1440 - 1640 A.D.
Testpit 27	Wk-10313	Kjølnes	697 + 132	1210 - 1410 / 1030 - 1450 A.D.
Testpit 29	Wk-10325	Laukvika	386 + 45	1440 - 1630 / 1430 - 1640 A.D.
Testpit 30	Wk-10194	Laukvika	396 + 37	1440 - 1620 / 1430 - 1640 A. D.
Testpit 31	Wk-10304	Laukvika	339 + 58	1480 - 1640 / 1440 - 1660 A.D.
Testpit 34	Wk-10317	Nordmannsett	1178 + 58	770 - 960 / 690 - 990

				A.D.
Testpit 38	Wk-10318	Tofteelva	503 + 65	1320 - 1470 / 1290 - 1620 A.D.
Testpit 38	Wk-10319	Tofteelva	585 + 67	1300 - 1410 / 1290 - 1440 A.D.

Table 9 Gammelvaer Test-pit 1 NISP.

Species	Test-pit 1 SU 2
Indeterminant bone	1
Total	**1**

Table 10 Gammelvaer Test-pit 2 NISP.

Species	Test-pit 2 SU 2
Mammal Indeterminant	2
Indeterminant bone	3
Total	**5**

Table 11 Gammelvær Test-pit 3 NISP.

Species	Test-pit 3 SU 1	Test-pit 3 SU 2
Fish		
Atlantic Cod (Gadus morhua L.)		1
Mammal Indeterminant	1	
Indeterminant bone	2	24

Birds		
Bird Indeterminant	1	1
Total	**4**	**26**

Table 12 Neselev Test-pits 7, 9, 10, 11 and 12 NISP.

Species	Test-pit 7 SU 2	Test-pit 9 SU 4	Test-pit10 SU 2	Test-pit11 SU 1	Test-pit11 SU 2	Test-pit12 SU 1
Fish						
Cod family (Gadidae)				35		
Atlantic Cod (Gadus morhua L.)		4		72		
Haddock (Melanogrammus aeglifinus)				6		
Halibut (Hippoglossus hippoglossus)				1		
Fish indeterminate		8		156		
Terrestrial mammals						
Bovidea (sheep/goat)				4		6
Sheep (Ovis aries)						
Goat (Capra hircus)						
Pig (Sus scrofa)				1		
Reindeer (Rangifer tarandus)						
Marine mammals						
Phocidae				1		1

Mammal Indeterminant		1		25		3
Indeterminate bone	1		1	8	2	
Mollusca						
Common mussel (Mytilus edulis)				53		
Common periwinkle (Littorina littorea)				4		
Mollusca indeterminate				47	1	
Total	**1**	**13**	**1**	**413**	**3**	**10**

Table 13 Værbukta Test-pit 15 NISP.

Taxon	**Test-pit 15 SU 1**	**Test-pit 15 SU 2**	**Test-pit 15 SU 3**	**Test-pit 15 SU 4**	**Test-pit 15 SU 5**
Fish					
Cod family (Gadidae)	1540	172	609	220	164
Atlantic Cod (Gadus morhua L.)	2444	203	807	597	370
Haddock (Melanogrammus aeglifinus)	158	15	102	24	50
Saithe (Pollachius virens)	264	12	48	40	27
Ling (Molva molva)	3				
Cusk (Bromse brosme)	99	35	42	19	8
Halibut (Hippoglossus hippoglossus)	7	3	4	4	2
Pleuronectes	4				

Wolf fish (Anarchichas lupus)	6	1	7	2	2
Merlucciidae	1				
Fish Indeterminant	2890	219	679	122	220
Terrestrial mammals					
Bovidea (sheep/goat)	3				
Pig (Sus scrofa)	3				
Reindeer (Rangifer tarandus)	1			2	
Mammal Indeterminant	40		15	10	6
Indeterminant bone	734	1	405		
Birds					
Bird Indeterminant			1		
Mollusca					
Common periwinkle (Littorina littorea)	2				
Mollusca indeterminate	9				
Total	**8208**	**661**	**2719**	**1040**	**849**

Table 14 Skonsvika Test-pits 19, 20 and 23 NISP.

Taxon	**Test-pit**	**Test-pit**	**Test-pit**	**Test-pit**	**Test-pit**	**Test-pit**	**Test-pit**	**Test-pit**

	19 SU 1	**19 SU 3**	**19 SU 5**	**20 SU 1**	**20 SU 2**	**20 SU 3**	**20 SU 4**	**23**
Fish								
Cod family (Gadidae)			9	2	4		6	
Atlantic Cod (Gadus morhua L.)	3		4	2	2		3	
Haddock (Melanogrammus aeglifinus)	4		15		1		5	1
Saithe (Pollachius virens)			1					
Halibut (Hippoglossus hippoglossus)			1					
Fish Indeterminant	10		23	33	14		54	
Terrestrial mammals								
Bovidea (sheep/goat)			8		2			
Sheep (Ovis aries)			1					
Pig (Sus scrofa)			3			1		
Reindeer (Rangifer tarandus)		1	2					
Marine mammals								
Phocidae			5					
Cetacea		2	7		3		1	
Mammal Indeterminant			19		22	4	9	
Indeterminant bone		1	17		1		50	
Birds								

Bird Indeterminant			1				1	
Mollusca								
Common mussel (Mytilus edulis)							17	
Mollusca indeterminate			1				16	
Total	**17**	**4**	**117**	**37**	**49**	**5**	**162**	**1**

Table 15 Kongshavn Test-pits 24 and 25 NISP.

Taxon	**Test-pit 24 SU 2**	**Test-pit 24 SU 3**	**Test-pit 24 SU 4**	**Test-pit 24 SU 5**	**Test-pit 25 SU 3**	**Test-pit 25 SU 4**	**Test-pit 25 SU 5**	**Test-pit 25 SU 6**
Fish								
Cod family (Gadidae)	1	4	1	13		2		
Atlantic Cod (Gadus morhua L.)		1					2	
Haddock (Melanogrammus aeglifinus)	1	3		6				6
Saithe (Pollachius virens)				5				3
Halibut (Hippoglossus hippoglossus)		2	1	2		3	4	3
Pleuronectes								7
Fish Indeterminant	1	9	24	147			3	21
Terrestrial mammals								
Pig (Sus scrofa)							1	
Marine mammals								
Phocidae						1		

Cetacea		1						
Mammal Indeterminant		4			3	3	2	3
Indeterminant bone		1						
Birds								
Bird Indeterminant		1		1				
Total	**3**	**26**	**26**	**174**	**3**	**9**	**12**	**43**

Table 16 Kjønes Test-pit 27 NISP.

Taxon	**Test-pit 27 SU 1**	**Test-pit 27 SU 2**	**Test-pit 27 SU 3**	**Test-pit 27 SU 4**
Fish				
Cod family (Gadidae)	2	4	7	
Atlantic Cod (Gadus morhua L.)	5		3	1
Haddock (Melanogrammus aeglifinus)			2	
Fish Indeterminant	6	6	60	5
Mammal Indeterminant			6	1
Indeterminant bone			1	
Birds				
Bird Indeterminant	1		1	
Mollusca				

Mollusca indeterminate			1	
Total	**14**	**10**	**81**	**7**

Table 17 Laukvika Test-pits 29, 30 and 31 NISP.

Taxon	**Test-pit 29 SU 1**	**Test-pit 29 SU 2**	**Test-pit 30 SU 1**	**Test-pit 30 SU 2**	**Test-pit 30 SU 3**	**Test-pit 30 SU 4**	**Test-pit 30 SU 5**	**Test-pit 31 SU 3**
Fish								
Cod family (Gadidae)	68	4	13	3	4	10		
Atlantic Cod (Gadus morhua L.)	91	36	33	29	10	17	5	
Haddock (Melanogrammus aeglifinus)	1		5			2		
Saithe (Pollachius virens)	1		4	2		2	1	
Halibut (Hippoglossus hippoglossus)			6	2	1	12	1	
Wolf fish (Anarchichas lupus)	1							
Fish Indeterminant	85	78	42	35	14	29	14	4
Terrestrial mammals								
Goat (Capra hircus)						1		
Pig (Sus scrofa)	5			1	1	3		
Reindeer (Rangifer tarandus)	2		4					
Marine mammals								
Phocidae	1				1	1		

Cetacea	3		1			2		
Walrus (Odobenus rosmarus)	1							
Mammal Indeterminant	17	1	17	3	21	27	2	4
Indeterminant bone	42	141	35	12		1		
Birds								
Bird Indeterminant			1			1	1	1
Mollusca								
Mollusca indeterminate	2							
Total	**320**	**260**	**161**	**87**	**52**	**108**	**24**	**11**

Table 18 Vadsøya Test-pit 35 NISP.

Taxon	**Test-pit 35 SU 1**	**Test-pit 35 SU 2**
Fish		
Cod family (Gadidae)	2	2
Atlantic Cod (Gadus morhua L.)	3	9
Haddock (Melanogrammus aeglifinus)	2	1
Saithe (Pollachius virens)	1	4
Halibut (Hippoglossus hippoglossus)		6
Fish Indeterminant	3	17

Terrestrial mammals		
Bovidea (sheep/goat)	4	1
Pig (Sus scrofa)	1	1
Reindeer (Rangifer tarandus)	1	
Marine mammals		
Phocidae	2	2
Cetacea	1	
Mammal Indeterminant	7	5
Indeterminant bone		
Total	**27**	**48**

Table 19 Kongshavn Room 0 TNF.

Taxon	**Room 0 TNF**	**%TNF**
Fish	214	62.03
Wild mammals		
medium to large	1	0.29
Mollusca	2	0.58
Indeterimant mammal	20	5.80
Indeterimant	108	31.30
TNF	**345**	**100.00**

Table 20 Kongshavn Room 0 NISP.

Taxon	**Room 0 NISP**	**%NISP**
Fish		

Atlantic Cod (Gadus morhua L.)	8	20.51
Haddock (Melanogrammus aeglifinus)	19	48.72
Halibut (Hippoglossus hippoglossus)	10	25.64
Saithe (Pollachius virens)	1	2.56
Terrestrial mammals		
Reindeer (Rangifer tarandus)	1	2.56
Total	**39**	**100.00**

Table 21 Kongshavn Room 0 Fragmentation.

Fragmentation	TNF	% TNF
Less than 1 cm	183	53.51
1 to 2 cm	101	29.53
2 to 5 cm	58	16.96
Greater than 5 cm	0	0.00
Total	**342**	**100.00**

Table 22 Kongshavn Room 1 TNF.

Taxon	TNF	%TNF
Fish	988	66.35
Domestic mammals		
small to medium	3	0.20
medium to large	2	0.13
Wild mammals		
small to medium	1	0.07
medium to large	9	0.60
Sea mammals		
small to medium	3	0.20
medium to large	29	1.95
Birds	45	3.02

Mollusca	170	11.42
Indeterimant mammal	90	6.04
Indeterimant	149	10.01
TNF	1489	100.00

Table 23 Kongshavn Room 1 NISP.

Taxon	Room 1 NISP	%NISP
Fish		
Atlantic Cod (Gadus morhua L.)	73	15.47
Haddock (Melanogrammus aeglifinus)	214	45.34
Halibut (Hippoglossus hippoglossus)	89	18.86
Saithe (Pollachius virens)	9	1.91
Wolffish (Anarhichas lupus)	3	0.64
Trisopterus sps.	1	0.21
Terrestrial mammals		
Cow (Bos taurus)	2	0.42
Bovidea (sheep/goat)	2	0.42
Pig (Sus scrofa)	1	0.21
Reindeer (Rangifer tarandus)	9	1.91
Vulpinae	1	0.21
Marine mammals		
Phocidae	3	0.64
Cetacea	29	6.14
Birds		
Eider Duck (Somateria mollissima)	1	0.21
Anitidae	3	0.64
Laridae	7	1.48
Great black-backed gull (Larus marinus)	1	0.21
Herring gull (Larus argentatus)	1	0.21
Mollusca		
Periwinkle (Littorina littorina)	23	4.87

Total	**472**	**100.00**

Table 24 Kongshavn Room 1 Cod Elemental Distribution.

COD- ELEMENT DISTRIBUTION		
	MAU	%MAU
Olfactory	1.00	3.01
Occipital	0.00	0.00
Otic	5.00	15.05
Investing	0.00	0.00
Lateral	2.50	7.53
Opercular	1.00	3.01
Mandicular	6.00	18.06
Hyoid Arch	4.50	13.55
Branchial Arch	3.00	9.03
Pectoral Girdle	6.50	19.57
Pelvic Girdle	2.00	6.02
Vertebral Column	1.25	3.76
Caudal Skeleton	0.46	1.40
Total	**33.21**	**100.00**

COD	MAU	%MAU
Head & Jaws	23.00	73.68
Pectoral girdle	6.50	20.82
Thoracic vert	1.25	4.00
Precaudal vert	0.00	0.00
Caudal vert	0.46	1.49
Total	**31.21**	**100.00**

COD-Vertebral Units	MAU	%MAU
Thoracic	1.25	72.92

Precaudal	0.00	0.00
Caudal	0.46	27.08
Total	**1.71**	**100.00**

COD	MAU	%MAU
Premaxilla	0.00	0.00
Posttemporal	7.00	53.85
Cleithrum	6.00	46.15
Total	**13.00**	**100.00**

Table 25 Kongshavn Room 1 Haddock Elemental Distribution.

HADDOCK-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	2.00	4.63
Occipital	2.50	5.78
Otic	1.50	3.47
Investing	1.00	2.31
Lateral	3.00	6.94
Opercular	1.00	2.31
Mandicular	1.00	2.31
Hyoid Arch	1.00	2.31
Branchial Arch	0.00	0.00
Pectoral Girdle	21.00	48.58
Pelvic Girdle	0.00	0.00
Vertebral Column	5.66	13.09
Caudal Skeleton	3.57	8.26
Total	**43.23**	**100.00**

HADDOCK	MAU	%MAU
Head & Jaws	13.00	30.78
Pectoral girdle	21.00	49.73
Thoracic vert	3.50	8.29
Precaudal vert	1.16	2.74
Caudal vert	3.57	8.46

Total	**42.23**	**100.00**

HADDOCK-Vertebral Units	MAU	%MAU
Thoracic	3.50	42.53
Precaudal	1.16	14.07
Caudal	3.57	43.40
Total	**8.23**	**100.00**

HADDOCK	MAU	%MAU
Premaxilla	0.00	0.00
Posttemporal	2.00	6.45
Cleithrum	29.00	93.55
Total	**31.00**	**100.00**

Table 26 Kongshavn Room 1 Halibut Elemental Distribution.

HALIBUT-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	0.00	0.00
Occipital	0.50	3.65
Otic	0.00	0.00
Investing	0.00	0.00
Lateral	4.50	32.87
Opercular	0.00	0.00
Mandicular	1.50	10.96
Hyoid Arch	0.50	3.65
Branchial Arch	0.00	0.00
Pectoral Girdle	3.00	21.91
Pelvic Girdle	0.00	0.00
Vertebral Column	1.87	13.65
Caudal Skeleton	1.82	13.30

Total	**13.69**	**100.00**

HALIBUT	MAU	%MAU
Head & Jaws	7.00	51.13
Pectoral girdle	3.00	21.91
Thoracic vert	1.50	10.96
Precaudal vert	0.37	2.69
Caudal vert	1.82	13.30
Total	**13.69**	**100.00**

HALIBUT-Vertebral Units	MAU	%MAU
Thoracic	1.50	40.65
Precaudal	0.37	9.98
Caudal	1.82	49.36
Total	**3.69**	**100.00**

HALIBUT	MAU	%MAU
Premaxilla	1.00	16.67
Posttemporal	1.00	16.67
Cleithrum	4.00	66.67
Total	**6.00**	**100.00**

Table 27 Kongshavn Room 1 Gnawing.

Taxon-gnawing	S.U. 7	S.U. 6	S.U. 5	S.U. 4	S.U. 3
Haddock (Melanogrammus aeglifinus)	1				2
Saithe (Pollachius virens)		1			
Halibut (Hippoglossus hippoglossus)	2	4			
Fish Indeterminant	1	4			
Reindeer (Rangifer tarandus)	1				
Other		1			
Total	**5**	**10**			**2**

Table 28 Kongshavn Room 1 Butchery.

Taxon-butchery	S.U. 7	S.U. 6	S.U. 5	S.U. 4	S.U. 3
Cod family (Gadidae)	3	4			
Atlantic Cod (Gadus morhua L.)	5	1			
Haddock (Melanogrammus aeglifinus)	1				2
Halibut (Hippoglossus hippoglossus)	1				
Fish Indeterminant	1	7			
Cetacea		2			
Other	1	4			
Total	**13**	**17**			**2**

Table 29 Kongshavn Room 1 Fragmentation.

Fragmentation	TNF	%TNF
Less than 1 cm	514	32.80
1 to 2 cm	327	20.87
2 to 5 cm	664	42.37
5 to 10 cm	48	3.06
Greater than 10 cm	14	0.89
Total	**1567**	**100.00**

Table 30 Kongshavn Room 2 TNF.

Taxon	TNF	% TNF
Fish	2033.00	81.75
Domestic mammals		
small to medium	6.00	0.24
medium to large	1.00	0.04
Wild mammals		
very small to small	5.00	0.20
medium to large	8.00	0.32
Sea mammals		
small to medium	32.00	1.29
medium to large	28.00	1.13
Birds	97.00	3.90
Mollusca	30.00	1.21
Indeterimant mammal	191.00	7.68
Indeterimant	56.00	2.25
TNF	**2487.00**	**100.00**

Table 31 Kongshavn Room 2 NISP.

Taxon	NISP	%NISP
Fish		
Atlantic Cod (Gadus morhua L.)	381	30.95
Haddock (Melanogrammus aeglifinus)	242	19.66
Saithe (Pollachius virens)	38	3.09
Cusk (Bromse brosme)	2	0.16
Halibut (Hippoglossus hippoglossus)	440	35.74
Merlucciidae	1	0.08
Terrestrial mammals		
Cow (Bos taurus)	1	0.08
Bovidea (sheep/goat)	4	0.32
Pig (Sus scrofa)	2	0.16
Rondentia	2	0.16
Water vole (Arvicola amphibius)	1	0.04
Lemming (Lemmus lemmus)	2	0.08
Reindeer (Rangifer tarandus)	8	0.65
Marine mammals		
Phocidae	32	2.60
Cetacea	28	2.27
Birds		
Laridae	9	0.73
Great black-backed gull (Larus marinus)	1	0.08
Buteo species	2	0.16
Tetraonidae (grouse)	1	0.08
Puffin (Fratercula arctica)	1	0.08
Herring gull (Larus argentatus)	4	0.32
Black-headed gull (Larus ridibundus)	1	0.08
Mollusca		
Pectinoidae, e.g. scallop	16	1.30
Periwinkle (Littorina littorina)	5	0.41
Ocean Quahog (Arctica islandica)	5	0.41
Blue mussel (Mytilus edilus)	2	0.16
Total	**1231**	**100.00**

Table 32 Kongshavn Room 2 Cod Elemental Distribution.

COD-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	14.00	10.32
Occipital	4.00	2.95
Otic	15.00	11.06
Investing	9.00	6.64
Lateral	30.00	22.12
Opercular	8.50	6.27
Mandicular	8.50	6.27
Hyoid Arch	5.50	4.06
Branchial Arch	9.63	7.10
Pectoral Girdle	12.50	9.22
Pelvic Girdle	5.50	4.06
Vertebral Column	9.47	6.98
Caudal Skeleton	4.04	2.98
Total	**135.63**	**100.00**

COD	MAU	%MAU
Head & Jaws	104.13	82.55
Pectoral girdle	12.50	9.91
Thoracic vert	4.00	3.17
Precaudal vert	1.47	1.17
Caudal vert	4.04	3.20
Total	**126.13**	**100.00**

COD-Vertebral Units	MAU	%MAU
Thoracic	4.00	42.06
Precaudal	1.47	15.50
Caudal	4.04	42.44
Total	**9.51**	**100.00**

COD	MAU	%MAU

Premaxilla	2.50	23.81
Posttemporal	1.50	14.29
Cleithrum	6.50	61.90
Total	**10.50**	**100.00**

Table 33 Kongshavn Room 2 Haddock Elemental Distribution.

HADDOCK-ELEMENT DISTRIBUTION		
	MAU	%MAU
Olfactory	0.00	0.00
Occipital	0.50	0.73
Otic	4.50	6.57
Investing	1.00	1.46
Lateral	11.50	16.80
Opercular	3.63	5.29
Mandicular	2.00	2.92
Hyoid Arch	9.50	13.88
Branchial Arch	1.50	2.19
Pectoral Girdle	27.00	39.44
Pelvic Girdle	0.00	0.00
Vertebral Column	3.91	5.71
Caudal Skeleton	3.43	5.01
Total	**68.46**	**100.00**

HADDOCK	MAU	%MAU
Head & Jaws	34.13	50.58
Pectoral girdle	27.00	40.02
Thoracic vert	1.75	2.59
Precaudal vert	1.16	1.72
Caudal vert	3.43	5.08
Total	**67.46**	**100.00**

HADDOCK-Vertebral Units	MAU	%MAU

Thoracic	1.75	27.62
Precaudal	1.16	18.27
Caudal	3.43	54.11
Total	**6.34**	**100.00**

HADDOCK	MAU	%MAU
Premaxilla	0	0.00
Posttemporal	2	9.09
Cleithrum	20	90.91
Total	**22**	**100.00**

Table 34 Kongshavn Room 2 Halibut Elemental Distribution.

HALIBUT-ELEMENT DISTRIBUTION	MAU	% MAU
Olfactory	5.00	4.35
Occipital	1.50	1.30
Otic	0.00	0.00
Investing	0.00	0.00
Lateral	13.00	11.31
Opercular	3.50	3.04
Mandicular	11.00	9.57
Hyoid Arch	9.00	7.83
Branchial Arch	8.54	7.43
Pectoral Girdle	3.50	3.04
Pelvic Girdle	3.00	2.61
Vertebral Column	5.64	4.91
Caudal Skeleton	51.29	44.61
Total	**114.97**	**100.00**

HALIBUT	MAU	% MAU
Head & Jaws	51.54	78.13
Pectoral girdle	3.50	5.31
Thoracic vert	1.75	2.65
Precaudal vert	1.89	2.87

Caudal vert	7.29	11.04
Total	**65.97**	**100.00**

HALIBUT-Vertebral Units	MAU	% MAU
Thoracic	1.75	16.01
Precaudal	1.89	17.33
Caudal	7.29	66.66
Total	**10.93**	**100.00**

HALIBUT	MAU	% MAU
Premaxilla	3.50	70.00
Posttemporal	0.50	10.00
Cleithrum	1.00	20.00
Total	**5.00**	**100.00**

Table 35 Kongshavn Room 2 Butchery.

Taxon-butchery	**S.U.6A**	**S.U.6**	**S.U.5**	**S.U.4**	**S.U.3**
Cod family (Gadidae)		2			8
Atlantic Cod (Gadus morhua L.)		4	1	1	5
Haddock (Melanogrammus aeglifinus)	2	3		2	2
Saithe (Pollachius virens)		1			
Halibut (Hippoglossus hippoglossus)		6			9
Fish Indeterminant	2	1	3		5
Reindeer (Rangifer tarandus)	1				1
Phocidae					2

Cetacea	1	1	1		2
Other		6	2	2	9
Total	**6**	**22**	**7**	**5**	**35**

Table 36 Kongshavn Room 2 Gnawing.

Taxon-gnawing	SU6A	SU6	SU5	SU4	SU3
Cod family (Gadidae)	1				
Atlantic Cod (Gadus morhua L.)	3				
Haddock (Melanogrammus aeglifinus)		1		1	1
Halibut (Hippoglossus hippoglossus)	2	9	3		18
Pig (Sus scrofa)		1			
Reindeer (Rangifer tarandus)					2
Other		2	3	2	3
Total	**6**	**13**	**6**	**3**	**24**

Table 37 Kongshavn Room 2 Fragmentation.

Fragmentation	TNF	%TNF
Less than 1 cm	245	10.00
1 to 2 cm	570	23.26
2 to 5 cm	1342	54.75
5 to 10 cm	271	11.06
Greater than 10 cm	23	0.94
Total	**2451**	**100.00**

Table 38 Kongshavn Room 3 TNF.

Taxon	TNF	%TNF
Fish	1612	92.54
Domestic mammals		
medium to large	14	0.80
Wild mammals		
small to medium	5	0.29
medium to large	2	0.11

Sea mammals		
medium to large	7	0.40
Birds	15	0.86
Mollusca	4	0.23
Indeterimant mammal	30	1.72
Indeterimant	53	3.04
Total	**1742**	**100.00**

Table 39 Kongshavn Room 3 NISP.

Taxon	**NISP**	**%NISP**
Fish		
Atlantic Cod (Gadus morhua L.)	597	63.99
Haddock (Melanogrammus aeglifinus)	94	10.08
Halibut (Hippoglossus hippoglossus)	204	21.86
Saithe (Pollachius virens)	3	0.32
Flatfish (Pleuronectidae)	1	0.11
Terrestrial mammals		
Bovidea (sheep/goat)	7	0.75
Pig (Sus scrofa)	7	0.75
Canidae	5	0.54
Reindeer (Rangifer tarandus)	2	0.21
Marine mammals		
Cetacea	7	0.75
Birds		
Laridae	4	0.43
Black Gullimot (Cepphus grylle)	1	0.11
Mollusca		
Pectinoidae, e.g. scallop	1	0.11
Total	**933**	**100.00**

Table 40 Kongshavn Room 3 Cod Elemental Distribution.

COD-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	18.00	8.15
Occipital	5.50	2.49
Otic	18.00	8.15
Investing	19.00	8.60
Lateral	45.00	20.37
Opercular	18.75	8.49
Mandicular	11.50	5.21
Hyoid Arch	27.00	12.22
Branchial Arch	4.79	2.17
Pectoral Girdle	11.00	4.98
Pelvic Girdle	1.00	0.45
Vertebral Column	38.46	17.41
Caudal Skeleton	2.93	1.33
Total	**220.93**	**100.00**

COD	MAU	%MAU
Head & Jaws	167.54	82.97
Pectoral girdle	11.00	5.45
Thoracic vert	13.25	6.56
Precaudal vert	7.21	3.57
Caudal vert	2.93	1.45
Total	**201.93**	**100.00**

COD-Vertebral Units	MAU	%MAU
Thoracic	13.25	56.65
Precaudal	7.21	30.83
Caudal	2.93	12.52
Total	**23.3891**	**100**

COD	MAU	%MAU

Premaxilla	6.50	46.43
Posttemporal	5.00	35.71
Cleithrum	2.50	17.86
Total	**14.00**	**100.00**

Table 41 Kongshavn Room 3 Haddock Elemental Distribution.

HADDOCK- ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	2.50	9.57
Occipital	0.00	0.00
Otic	0.00	0.00
Investing	1.50	5.74
Lateral	6.50	24.88
Opercular	1.38	5.26
Mandicular	0.50	1.91
Hyoid Arch	3.50	13.39
Branchial Arch	1.00	3.83
Pectoral Girdle	7.00	26.79
Pelvic Girdle	0.00	0.00
Vertebral Column	0.93	3.58
Caudal Skeleton	1.32	5.06
Total	**26.13**	**100.00**

HADDOCK	MAU	%MAU
Head & Jaws	16.88	64.58
Pectoral girdle	7.00	26.79
Thoracic vert	0.25	0.96
Precaudal vert	0.68	2.62
Caudal vert	1.32	5.06
Total	**26.13**	**100.00**

HADDOCK-Vertebral Units	MAU	%MAU
Thoracic	0.25	11.08
Precaudal	0.68	30.33

Caudal	1.32	58.58
Total	**2.26**	**100.00**

HADDOCK	MAU	%MAU
Premaxilla	0.50	8.33
Posttemporal	1.50	25.00
Cleithrum	4.00	66.67
Total	**6.00**	**100.00**

Table 42 Kongshavn Room 3 Halibut Elemental Distribution.

HALIBUT-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	2.00	4.34
Occipital	1.50	3.25
Otic	0.00	0.00
Investing	0.00	0.00
Lateral	14.50	31.45
Opercular	2.00	4.34
Mandicular	5.50	11.93
Hyoid Arch	3.00	6.51
Branchial Arch	6.50	14.10
Pectoral Girdle	2.00	4.34
Pelvic Girdle	2.00	4.34
Vertebral Column	0.92	2.00
Caudal Skeleton	6.18	13.40
Total	**46.09**	**100**

HALIBUT	MAU	%MAU
Head & Jaws	35.00	85.16
Pectoral girdle	2.00	4.87
Thoracic vert	0.50	1.22
Precaudal vert	0.42	1.02
Caudal vert	3.18	7.73
Total	**41.10**	**100.00**

HALIBUT-Vertebral Units	MAU	%MAU
Thoracic	0.50	12.20
Precaudal	0.42	10.27
Caudal	3.18	77.53
Total	**4.10**	**100.00**

HALIBUT	MAU	%MAU
Premaxilla	3.5	77.78
Posttemporal	0	0.00
Cleithrum	1	22.22
Total	**4.5**	**100.00**

Table 43 Kongshavn Room 3 Butchery.

Taxon-butchery	**S.U.5**	**S.U.4b**	**S.U.4b/4a**	**S.U.4a**
Cod family (Gadidae)	2	1		2
Atlantic Cod (Gadus morhua L.)	11	3	2	3
Haddock (Melanogrammus aeglifinus)	1	1		
Halibut (Hippoglossus hippoglossus)	2		1	
Fish Indeterminant	3			
Cetacea	2			
other	3			4
Total	**22**	**4**	**3**	**7**

Table 44 Kongshavn Room 3 Gnawing.

Taxon-gnawing	SU5	SU4b	SU4b/4a	SU4a
Cod family (Gadidae)	1			
Halibut (Hippoglossus hippoglossus)	3			
Total	**4**			

Table 45 Kongshavn Room 3 Fragmentation.

Fragmentation (SU5)	TNF	% TNF
Less than 1 cm	147	8.64
1 to 2 cm	496	29.14
2 to 5 cm	919	54.00
5 to 10 cm	126	7.40
Greater than 10 cm	14	0.82
Total	**1702**	**100.00**

Table 46 Kongshavn Room 4 TNF.

Taxon	**TNF**	**%TNF**
Fish	1971	84.27
Domestic mammals		
small to medium	8	0.34
Wild mammals		
medium to large	26	1.11
Sea mammals		
small to medium	4	0.17
medium to large	12	0.51
Birds	41	1.75
Mollusca	10	0.43
Indeterimant mammal	119	5.09
Indeterimant	148	6.33
Total	**2339**	**100.00**

Table 47 Kongshavn Room 4 NISP.

Taxon	**NISP**	**%NISP**
Fish		
Atlantic Cod (Gadus morhua L.)	264	29.40
Haddock (Melanogrammus aeglifinus)	245	27.28
Halibut (Hippoglossus hippoglossus)	296	32.96
Saithe (Pollachius virens)	32	3.56
Cusk (Bromse brosme)	8	0.89
Redfish (Sebastes mentella)	2	0.22
Terrestrial mammals		
Bovidea (sheep/goat)	7	0.78
Pig (Sus scrofa)	1	0.11
Reindeer (Rangifer tarandus)	26	2.90
Marine mammals		

Phocidae	4	0.45
Cetacea	12	1.34
Mollusca		
Periwinkle (Littorina littorina)	1	0.11
Total	**898**	**100.00**

Table 48 Kongshavn Room 4 Cod Elemental Distribution.

COD-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	16.00	12.46
Occipital	3.00	2.34
Otic	3.50	2.73
Investing	7.00	5.45
Lateral	29.50	22.98
Opercular	15.88	12.37
Mandicular	13.50	10.52
Hyoid Arch	16.00	12.46
Branchial Arch	6.46	5.03
Pectoral Girdle	9.50	7.40
Pelvic Girdle	0.50	0.39
Vertebral Column	6.32	4.92
Caudal Skeleton	1.21	0.95
Total	**128.36**	**100.00**

COD	MAU	%MAU
Head & Jaws	110.83	88.76
Pectoral girdle	9.50	7.61
Thoracic vert	2.00	1.60
Precaudal vert	1.32	1.05
Caudal vert	1.21	0.97
Total	**124.86**	**100.00**

COD-Vertebral Units	MAU	%MAU

Thoracic	2.00	44.15
Precaudal	1.32	29.05
Caudal	1.21	26.80
Total	**4.53**	**100.00**

COD	MAU	%MAU
Premaxilla	4.00	40.00
Posttemporal	3.50	35.00
Cleithrum	2.50	25.00
Total	**10.00**	**100.00**

Table 49 Kongshavn Room 4 Haddock Elemental Distribution.

HADDOCK-ELEMENT DISTRIBUTION	MAU	% MAU
Olfactory	1.00	5.82
Occipital	0.00	0.00
Otic	0.50	2.91
Investing	0.00	0.00
Lateral	2.50	14.56
Opercular	0.63	3.64
Mandicular	0.00	0.00
Hyoid Arch	2.50	14.56
Branchial Arch	0.00	0.00
Pectoral Girdle	8.00	46.60
Pelvic Girdle	0.00	0.00
Vertebral Column	0.58	3.37
Caudal Skeleton	1.46	8.53
Total	**17.17**	**100.00**

HADDOCK	MAU	% MAU
Head & Jaws	7.13	41.50
Pectoral girdle	8.00	46.60
Thoracic vert	0.00	0.00

Precaudal vert	0.58	3.37
Caudal vert	1.46	8.53
Total	**17.17**	**100.00**

HADDOCK-Vertebral Units	MAU	% MAU
Thoracic	0.00	0.00
Precaudal	0.58	28.33
Caudal	1.46	71.67
Total	**2.04**	**100.00**

HADDOCK	MAU	% MAU
Premaxilla	0.50	6.25
Posttemporal	1.00	12.50
Cleithrum	6.50	81.25
Total	**8.00**	**100.00**

Table 50 Kongshavn Room 4 Halibut Elemental Distribution.

HALIBUT-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	0.00	0.00
Occipital	0.00	0.00
Otic	0.00	0.00
Investing	0.00	0.00
Lateral	3.50	24.90
Opercular	1.00	7.11
Mandicular	1.00	7.11
Hyoid Arch	0.00	0.00
Branchial Arch	1.54	10.97
Pectoral Girdle	2.50	17.78
Pelvic Girdle	0.00	0.00
Vertebral Column	3.05	21.71
Caudal Skeleton	1.46	10.42

Total	**14.06**	**100.00**

HALIBUT	MAU	%MAU
Head & Jaws	7.04	53.92
Pectoral girdle	2.50	19.14
Thoracic vert	2.00	15.32
Precaudal vert	0.05	0.40
Caudal vert	1.46	11.21
Total	**13.06**	**100.00**

HALIBUT-Vertebral Units	MAU	%MAU
Thoracic	2.00	56.87
Precaudal	0.05	1.50
Caudal	1.46	41.64
Total	**3.52**	**100.00**

HALIBUT	MAU	%MAU
Premaxilla	0.00	0.00
Posttemporal	0.00	0.00
Cleithrum	1.50	100.00
Total	**1.50**	**100.00**

Table 51 Kongshavn Room 4 Butchery.

Taxon-butchery	**SU7**	**SU 6**	**SU5**	**SU4**
Cod family (Gadidae)		3		
Atlantic Cod (Gadus morhua L.)		4	1	
Haddock (Melanogrammus aeglifinus)				1
Halibut (Hippoglossus hippoglossus)				3
Reindeer (Rangifer tarandus)		1	12	
Cetacea				1
Phocidea	1			
Indeterminant bone				1

Total	**1**	**8**	**13**	**6**

Table 52 Kongshavn Room 4 Gnawing.

Taxon-gnawing	**SU7**	**SU 6**	**SU5**	**SU4**
Haddock (Melanogrammus aeglifinus)				1
Halibut (Hippoglossus hippoglossus)	3	2	4	
Bovidea (sheep/goat)			1	
Total	**3**	**2**	**5**	**1**

Table 53 Kongshavn Room 4 Fragmentation.

Fragmentation	**TNF**	**%TNF**
Less than 1 cm	184	12.82
1 to 2 cm	491	34.22
2 to 5 cm	706	49.20
5 to 10 cm	52	3.62
Greater than 10 cm	2	0.14
Total	**1435**	**100.00**

Table 54 Kongshavn Midden A TNF.

	TNF	**%TNF**
Fish	8704	90.02
Domestic mammals		
small to medium	4	0.04
Wild mammals		
very small to small	1	0.01
small to medium	1	0.01
medium to large	15	0.16
Sea mammals		

small to medium	1	0.01
medium to large	81	0.84
Mollusca	22	0.23
Indeterimant mammal	35	0.36
Indeterimant	805	8.33
TNF	**9669**	**100.00**

Table 55 Kongshavn Midden A NISP.

Species	**NISP**	**%NISP**
Fish		
Atlantic Cod (Gadus morhua L.)	3983	72.31
Haddock (Melanogrammus aeglifinus)	1023	18.57
Halibut (Hippoglossus hippoglossus)	346	6.28
Saithe (Pollachius virens)	46	0.84
Wolffish (Anarhichas lupus)	2	0.04
Flatfish (Pleuronectidae)	2	0.04
Ling (Molva molva)	2	0.04
Herring (Clupea harengus)	2	0.04
Terrestrial mammals		
Bovidea (sheep/goat)	2	0.04
Sheep (Ovis aries)	1	0.02
Goat (Capra hircus)	1	0.02
Reindeer (Rangifer tarandus)	15	0.27
Lemming (Lemmus lemmus)	1	0.02
Marine mammals		
Phocidae	1	0.02
Cetacea	81	1.47
Mollusca		
Periwinkle (Littorina littorina)	12	0.22
Total	**5508**	**100.00**

Table 56 Kongshavn Midden A Reindeer FUI/Bone Density.

Reindeer	**MAU**	**%MAU**	**FUI (Metacalfe and Jones**	**Bone density (Lyman**

			1988)	**1994)**
Antler	1.00	22.91	1.00	
Skull			9.10	
Mandible (w/tongue)			31.10	0.57
Atlas/Axis			10.20	0.26
Cervical vert.			37.10	0.19
Thoracic vert.			47.30	0.32
Lumbar	0.16	3.67	33.20	0.3
Rib	0.08	1.83	51.60	0.4
Sternum			66.60	0.22
Scapula			44.70	0.49
Humerus			36.80	0.63
Radius-ulna			25.80	0.68
Metacarpal	2.5	57.27	5.20	0.72
Innominate			49.30	0.27
Femur			100.00	0.57
Tibia-fibula			62.80	0.74
Metatarsal	0.5	11.45	37.00	0.74
Phalanges	0.13	2.86	19.40	0.57
Total	**4.37**	**100.00**		
Pearson's r %MAU/FUI	-0.69			
Pearson's r %MAU/Bone Density	0.60			

Table 57 Kongshavn Midden A Cod Elemental Distribution.

COD-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	210.50	10.32
Occipital	69.00	3.38
Otic	200.00	9.80
Investing	120.50	5.91
Lateral	472.00	23.14

Opercular	147.00	7.21
Mandicular	228.00	11.18
Hyoid Arch	267.00	13.09
Branchial Arch	158.67	7.78
Pectoral Girdle	134.50	6.59
Pelvic Girdle	1.00	0.05
Vertebral Column	31.11	1.52
Caudal Skeleton	0.61	0.03
Total	**2039.88**	**100.00**

COD	MAU	%MAU
Head & Jaws	1872.67	92.57
Pectoral girdle	134.50	6.65
Thoracic vert	15.00	0.74
Precaudal vert	0.11	0.01
Caudal vert	0.61	0.03
Total	**2022.88**	**100.00**

COD-Vertebral Units	MAU	%MAU
Thoracic	15.00	95.47
Precaudal	0.11	0.67
Caudal	0.61	3.86
Total	**15.71**	**100.00**

COD	MAU	%MAU
Premaxilla	62	50.20
Posttemporal	61	49.39
Cleithrum	0.5	0.40
Total	**123.5**	**100.00**

Table 58 Kongshavn Midden A Haddock Elemental Distribution.

	MAU	%MAU
Olfactory	38.50	8.66

Occipital	16.50	3.71
Otic	28.50	6.41
Investing	32.00	7.19
Lateral	141.50	31.81
Opercular	41.13	9.25
Mandicular	26.50	5.96
Hyoid Arch	41.00	9.22
Branchial Arch	11.67	2.62
Pectoral Girdle	41.00	9.22
Pelvic Girdle	0.00	0.00
Vertebral Column	20.05	4.51
Caudal Skeleton	6.43	1.45
Total	**444.77**	**100.00**

HADDOCK	MAU	% MAU
Head & Jaws	377.29	86.58
Pectoral girdle	41.00	9.41
Thoracic vert	6.00	1.38
Precaudal vert	5.05	1.16
Caudal vert	6.43	1.48
Total	**435.77**	**100.00**

HADDOCK-Vertebral Units	MAU	% MAU
Thoracic	6.00	34.32
Precaudal	5.05	28.90
Caudal	6.43	36.77
Total	**17.48**	**100.00**

HADDOCK	MAU	% MAU
Premaxilla	11.5	27.71
Posttemporal	11	26.51
Cleithrum	19	45.78
Total	**41.5**	**100.00**

Table 59 Kongshavn Midden A Halibut Elemental Distribution.

	MAU	%MAU
Olfactory	5.00	3.29
Occipital	6.50	4.28
Otic	2.00	1.32
Investing	0.00	0.00
Lateral	17.80	11.72
Opercular	4.00	2.63
Mandicular	5.50	3.62
Hyoid Arch	6.50	4.28
Branchial Arch	4.13	2.72
Pectoral Girdle	4.50	2.96
Pelvic Girdle	0.00	0.00
Vertebral Column	8.47	5.58
Caudal Skeleton	87.50	57.60
Total	**151.90**	**100.00**

HALIBUT	MAU	%MAU
Head & Jaws	51.43	81.76
Pectoral girdle	4.50	7.15
Thoracic vert	2.00	3.18
Precaudal vert	0.47	0.75
Caudal vert	4.50	7.15
Total	**62.90**	**100.00**

HALIBUT-Vertebral Units	MAU	%MAU
Thoracic	2.00	28.68
Precaudal	0.47	6.79
Caudal	4.50	64.53
Total	**6.97**	**100.00**

HALIBUT	MAU	%MAU

Premaxilla	2.5	55.56
Posttemporal	1.5	33.33
Cleithrum	0.5	11.11
Total	**4.5**	**100.00**

Table 60 Kongshavn Midden A Butchery.

Taxon-butchery	Skeletal Element	Butchery-mark	Frequency
Cod family (Gadidae)	cleithrum	chopped	1
Atlantic Cod (Gadus morhua L.)	supracleithrum	whittle	47
	palatine	slice	1
	ectopterygoid	slice	1
	posttemporal	slice	1
	supracleithrum	chopped	1
	palatine	knife	1
	supracleithrum	knife	3
	premaxilla	knife	1
Haddock (Melanogrammus aeglifinus)	caudal vertebrae	slice	1
	precaudal vertebrae	slice	1
	cleithrum	slice	2
	subopercle	slice	1
	subopercle	knife	1
Halibut (Hippoglossus hippoglossus)	caudal vertebrae	chop	5
	basioccipital	chop	1
	vertebrae	chop	1

	vertebrae	slice	1
	caudal vertebrae	slice	3
Fish Indeterminant	rib	sliced	20
	indeterminant	sliced	18
Reindeer (Rangifer tarandus)	antler	chop	1
	metacarpal	chop	1
	lumbar vertebrae	knife/chop	1
	metatarsal	knife	1
	rib	knife	2
	first phalanges	knife	1
Cetacea	indeterminat	chopped	4
	indeterminat	knife	1
	indeterminat	sawn	2
	indeterminat	worked	16
Total			**142**

Table 61 Kongshavn Midden A Gnawing.

Taxon-gnawing	**Frequency**
Haddock (Melanogrammus aeglifinus)	1
Halibut (Hippoglossus hippoglossus)	2
Total	**3**

Table 62 Kongshavn Midden A Fragmentation.

Fragmentation	TNF	% TNF
Less than 1 cm	703.00	7.27
1 to 2 cm	2473.00	25.58
2 to 5 cm	5003.00	51.74
5 to 10 cm	1288.00	13.32
Greater than 10 cm	202.00	2.09
Total	**9669.00**	**100.00**

Table 63 Kongshavn Midden B TNF.

Taxon	**TNF**	**%TNF**
Fish	5880	92.22
Domestic mammals		
small to medium	7	0.11
Wild mammals		
small to medium	1	0.02
medium to large	37	0.58
Sea mammals		
small to medium	10	0.16
medium to large	42	0.66
Bird	77	1.21
Mollusca	33	0.52
Indeterimant mammal	179	2.81
Indeterimant	110	1.73
TNF	**6376**	**100.00**

Table 64 Kongshavn Midden B NISP.

Taxon	**NISP**	**%NISP**
Fish		

Atlantic Cod (Gadus morhua L.)	1491	43.70
Haddock (Melanogrammus aeglifinus)	879	25.76
Halibut (Hippoglossus hippoglossus)	861	25.23
Saithe (Pollachius virens)	39	1.14
Cusk (Bromse brosme)	3	0.09
Ling (Molva molva)	2	0.06
Whitting (Merlangius merlangus)	2	0.06
Trisopterus sps.	1	0.03
Terrestrial mammals		
Bovidea (sheep/goat)	6	0.18
Pig (Sus scrofa)	1	0.03
Reindeer (Rangifer tarandus)	37	1.08
Arctic fox (Alopex lagopus)	1	0.03
Marine mammals		
Phocidae	10	0.29
Cetacea	42	1.23
Birds		
Eider Duck (Somateria mollissima)	1	0.03
Anitidae	1	0.03
Laridae	13	0.38
Falconidae	2	0.06
Tetraonidae (grouse)	3	0.09
Puffin (Fratercula arctica)	3	0.09
Herring gull (Larus argentatus)	1	0.03
Black-headed gull (Larus ridibundus)	3	0.09
Mollusca		
Periwinkle (Littorina littorina)	10	0.29
Total	**3412**	**100.00**

Table 65 Kongshavn Midden B Reindeer Elemental Frequency vs. Food Utility Index and Bone Density.

Reindeer	MAU	%MAU	FUI (Metcalfe and Jones	Bone Density (Lyman 1994)

			1988)	
Antler	4	33.32	1	
Skull	1	8.33	9.1	
Mandible (w/tongue)	1	8.33	31.1	0.57
Atlas/Axis	1	8.33	10.2	0.26
Cervical vert.			37.1	0.19
Thoracic vert.	0.23	1.92	47.3	0.32
Lumbar			33.2	0.3
Rib	0.15	1.25	51.6	0.4
Sternum			66.6	0.22
Scapula	1	8.33	44.7	0.49
Humerus			36.8	0.63
Radius-ulna			25.8	0.68
Metacarpal	1.5	12.49	5.2	0.72
Innominate	0.5	4.16	49.3	0.27
Femur			100	0.57
Tibia-fibula			62.8	0.74
Metatarsal	1.5	12.49	37	0.74
Phalanges	0.13	1.04	19.4	0.57
Total	**12.01**	**100**		
Pearson's r %MAU/FUI	-0.60			
Pearson's r %MAU/Bone Density	-0.98			

Table 66 Kongshavn Midden B Cod Elemental Distribution.

COD-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	82.00	10.24
Occipital	22.00	2.75
Otic	65.50	8.18
Investing	53.50	6.68
Lateral	204.00	25.47
Opercular	52.50	6.55
Mandicular	80.00	9.99
Hyoid Arch	99.50	12.42
Branchial Arch	37.33	4.66
Pectoral Girdle	61.50	7.68

Pelvic Girdle	5.00	0.62
Vertebral Column	35.68	4.45
Caudal Skeleton	2.50	0.31
Total	**801.02**	**100.00**

COD	MAU	%MAU
Head & Jaws	696.33	90.78
Pectoral girdle	61.50	8.02
Thoracic vert	5.00	0.65
Precaudal vert	1.68	0.22
Caudal vert	2.50	0.33
Total	**767.02**	**100.00**

COD-Vertebral Units	MAU	%MAU
Thoracic	5.00	54.44
Precaudal	1.68	18.34
Caudal	2.50	27.22
Total	**9.18**	**100.00**

COD	MAU	%MAU
Premaxilla	34	50.37
Posttemporal	25.5	37.78
Cleithrum	8	11.85
Total	**67.5**	**100.00**

Table 67 Midden B Haddock Elemental Distribution.

HADDOCK-ELEMENT DISTRIBUTION	MAU	% MAU
Olfactory	26.00	8.08
Occipital	24.50	7.62
Otic	21.50	6.68
Investing	11.00	3.42
Lateral	73.50	22.85

Opercular	24.75	7.69
Mandicular	6.50	2.02
Hyoid Arch	42.00	13.06
Branchial Arch	6.17	1.92
Pectoral Girdle	60.50	18.81
Pelvic Girdle	0.00	0.00
Vertebral Column	17.54	5.45
Caudal Skeleton	7.75	2.41
Total	**321.71**	**100.00**

HADDOCK	MAU	% MAU
Head & Jaws	235.92	75.44
Pectoral girdle	60.50	19.35
Thoracic vert	4.75	1.52
Precaudal vert	3.79	1.21
Caudal vert	7.75	2.48
Total	**312.71**	**100.00**

HADDOCK-Vertebral Units	MAU	% MAU
Thoracic	4.75	29.16
Precaudal	3.79	23.26
Caudal	7.75	47.58
Total	**16.29**	**100.00**

HADDOCK	MAU	% MAU
Premaxilla	2.5	4.76
Posttemporal	9.5	18.10
Cleithrum	40.5	77.14
Total	**52.5**	**100.00**

Table 68 Kongshavn Midden B Halibut Elemental Distribution.

HALIBUT-ELEMENT DISTRIBUTION	MAU	%MAU

Olfactory	5.00	2.91
Occipital	3.50	2.03
Otic	0.00	0.00
Investing	0.00	0.00
Lateral	13.50	7.85
Opercular	5.00	2.91
Mandicular	8.00	4.65
Hyoid Arch	3.00	1.74
Branchial Arch	0.00	0.00
Pectoral Girdle	5.00	2.91
Pelvic Girdle	2.00	1.16
Vertebral Column	9.11	5.29
Caudal Skeleton	117.93	68.55
Total	**172.03**	**100.00**

HALIBUT	MAU	%MAU
Head & Jaws	38.00	65.48
Pectoral girdle	5.00	8.62
Thoracic vert	5.00	8.62
Precaudal vert	1.11	1.90
Caudal vert	8.93	15.39
Total	**58.03**	**100.00**

Vertebral Units	MAU	%MAU
Thoracic	5.00	33.26
Precaudal	1.11	7.35
Caudal	8.93	59.39
Total	**15.03**	**100.00**

HALIBUT	MAU	%MAU
Premaxilla	2.5	19.23
Posttemporal	0	0.00
Cleithrum	3.5	26.92
Total	**13**	**100.00**

Table 69 Kongshavn Midden B Butchery.

Taxon-butchery	Skeletal Element	Butchery-mark	Frequency
Cod family (Gadidae)	cleithrum	sliced	13
Atlantic Cod (Gadus morhua L.)	supracleithrum	slice	8
	ectopterygoid	slice	1
	cleithrum	slice	5
	supracleithrum	knife	3
Haddock (Melanogrammus aeglifinus)	cleithrum	slice	4
	cleithrum	chop	3
Halibut (Hippoglossus hippoglossus)	caudal vertebrae	slice	3
Fish Indeterminant	indeterminant	slice	12
Reindeer (Rangifer tarandus)	rib	knife	3
	thoracic vertebrae	knife	1
	metacarpal	knife	1
	antler	knife	4
	antler	chop	4
	atlas	chop	1
	innominant	chop	1
	vertebrae	chop	1
	antler	worked	4
Cetacea	indeterminat	chopped	9

	indeterminat	worked	4
Total			**85**

Table 70 Kongshavn Midden B Fragmentation.

Fragmentation	**TNF**	**% TNF**
Less than 1 cm	1176.00	23.42
1 to 2 cm	960.00	19.12
2 to 5 cm	2313.00	46.06
5 to 10 cm	523.00	10.41
Greater than 10 cm	50.00	1.00
Total	**5022.00**	**100.00**

Table 71 Kongshavn Exterior Midden TNF.

Taxa	**TNF**	**%TNF**
Fish	7471	83.18
Domestic mammals		
small to medium	29	0.32
Wild mammals		
medium to large	3	0.03
Sea mammals		
small to medium	3	0.03
medium to large	21	0.23
Birds	21	0.23
Mollusca	108	1.20
Indeterimant mammal	115	1.28
Indeterimant	1211	13.48
TNF	**8982**	**100.00**

Table 72 Kongshavn Exterior Midden NISP.

Taxa	**NISP**	**%NISP**
Fish		
Atlantic Cod (Gadus morhua L.)	4137	95.06
Haddock (Melanogrammus aeglifinus)	36	0.83
Halibut (Hippoglossus hippoglossus)	31	0.71
Saithe (Pollachius virens)	67	1.54
Cusk (Bromse brosme)	8	0.18
Terrestrial mammals		
Rodentia	4	0.09
Bovidea (sheep/goat)	1	0.02
Pig (Sus scrofa)	24	0.55
Reindeer (Rangifer tarandus)	3	0.07
Polar bear (Ursus maritimus)	1	0.02
Marine mammals		
Harbor seal (Phoca vitulina)	2	0.05
Grey seal (Halichoerus grypus)	1	0.02
Cetacea	26	0.60
Birds		
Eider duck (Somateria mollissima)	1	0.02
Black-headed gull (Larus ridibundus)	1	0.02
Anitidae	2	0.05
Laridae	5	0.11
Anserinae	1	0.02
Mollusca		
Ocean Quahog (Arctica islandica)	1	0.02
Total	**4352**	**100.00**

Table 73 Kongshavn Exterior Midden Pig Elemental Frequency vs. MGUI and Bone Density.

Pig	**MAU**	**% MAU**	**MGUI**	**Bone Density**
CalC	0			1.49
CalB	0			1.49
PMx	0			1.49
MxC	0			1.49

MxB	0			1.49
Mn	0.5	17.02128	13.86	1.55
Hy	0			0.75
In	0			2
Cn	0			2
PM	0			2
Mo	0			2
Tfrg	0			1.9
At	0			1.45
Ax	0			1.38
Cvo	0			1.26
Th	0			1.28
Lum	0			1.35
Sac	0			1.5
Cdl	0			1
Inm	0			1.52
Rib	0			1.07
Sc	0			1.4
HuW	0			0.75
HuP	0			0.87
HuD	0			1.41
HuS	0			1
RaW	0			0.75
RaP	0			1.33
RaD	0			1.36
RaS	0			1
UlW	0			1.25
UlP	0			1.25
UlD	0			1.5
Car	0			1.19
McW	0.5	17.02128	12.18	0.75
McP	0			1.25
McD	0.25	8.510638	10.5	1.28
McS	0			1
Ast	0			1.28
Clc	0.5	17.02128	31.66	1.28
NvC	0			1.29
TarO	0			1.29
MtW	0.125	4.255319	29.93	0.75
MtP	0			1.33
MtD	0.25	8.510638	23.93	1.2
MtS	0			1
MpW	0			0.75

MpP	0			1.29
MpD	0.125	4.255319	17.215	1.24
MpS	0			1
P1W	0.125	4.255319	13.72	0.9
P1P	0.0625	2.12766	13.72	0.9
P1D	0			0.9
P1S	0			0.9
P2W	0.1875	6.382979	13.72	0.81
P2P	0			0.81
P2D	0			0.81
P2S	0			0.81
P3W	0.25	8.510638	13.72	0.76
P3P	0.0625	2.12766	13.72	0.76
P3D	0			0.76
Pfrg	0			0.8
FeW	0			0.75
FeP	0			1.29
FeD	0			1.14
FeS	0			1
Pat	0			1.5
TiW	0			0.75
TiP	0			1.19
TiD	0			1.46
TiS	0			1
FibW	0			1.25
FibP	0			1.25
FibD	0			1.25
FibS	0			1.25
StnC	0			0.76
StnB	0			0.76
Ses	0			0.75
Total	**2.9375**	**100**		
Pearson's r %MAU/MGUI	-0.18			
Pearson's r %MAU/Bone Density	-0.08			

Table 74 Kongshavn Exterior Midden Cod Elemental Distribution.

COD-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	283.00	13.04

Occipital	51.00	2.35
Otic	42.50	1.96
Investing	55.67	2.57
Lateral	537.50	24.77
Opercular	186.00	8.57
Mandicular	279.00	12.86
Hyoid Arch	274.50	12.65
Branchial Arch	107.17	4.94
Pectoral Girdle	250.50	11.54
Pelvic Girdle	0.00	0.00
Vertebral Column	101.20	4.66
Caudal Skeleton	2.04	0.09
Total	**2170.07**	**100.00**

COD	MAU	%MAU
Head & Jaws	1816.33	87.15
Pectoral girdle	250.50	12.02
Thoracic vert	14.25	0.68
Precaudal vert	0.95	0.05
Caudal vert	2.04	0.10
Total	**2084.07**	**100**

COD	MAU	%MAU
Thoracic	14.25	82.69
Precaudal	0.95	5.50
Caudal	2.04	11.81
Total	**17.23**	**100**

COD	MAU	%MAU
Premaxilla	96	43.24
Posttemporal	126	56.76
Cleithrum	0	0.00
Total	**222**	**100**

Table 75 Kongshavn Exterior Midden Butchery.

Taxon-butchery	**Skeletal**	**Butchery-mark**	**Frequency**

	Element		
Atlantic Cod (Gadus morhua L.)	premaxilla	slice	5
	posttemporal	slice	10
	subopercle	slice	2
	postcleithrum	slice	8
	urohyal	knife	2
	posttemporal	knife	11
Total			**38**

Table 76 Kongshavn Exterior Midden Fragmentation.

Fragmentation	**TNF**	**%TNF**
Less than 1 cm	1605	12.0904
1 to 2 cm	3720	28.0226
2 to 5 cm	6894	51.9322
5 to 10 cm	1014	7.63842
Greater than 10 cm	42	0.31638
Total	**13275**	**100**

Table 77 Skonsvika SU 12 TNF.

	TNF	% TNF
Fish	6962	77.89
Domestic mammals		
small to medium	11	0.12
Wild mammals		
very small to small	2	0.02
small to medium	12	0.13
medium to large	17	0.19
Sea mammals		
small to medium	6	0.07
medium to large	23	0.26
Birds	80	0.90

Mollusca	461	5.16
Indeterimant mammal	240	2.69
Indeterimant	1124	12.58
TNF	**8938**	**100.00**

Table 78 Skonsvika SU 12 NISP.

Fish	NISP	% NISP
Atlantic Cod (Gadus morhua L.)	967	33.26
Haddock (Melanogrammus aeglifinus)	991	34.09
Halibut (Hippoglossus hippoglossus)	531	18.27
Saithe (Pollachius virens)	89	3.06
Cusk (Bromse brosme)	29	1.00
Whitting (Merlangius merlangus)	4	0.14
Redfish (Sebastes mentella)	1	0.03
Wolffish (Anarhichas lupus)	5	0.17
Scorpaeniformes	1	0.03
Salmonidae	1	0.03
Terrestrial mammals		
Bovidea (sheep/goat)	8	0.28
Pig (Sus scrofa)	3	0.10
Rondentia	2	0.07
Reindeer (Rangifer tarandus)	21	0.72
Arctic fox (Alopex lagopus)	3	0.10
Vulpinae	9	0.31
Canidae	7	0.24
Marine mammals		
Phocidae	6	0.21
Cetacea	51	1.75
Birds		
Tufted Duck (Aythya fuligula)	1	0.03
Eider Duck (Somateria mollissima)	7	0.24

Anitidae	1	0.03
Scolopacidae	1	0.03
Fulmar (Fulmarus glacialis)	2	0.07
Black Gullimot (Cepphus grylle)	1	0.03
Laridae	5	0.17
Great black-backed gull (Larus marinus)	1	0.03
Herring gull (Larus argentatus)	7	0.24
Mollusca		
Common periwinkle (Littorina littorea)	27	0.93
Blue mussel (Mytilus edulis)	107	3.68
Pectinoidae, e.g. scallop	17	0.58
Whelk (Buccinum undatum)	1	0.03
Total	**2907**	100.00

Table 79 Skonsvika SU12 Reindeer Elemental Frequency vs. Food Utility Index and Bone Density.

Reindeer	**MAU**	**%MAU**	**FUI (Metcalfe and Jones 1988)**	**Bone Density (Lyman 1994)**
Antler	0.5	12.38	1	
Skull			9.1	
Mandible (w/tongue)			31.1	0.57
Atlas/Axis	1	24.75	10.2	0.26
Cervical vert.			37.1	0.19
Thoracic vert.			47.3	0.32
Lumbar			33.2	0.3
Rib			51.6	0.4
Sternum			66.6	0.22
Scapula	1	24.75	44.7	0.49
Humerus			36.8	0.63
Radius-ulna			25.8	0.68
Metacarpal	1	24.75	5.2	0.72
Innominate	0.16	3.96	49.3	0.27
Femur			100	0.57
Tibia-fibula			62.8	0.74

Metatarsal	0.25	6.19	37	0.74
Phalanges	0.13	3.22	19.4	0.57
Total	**4.04**	**100.00**		
Pearson's r %MAU/FUI	-0.33			
Pearson's r %MAU/Bone Density	-0.06			

Table 80 Skonsvika SU 12 Cod Elemental Distribution.

COD-ELEMENT DISTRIBUTION

	MAU	% MAU
Olfactory	29.00	7.63
Occipital	11.50	3.02
Otic	37.00	9.73
Investing	20.50	5.39
Lateral	66.50	17.49
Opercular	31.75	8.35
Mandicular	41.00	10.78
Hyoid Arch	57.00	14.99
Branchial Arch	25.17	6.62
Pectoral Girdle	30.00	7.89
Pelvic Girdle	3.50	0.92
Vertebral Column	19.95	5.25
Caudal Skeleton	7.36	1.93
Total	**380.22**	**100.00**

COD	MAU	% MAU
Head & Jaws	319.42	87.34
Pectoral girdle	30.00	8.20
Thoracic vert	7.00	1.91
Precaudal vert	1.95	0.53
Caudal vert	7.36	2.01
Total	**365.72**	**100.00**

COD-Vertebral Units	MAU	% MAU
Thoracic	7.00	42.93
Precaudal	1.95	11.94
Caudal	7.36	45.12
Total	**16.30**	**100.00**

COD	MAU	% MAU
Premaxilla	12.50	42.37
Posttemporal	11.50	38.98
Cleithrum	5.50	18.64
Total	**29.50**	**100.00**

Table 81 Skonsvika SU 12 Haddock Elemental Distribution.

HADDOCK-ELEMENT DISTRIBUTION

	MAU	% MAU
Olfactory	31.50	8.70
Occipital	20.00	5.52
Otic	24.00	6.63
Investing	12.00	3.31
Lateral	77.00	21.26
Opercular	28.25	7.80
Mandicular	28.50	7.87
Hyoid Arch	43.50	12.01
Branchial Arch	12.67	3.50
Pectoral Girdle	55.50	15.32
Pelvic Girdle	4.00	1.10
Vertebral Column	16.28	4.49
Caudal Skeleton	8.96	2.48
Total	**362.16**	**100.00**

HADDOCK	MAU	% MAU
Head & Jaws	277.42	78.11
Pectoral girdle	55.50	15.63

Thoracic vert	7.75	2.18
Precaudal vert	5.53	1.56
Caudal vert	8.96	2.52
Total	**355.16**	**100.00**

HADDOCK-Vertebral Units	MAU	% MAU
Thoracic	7.75	34.85
Precaudal	5.53	24.85
Caudal	8.96	40.31
Total	**22.24**	**100.00**

HADDOCK	MAU	% MAU
Premaxilla	9.00	18.18
Posttemporal	11.00	22.22
Cleithrum	29.50	59.60
Total	**49.50**	**100.00**

Table 82 Skonsvika SU 12 Halibut Elemental Distribution.

HALIBUT-ELEMENT DISTRIBUTION	MAU	% MAU
Olfactory	2.50	2.40
Occipital	4.50	4.32
Otic	8.00	7.67
Investing	0.00	0.00
Lateral	10.50	10.07
Opercular	0.50	0.48
Mandicular	10.50	10.07
Hyoid Arch	7.50	7.20
Branchial Arch	9.33	8.95
Pectoral Girdle	5.50	5.28
Pelvic Girdle	1.00	0.96
Vertebral Column	13.37	12.82
Caudal Skeleton	31.04	29.77

Total	**104.24**	**100.00**

HALIBUT	MAU	% MAU
Head & Jaws	53.33	72.82
Pectoral girdle	5.50	7.51
Thoracic vert	5.00	6.83
Precaudal vert	1.37	1.87
Caudal vert	8.04	10.97
Total	**73.24**	**100.00**

HALIBUT-Vertebral Units	MAU	% MAU
Thoracic	5.00	34.71
Precaudal	1.37	9.50
Caudal	8.04	55.79
Total	**14.40**	**100.00**

HALIBUT	MAU	% MAU
Premaxilla	4	66.67
Posttemporal	0	0.00
Cleithrum	2	33.33
Total	**6**	**100.00**

Table 83 Skonsvika SU 12 Butchery.

Taxon-butchery	**Skeletal Element**	**Butchery-mark**	**Frequency**
Cod family (Gadidae)	cleithrum	slice	9
	cleithrum	knife	1
	opithotic	slice	1
	vertebrae	chop	2
Atlantic Cod (Gadus morhua L.)	maxilla	slice	1
	subopercle	slice	1
	caudal	slice	3

	posttemporal	slice	1
	premaxilla	slice	1
	cleithrum	slice	1
	supracleithrum	knife	1
Haddock (Melanogrammus aeglifinus)	cleithrum	slice	2
	postcleithrum	slice	2
	posttemporal	knife	1
	postcleithrum	knife	1
	cleithrum	knife	1
Cusk (Brosme brosme)	supracleithrum	slice	1
Halibut (Hippoglossus hippoglossus)	caudal vertebrae	slice	2
	certohyal	slice	1
	caudal vertebrae	chop	10
	vertebrae	chop	2
Fish indeterminant	indeterminant	slice	18
	caudal vertebrae	slice	1
	vertebrae	slice	1
Cetacea	indeterminant	slice	3
	indeterminant	chop	2
Bird indeterminant	femur	knife	1
Total			**71**

Table 84 Skonsvika SU 12 Gnawing.

Taxon-gnawing	**Skeletal Element**	**Gnaw-mark**	**Frequency**

Atlantic Cod (Gadus morhua L.)	caudal vertebrae	unknown	2
Halibut (Hippoglossus hippoglossus)	caudal vertebrae	unknown	11
	thoracic vertebrae	unknown	1
	vertebrae	unknown	1
Pig (Sus scrofa)	fibula distal epiphysis	canine	1
Reindeer (Rangifer tarandus)	Second phalax	canine	1
Indeterminant mammal	indeterminant	canine	2
Total			**19**

Table 85 Skonsvika SU 12 Fragmentation.

Fragmentation	**TNF**	**% TNF**
Less than 1 cm	2599.00	28.39
1 to 2 cm	2610.00	28.51
2 to 5 cm	3375.00	36.87
5 to 10 cm	468.00	5.11
Greater than 10 cm	103.00	1.13
Total	**9155.00**	**100.00**

Table 86 Skonsvika SU 14 TNF.

Taxa	**TNF**	**%TNF**
Fish	4152	84.61
Domestic mammals		
small to medium	1	0.02

Wild mammals		
very small to small	4	0.08
small to medium	17	0.35
medium to large	45	0.92
Sea mammals		
small to medium	6	0.12
medium to large	32	0.65
Birds	37	0.75
Mollusca	59	1.20
Indeterimant mammal	188	3.83
Indeterimant	366	7.46
TNF	**4907**	**100.00**

Table 87 Skonsvika SU 14 NISP.

Taxon	**NISP**	**%NISP**
Fish		
Atlantic Cod (Gadus morhua L.)	953	44.93
Haddock (Melanogrammus aeglifinus)	646	30.46
Halibut (Hippoglossus hippoglossus)	321	15.13
Saithe (Pollachius virens)	21	0.99
Cusk (Bromse brosme)	16	0.75
Redfish (Sebastes mentella)	2	0.09
Flatfish (Pleuronectidae)	1	0.05
Scorpaeniformes	1	0.05
Salmonidae	1	0.05
Terrestrial mammals		
Bovidea (sheep/goat)	1	0.05
Lemming (Lemmus lemmus)	3	0.14
Reindeer (Rangifer tarandus)	45	2.12
Arctic fox (Alopex lagopus)	2	0.09
Vulpinae	11	0.52
Canidae	3	0.14

Otter (Lutra lutra)	1	0.05
Marine mammals		
Phocidae	6	0.28
Cetacea	32	1.51
Birds		
Anitidae	1	0.05
Laridae	4	0.19
Great black-backed gull (Larus marinus)	1	0.05
Herring gull (Larus argentatus)	1	0.05
Puffin (Fratercula arctica)	1	0.05
Phalacrocoracidae (Cormorant/Shag sps.)	1	0.05
Mollusca		
Pectinoidae, e.g. scallop	10	0.47
Common periwinkle (Littorina littorea)	7	0.33
Whelk (Buccinum undatum)	2	0.09
Blue mussel (Mytilus edulis)	27	1.27
Total	**2121**	**100.00**

Table 88 Skonsvika SU 14 Reindeer Elemental Frequency vs. Food Utility Index and Bone Density.

Reindeer	**MAU**	**% MAU**	**FUI (Metcalfe and Jones 1988)**	**Bone Density (Lyman 1994)**
Antler	3.00	20.69	1	
Skull	0.50	3.45	9.1	
Mandible (w/tongue)	0.67	4.62	31	0.57
Atlas/Axis	2.00	13.79	10	0.26
Cervical vert.	0.20	1.38	37	0.19
Thoracic vert.	0.15	1.03	47	0.32
Lumbar	0.17	1.17	33	0.3
Rib	0.04	0.28	52	0.4
Sternum	0.14	0.97	67	0.22
Scapula	0.50	3.45	45	0.49
Humerus			37	0.63

Radius-ulna	3.00	20.69	26	0.68
Metacarpal	1.00	6.90	5.2	0.72
Innominate			49	0.27
Femur	0.50	3.45	100	0.57
Tibia-fibula	0.50	3.45	63	0.74
Metatarsal	1.00	6.90	37	0.74
Phalanges	1.13	7.79	19	0.57
Total	**14.50**	**100.00**		
Pearson's r %MAU/FUI	-0.49			
Pearson's r %MAU/Bone Density	0.38			

Table 89 Skonsvika SU 14 Canine Skeletal Distribution.

Context	**Species**	**Element**
	Vulpinae	Metatarsal
	Vulpinae	Metatarsal
	Vulpinae	Metatarsal
	Vulpinae	Metatarsal
	Vulpinae	Calcanium
	Vulpinae	Astragelus
	Canidae	Phalax 1st
	Canidae	Caudal vertebrae
	Arctic fox (Alopex lagopus)	Thoracic vertebrae
Bottom	Arctic fox (Alopex lagopus)	Ulna
Bottom	Vulpinae	Calcanium
Profile	Vulpinae	Ulna
Profile	Vulpinae	Calcanium
Bottom	Vulpinae	Ulna
Found on board	Vulpinae	Phalax 1st

Table 90 Skonsvika SU 14 Cod Elemental Distribution.

COD-ELEMENT DISTRIBUTION

	MAU	% MAU
Olfactory	53.00	11.57
Occipital	11.00	2.40
Otic	41.00	8.95

Investing	19.50	4.26
Lateral	108.50	23.69
Opercular	32.00	6.99
Mandicular	50.50	11.02
Hyoid Arch	60.50	13.21
Branchial Arch	17.33	3.78
Pectoral Girdle	32.50	7.09
Pelvic Girdle	10.50	2.29
Vertebral Column	17.42	3.80
Caudal Skeleton	4.32	0.94
Total	**458.08**	**100.00**

COD	MAU	% MAU
Head & Jaws	393.33	90.51
Pectoral girdle	32.50	7.48
Thoracic vert	3.00	0.69
Precaudal vert	1.42	0.33
Caudal vert	4.32	0.99
Total	**434.58**	**100.00**

COD-Vertebral Units	MAU	% MAU
Thoracic	3.00	34.32
Precaudal	1.42	16.25
Caudal	4.32	49.43
Total	**8.74**	**100.00**

COD	MAU	% MAU
Premaxilla	25.00	60.98
Posttemporal	10.00	24.39
Clethrium	6.00	14.63
Total	**41.00**	**100.00**

Table 91 Skonsvika SU 14 Haddock Elemental Distribution.

HADDOCK-ELEMENT DISTRIBUTION	MAU	% MAU
Olfactory	17.00	7.41
Occipital	13.50	5.89
Otic	18.00	7.85
Investing	6.00	2.62
Lateral	40.50	17.66
Opercular	18.50	8.06
Mandicular	11.00	4.80
Hyoid Arch	31.50	13.73
Branchial Arch	14.13	6.16
Pectoral Girdle	38.50	16.78
Pelvic Girdle	0.00	0.00
Vertebral Column	16.09	7.01
Caudal Skeleton	4.68	2.04
Total	**229.40**	**100.00**

HADDOCK	MAU	% MAU
Head & Jaws	170.13	77.54
Pectoral girdle	38.50	17.55
Thoracic vert	3.25	1.48
Precaudal vert	2.84	1.30
Caudal vert	4.68	2.13
Total	**219.40**	**100.00**

HADDOCK-Vertebral Units	MAU	% MAU
Thoracic	3.25	30.17
Precaudal	2.84	26.39
Caudal	4.68	43.44
Total	**10.77**	**100.00**

HADDOCK	MAU	% MAU
Premaxilla	3.50	10.61
Posttemporal	8.50	25.76
Cleithrum	21.00	63.64
Total	**33.00**	**100.00**

Table 92 Skonsvika SU 14 Halibut Elemental Distribution.

HALIBUT ELEMENT DISTRIBUTION	MAU	% MAU
Olfactory	2.00	3.60
Occipital	1.50	2.70
Otic	2.00	3.60
Investing	0.00	0.00
Lateral	7.50	13.50
Opercular	3.00	5.40
Mandicular	5.50	9.90
Hyoid Arch	5.50	9.90
Branchial Arch	4.00	7.20
Pectoral Girdle	5.00	9.00
Pelvic Girdle	2.50	4.50
Vertebral Column	4.91	8.83
Caudal Skeleton	12.14	21.86
Total	**55.55**	**100.00**

HALIBUT	MAU	% MAU
Head & Jaws	31.00	70.37
Pectoral girdle	5.00	11.35
Thoracic vert	1.75	3.97
Precaudal vert	1.16	2.63
Caudal vert	5.14	11.67
Total	**44.05**	**100.00**

HALIBUT-Vertebral Units	MAU	% MAU
Thoracic	1.75	21.74
Precaudal	1.16	14.38
Caudal	5.14	63.88
Total	**8.05**	**100.00**

HALIBUT	MAU	% MAU
Premaxilla	2.50	45.45
Posttemporal	1.00	18.18
Cleithrum	2.00	36.36
Total	**5.50**	**100.00**

Table 93 Skonsvika SU 14 Butchery.

Taxon-butchery	Skeletal Element	Butchery-mark	Frequency
Cod family (Gadidae)	cleithrum	slice	15
Atlantic Cod (Gadus morhua L.)	supracleithrum	whittle	4
	cleithrum	slice	7
	maxilla	knife	2
	caudal	slice	1
	pterygoid	slice	1
	basipterygium	slice	1
Haddock (Melanogrammus aeglifinus)	ceratohyal	slice	1
	cleithrum	slice	6
	cleithrum	knife	2
	supracleithrum	whittle	2
Halibut	caudal	slice	5

(Hippoglossus hippoglossus)			
	caudal	knife	1
	maxilla	slice	1
	premaxilla	slice	1
	thoracic vertebrae	knife	1
	ultimate vertebrae	slice	2
Fish indeterminant	rib	sliced	4
	indeterminant	sliced	36
	indeterminant	knife	1
Reindeer (Rangifer tarandus)	antler	chop	1
	antler	worked	4
	1st phalax	knife	1
	ulna	knife	1
	ulna + radii	chop/knife	1
	radii	chop/knife	1
	sacrum	chop	1
	femur	chop/puncture	1
	sternum	knife/chop	1
	sternum	chop	1
	axial	chop	1
Otter (Lutra lutra)	mandible	knife	2
Cetacea	indeterminant	worked	2
	indeterminant	chopped	3
Total			**115**

Table 94 Skonsvika SU 14 Gnawing.

Taxon-gnawing	Skeletal Element	Gnaw-mark	Frequency
Atlantic Cod	caudal	unknown	7

(Gadus morhua L.)	vertebra		
	dentary	canine	1
Halibut (Hippoglossus hippoglossus)	caudal vertebrae	unknown	18
	precaudal vertebrae	unknown	1
	vertebrae	unknown	1
	premaxilla	unknown	1
Reindeer (Rangifer tarandus)	ulna	canine ?	1
	metacarpal	canine ?	1
	first phalanx	canine ?	1
Indeterminat mammal bone	indeterminant	canine ?	3
	indeterminant	canine	3
	indeterminant	unknown	1
Total			**39**

Table 95 Skonsvika SU 14 Fragmentation.

Fragmentation	TNF	% TNF
Less than 1 cm	873	17.64
1 to 2 cm	1364	27.56
2 to 5 cm	2410	48.70
5 to 10 cm	264	5.33
Greater than 10 cm	38	0.77
Total	**4949**	**100.00**

Table 96 Skonsvika SU 46 TNF.

Taxon	TNF	% TNF
Fish	3689	88.40

Wild mammals		
very small to small	7	0.17
small to medium	4	0.10
medium to large	19	0.46
Sea mammals		
small to medium	6	0.14
medium to large	9	0.22
Birds	18	0.43
Mollusca	75	1.80
Indeterimant mammal	89	2.13
Indeterimant	257	6.16
TNF	**4173**	**100.00**

Table 97 Skonsvika SU 46 NISP.

Taxon	**NISP**	**%NISP**
Fish		
Atlantic Cod (Gadus morhua L.)	1064	47.63
Haddock (Melanogrammus aeglifinus)	806	36.08
Halibut (Hippoglossus hippoglossus)	233	10.43
Saithe (Pollachius virens)	20	0.90
Cusk (Bromse brosme)	35	1.57
Wolffish (Anarhichas lupus)	9	0.40
Terrestrial mammals		
Reindeer (Rangifer tarandus)	19	0.85
Canidae	1	0.04
Mustelidae	2	0.09
Otter (Lutra lutra)	1	0.04
Rodentia	7	0.31
Marine mammals		
Phocidae	4	0.18

Grey seal (Halichoerus grypus)	2	0.09
Cetacea	9	0.40
Birds		
Anitidae	1	0.04
Herring gull (Larus argentatus)	1	0.04
Mollusca		
Pectinoidae, e.g. scallop	5	0.22
Whelk (Buccinum undatum)	2	0.09
Blue mussel (Mytilus edulis)	13	0.58
Total	**2234**	**100.00**

Table 98 Skonsvika SU 46 Reindeer Elemental Frequency vs. Food Utility Index and Bone Density.

Reindeer	**MAU**	**%MAU**	**FUI (Metcalfe and Jones 1988)**	**Bone Density (Lyman 1994)**
Antler	1.5	26.64	1	
Skull			9.1	
Mandible (w/tongue)	0.5	8.88	31.1	0.57
Atlas/Axis			10.2	0.26
Cervical vert.			37.1	0.19
Thoracic vert.			47.3	0.32
Lumbar			33.2	0.3
Rib			51.6	0.4
Sternum			66.6	0.22
Scapula	1.5	26.64	44.7	0.49
Humerus	0.5	8.88	36.8	0.63
Radius-ulna			25.8	0.68
Metacarpal			5.2	0.72
Innominate			49.3	0.27
Femur			100	0.57
Tibia-fibula			62.8	0.74
Metatarsal	1.5	26.64	37	0.74
Phalanges	0.13	2.31	19.4	0.57

Total	**5.63**	**100.00**

Pearson's r %MAU/FUI	0.02
Pearson's r %MAU/Bone Density	0.17

Table 99 Skonsvika SU 46 Cod Elemental Distribution.

COD-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	65.00	12.07
Occipital	17.00	3.16
Otic	47.00	8.73
Investing	22.50	4.18
Lateral	110.00	20.43
Opercular	36.38	6.76
Mandicular	65.50	12.17
Hyoid Arch	67.50	12.54
Branchial Arch	46.13	8.57
Pectoral Girdle	34.00	6.31
Pelvic Girdle	3.50	0.65
Vertebral Column	21.05	3.91
Caudal Skeleton	2.86	0.53
Total	**538.41**	**100.00**

COD	MAU	%MAU
Head & Jaws	477.00	92.10
Pectoral girdle	34.00	6.56
Thoracic vert	3.00	0.58
Precaudal vert	1.05	0.20
Caudal vert	2.86	0.55
Total	**517.91**	**100.00**

COD-Vertebral Units	MAU	%MAU
Thoracic	3.00	43.42
Precaudal	1.05	15.23

Caudal	2.86	41.35
Total	**6.91**	**100.00**

COD	MAU	%MAU
Premaxilla	20.50	53.95
Posttemporal	14.50	38.16
Cleitrhum	3.00	7.89
Total	**38.00**	**100.00**

Table 100 Skonsvika SU 46 Haddock Elemental Distribution.

HADDOCK-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	18.00	6.96
Occipital	9.50	3.67
Otic	13.50	5.22
Investing	7.00	2.70
Lateral	55.50	21.45
Opercular	17.25	6.67
Mandicular	10.00	3.86
Hyoid Arch	28.00	10.82
Branchial Arch	9.75	3.77
Pectoral Girdle	49.50	19.13
Pelvic Girdle	3.50	1.35
Vertebral Column	26.76	10.34
Caudal Skeleton	10.54	4.07
-	-	-
Total	**258.80**	**100.00**

HADDOCK	MAU	%MAU
Head & Jaws	168.50	70.71
Pectoral girdle	49.50	20.77
Thoracic vert	4.50	1.89
Precaudal vert	5.26	2.21

Caudal vert	10.54	4.42
Total	**238.30**	**100.00**

HADDOCK-Vertebral Units	MAU	%MAU
Thoracic	4.50	22.17
Precaudal	5.26	25.93
Caudal	10.54	51.90
Total	**20.30**	**100.00**

HADDOCK	MAU	%MAU
Premaxilla	6.50	8.55
Posttemporal	10.00	13.16
Cleitrhum	59.50	78.29
Total	**76.00**	**100.00**

Table 101 Skonsvika SU 46 Halibut Elemental Distribution.

HALIBUT-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	2.00	3.46
Occipital	2.00	3.46
Otic	0.00	0.00
Investing	0.00	0.00
Lateral	11.50	19.89
Opercular	1.50	2.59
Mandicular	7.00	12.11
Hyoid Arch	4.00	6.92
Branchial Arch	1.17	2.02
Pectoral Girdle	2.00	3.46
Pelvic Girdle	1.00	1.73
Vertebral Column	3.22	5.58
Caudal Skeleton	22.43	38.79
Total	**57.82**	**100.00**

HALIBUT	MAU	%MAU
Head & Jaws	29.17	77.12
Pectoral girdle	2.00	5.29
Thoracic vert	1.75	4.63
Precaudal vert	0.47	1.25
Caudal vert	4.43	11.71
Total	**37.82**	**100.00**

HALIBUT-Vertebral Units	MAU	%MAU
Thoracic	1.75	26.31
Precaudal	0.47	7.12
Caudal	4.43	66.57
Total	**6.65**	**100.00**

HALIBUT	MAU	%MAU
Premaxilla	3.50	35.00
Posttemporal	0.00	0.00
Cleithrum	1.50	15.00
Total	**10.00**	**100.00**

Table 102 Skonsvika SU 46 Butchery.

Taxon-butchery	Skeletal Element	Butchery-mark	Frequency
Cod family (Gadidae)	cleitrum	slice	17
	postcleithrum	slice	1
	vertebrae	slice	1
Atlantic Cod (Gadus morhua L.)	cleithrum	sliced	5
	caudal vertebrae	sliced	3
	caudal vertebrae	knife	1

	postcleithrum	sliced	1
	postcleithrum	whittle	1
	supracleithrum	whittle	4
	supracleithrum	knife	1
	thoracic vertebrae	sliced	1
Haddock (Melanogrammus aeglifinus)	cleithrum	sliced	11
	cleithrum	knife	2
	dentary	sliced	3
	precaudal vertebrae	sliced	3
	supracleithrum	knife	1
Halibut (Hippoglossus hippoglossus)	caudal vertebrae	sliced	4
	caudal vertebrae	chopped	2
	caudal vertebrae	knife	2
Saithe (Pollachius virens)	vertebrae	slice	1
Fish Indeterminant	cleithrum	slice	2
	rib	slice	12
	indeterminant	slice	6
Grey seal (Halichoerus gryphus)	mandible	slice	1
Reindeer (Rangifer tarandus)	calcanuem	worked	1
	metatarsael	impact	1
	antler	slice/worked	1
	scapula	slice	1

	rib	knife mark	1
	antler	worked	1
Total			**92**

Table 103 Skonsvika SU 46 Gnawing.

Taxon-gnawing	**Skeletal Element**	**Gnaw-mark**	**Frequency**
Cod family (Gadidae)	vertebrae	unknown	2
Atlantic Cod (Gadus morhua L.)	vertebrae	unknown	2
Atlantic Cod (Gadus morhua L.)	dentary	unknown	1
Haddock (Melanogrammus aeglifinus)	vertebrae	unknown	2
Halibut (Hippoglossus hippoglossus)	caudal vertebrae	unknown	30
Halibut (Hippoglossus hippoglossus)	thoracic vertebrae	unknown	1
Halibut (Hippoglossus hippoglossus)	vertebrae	unknown	2
Cusk (Brosme brosme)	caudal vertebrae	unknown	1
Fish Indeterminant	vertebrae	unkown	2
Total			**43**

Table 104 Skonsvika SU 46 Fragmentation.

Fragmentation	TNF	% TNF
Less than 1 cm	780.00	18.69
1 to 2 cm	1050.00	25.16
2 to 5 cm	1880.00	45.05
5 to 10 cm	414.00	9.92
Greater than 10 cm	49.00	1.17
Total	**4173.00**	**100.00**

Table 105 Skonsvika Pit 7 TNF.

Taxon	Pit 7 TNF	Pit 7 %TNF
Fish	2683	88.26
Domestic mammals		
small to medium	7	0.23
Wild mammals		
very small to small	1	0.03
small to medium		
medium to large	3	0.10
Sea mammals		
small to medium	4	0.13
medium to large	22	0.72
Birds	8	0.26
Mollusca	44	1.45
Indeterimant mammal	115	3.78
Indeterimant	153	5.03
Total	**3040**	**100.00**

Table 106 Skonsvika Pit 7 NISP.

Taxon	**Pit 7 NISP**	**Pit 7 %NISP**
Fish		
Atlantic Cod (Gadus morhua L.)	461	34.22
Haddock (Melanogrammus aeglifinus)	621	46.10
Halibut (Hippoglossus hippoglossus)	195	14.48
Saithe (Pollachius virens)	17	1.26
Flatfish (Pleuronectidae)	4	0.30
Terrestrial mammals		
Bovidea (sheep/goat)	5	0.37
Sheep (Ovis aries)	2	0.15
Rodentia	1	0.07
Reindeer (Rangifer tarandus)	3	0.22
Marine mammals		
Phocidae	4	0.30
Cetacea	22	1.63
Mollusca		
Periwinkle (Littorina littorina)	1	0.07
Blue mussel (Mytilus edilus)	2	0.15
Whelk (Buccinum undatum)	1	0.07
Birds		

Eider Duck (Somateria mollissima)	3	0.22
Fulmar (Fulmarus glacialis)	1	0.07
Black Guillemot (Cepphus grylle)	1	0.07
Cepphus (Guillemot)	1	0.07
Herring gull (Larus argentatus)	2	0.15
Total	**1347**	**100.00**

Table 107 Skonsvika Pit 7 Cod Elemental Distribution.

COD-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	17.00	9.40
Occipital	4.00	2.21
Otic	18.50	10.23
Investing	5.00	2.77
Lateral	32.50	17.98
Opercular	10.00	5.53
Mandicular	23.00	12.72
Hyoid Arch	24.00	13.28
Branchial Arch	8.00	4.43
Pectoral Girdle	15.00	8.30
Pelvic Girdle	8.00	4.43
Vertebral Column	11.53	6.38
Caudal Skeleton	4.25	2.35
Total	**180.78**	**100.00**

COD	MAU	%MAU
Head & Jaws	142.00	85.66
Pectoral girdle	15.00	9.05
Thoracic vert	3.00	1.81
Precaudal vert	1.53	0.92

Caudal vert	4.25	2.56
Total	**165.78**	**100.00**

COD-Vertebral Units	MAU	%MAU
Thoracic	3.00	34.18
Precaudal	1.53	17.39
Caudal	4.25	48.43
Total	**8.78**	**100.00**

COD	MAU	%MAU
Premaxilla	4.00	40.00
Posttemporal	3.50	35.00
Cleithrum	2.50	25.00
Total	**10.00**	**100.00**

Table 108 Skonsvika Pit 7 Haddock Elemental Distribution.

HADDOCK-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	7.50	5.05
Occipital	14.50	9.76
Otic	11.00	7.41
Investing	4.00	2.69
Lateral	25.00	16.83
Opercular	5.13	3.45
Mandicular	4.50	3.03
Hyoid Arch	11.00	7.41
Branchial Arch	1.00	0.67
Pectoral Girdle	36.00	24.24
Pelvic Girdle	0.00	0.00
Vertebral Column	15.61	10.51
Caudal Skeleton	13.29	8.95
Total	**148.52**	**100.00**

HADDOCK	MAU	%MAU
Head & Jaws	83.63	59.51
Pectoral girdle	36.00	25.62
Thoracic vert	5.50	3.91
Precaudal vert	5.11	3.63
Caudal vert	10.29	7.32
Total	**140.52**	**100.00**

HADDOCK-Vertebral Units	MAU	%MAU
Thoracic	5.50	26.33
Precaudal	5.11	24.44
Caudal	10.29	49.24
Total	**20.89**	**100.00**

HADDOCK	MAU	%MAU
Premaxilla	2.50	8.77
Posttemporal	4.00	14.04
Cleithrum	22.00	77.19
Total	**28.50**	**100.00**

Table 109 Skonsvika Pit 7 Halibut Elemental Distribution.

HALIBUT-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	1.00	2.52
Occipital	0.50	1.26
Otic	0.00	0.00
Investing	0.00	0.00
Lateral	6.50	16.40
Opercular	1.00	2.52
Mandicular	2.50	6.31
Hyoid Arch	2.50	6.31
Branchial Arch	0.42	1.05
Pectoral Girdle	3.00	7.57

Pelvic Girdle	6.00	15.14
Vertebral Column	0.42	1.06
Caudal Skeleton	15.79	39.84
Total	**39.62**	**100.00**

HALIBUT	MAU	%MAU
Head & Jaws	14.42	66.67
Pectoral girdle	3.00	13.87
Thoracic vert	0.00	0.00
Precaudal vert	0.42	1.95
Caudal vert	3.79	17.51
Total	**21.62**	**100.00**

HALIBUT-Vertebral Units	MAU	%MAU
Thoracic	0.00	0.00
Precaudal	0.42	10.01
Caudal	3.79	89.99
Total	4.21	100.00

HALIBUT	MAU	%MAU
Premaxilla	1.00	28.57
Posttemporal	1.00	28.57
Cleithrum	1.50	42.86
Total	3.50	100.00

Table 110 Skonsvika Pit 7 Butchery.

Taxon-butchery	Skeletal Element	Butchery-mark	Frequency
Cod family	cleithrum	slice	48

(Gadidae)	caudal vertebrae	slice	1
Atlantic Cod (Gadus morhua L.)	supracleithrum	whittle	2
	supracleithrum	knife	1
	caudal vertebrae	slice	2
Haddock (Melanogrammus aeglifinus)	cleithrum	knife	1
	cleithrum	slice	5
	caudal vertebrae	slice	1
	caudal vertebrae	chopped	2
Halibut (Hippoglossus hippoglossus)	ishaemal spine	knife	1
	caudal vertebrae	chop	3
	precaudal vertebrae	slice	4
	vertebrae	slice	2
	cleithrum	slice	1
Fish indeterminant	vertebrae	chopped	2
Cetacea	indeterminant	worked	5
	indeterminant	chopped	1
	indeterminant	impact	1
Total			**83**

Table 111 Skonsvika Pit 7 Gnawing.

Taxon-	Skeletal	Gnaw-	Frequency

gnawing	Element	mark	
Atlantic Cod (Gadus morhua L.)	caudal vertebrae	unknown	1
Haddock (Melanogrammus aeglifinus)	caudal vertebrae	unknown	3
Halibut (Hippoglossus hippoglossus)	caudal vertebrae	unknown	14
Fish indeterminant	vertebrae	unknown	1
Bovidea (sheep/goat)	carpal	canine ?	1
Total			**20**

Table 112 Skonsvika Pit 7 Fragmentation.

Fragmentation	TNF	% TNF
Less than 1 cm	604.00	18.85
1 to 2 cm	819.00	25.55
2 to 5 cm	1566.00	48.86
5 to 10 cm	209.00	6.52
Greater than 10 cm	7.00	0.22
Total	**3205.00**	**100.00**

Table 113 Skonsvika Pits 2 and 3 SU 46 TNF.

Taxon	Pit 2 TNF (S.U. 46)	Pit 2 %TNF (S.U. 46)	Pit 3 TNF (S.U. 46)	Pit 3 %TNF (S.U. 46)
Fish	634	66.11	385	80.21
Wild mammals				
medium to	4	0.42	1	0.21

large				
Sea mammals medium to large	7	0.73	1	0.21
Birds	2	0.21	1	0.21
Mollusca	24	2.50	11	2.29
Indeterimant mammal	18	1.88	7	1.46
Indeterimant	270	28.15	74	15.42
Total	**959**	**100.00**	**480**	**100.00**

Table 114 Skonsvika Pits 2 and 3 SU 46 NISP.

Taxon	**Pit 2 NISP (S.U. 46)**	**Pit 2 %NISP (S.U. 46)**	**Pit 3 NISP (S.U. 46)**	**Pit 3 %NISP (S.U. 46)**
Fish				
Atlantic Cod (Gadus morhua L.)	151	46.46	32	21.33
Haddock (Melanogrammus aeglifinus)	114	35.08	1	0.67
Halibut (Hippoglossus hippoglossus)	14	4.31	54	36.00
Saithe (Pollachius virens)	6	1.85	20	13.33
Cusk (Bromse brosme)	26	8.00	22	14.67
Ling (Molva molva)			4	2.67
Wolffish (Anarhichas lupus)			1	0.67

Terrestrial mammals				
Reindeer (Rangifer tarandus)	4	1.23	4	2.67
Arctic fox (Alopex lagopus)			1	0.67
Marine mammals				
Cetacea	7	2.15	2	1.33
Mollusca				
Periwinkle (Littorina littorina)			3	2.00
Blue mussel (Mytilus edilus)			2	1.33
Pectinoidae, e.g. scallop	1	0.31	2	1.33
Ocean Quahog (Arctica islandica)			1	0.67
Birds				
Razor bill	1	0.31		
Bird Indeterminant	1	0.31	1	0.67
Total	**325**	**100.00**	**150**	**100.00**

Table 115 Skonsvika Pit 2 SU 46 Cod Elemental Distribution.

COD-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	8.00	14.62
Occipital	3.50	6.40
Otic	6.00	10.97
Investing	3.00	5.48
Lateral	10.50	19.19
Opercular	3.00	5.48
Mandicular	4.00	7.31

Hyoid Arch	7.00	12.79
Branchial Arch	1.50	2.74
Pectoral Girdle	3.50	6.40
Pelvic Girdle	0.50	0.91
Vertebral Column	2.71	4.95
Caudal Skeleton	1.50	2.74
Total	**54.71**	**100.00**

COD	MAU	%MAU
Head & Jaws	46.50	85.78
Pectoral girdle	3.50	6.46
Thoracic vert	1.50	2.77
Precaudal vert	1.21	2.23
Caudal vert	1.50	2.77
Total	**54.21**	**100.00**

COD-Vertebral Units	MAU	%MAU
Thoracic	1.50	35.63
Precaudal	1.21	28.75
Caudal	1.50	35.63
Total	**4.21**	**100.00**

COD	MAU	%MAU
Premaxilla	3	66.67
Posttemporal	1	22.22
Cleithrum	0.5	11.11
Total	**4.5**	**100.00**

Table 116 Skonsvika Pit 2 SU 46 Haddock Elemental Distribution.

HADDOCK-ELEMENT DISTRIBUTION	MAU	%MAU
Olfactory	1.00	4.82
Occipital	0.00	0.00

Otic	1.50	7.24
Investing	0.00	0.00
Lateral	3.50	16.89
Opercular	1.50	7.24
Mandicular	1.00	4.82
Hyoid Arch	1.00	4.82
Branchial Arch	0.00	0.00
Pectoral Girdle	7.50	36.18
Pelvic Girdle	0.00	0.00
Vertebral Column	1.26	6.09
Caudal Skeleton	2.46	11.89
Total	**20.73**	**100.00**

HADDOCK	MAU	%MAU
Head & Jaws	9.50	48.16
Pectoral girdle	7.50	38.02
Thoracic vert	0.00	0.00
Precaudal vert	0.26	1.33
Caudal vert	2.46	12.49
Total	**19.73**	**100.00**

Vertebral Units	MAU	%MAU
Thoracic	0.00	0.00
Precaudal	0.26	9.65
Caudal	2.46	90.35
Total	**2.73**	**100.00**

HADDOCK	MAU	%MAU
Premaxilla	0	0.00
Posttemporal	0.5	7.14
Cleithrum	6.5	92.86
Total	**7**	**100.00**

Table 117 Skonsvika Pit 2 SU 46 Butchery.

Taxon-butchery (SU 46)	**Skeletal Element**	**Butchery-mark**	**Frequency**
Cod family (Gadidae)	cleithrum	slice	7
Atlantic Cod (Gadus morhua L.)	supracleithrum	whittle	1
	supracleithrum	slice	1
Haddock (Melanogrammus aeglifinus)	cleithrum	knife	1
Fish indeterminant	cleithrum	slice	1
	indeterminant	slice	2
Reindeer (Rangifer tarandus)	antler	worked	2
Total			**15**

Table 118 Skonsvika Pit 2 SU 46 Gnawing.

Taxa-gnaw (SU 46)	**Skeletal Element**	**Gnaw-mark**	**Frequency**
Cod family (Gadidae)	caudal vertebrae	unknown	1
Atlantic Cod (Gadus morhua L.)	caudal vertebrae	unknown	2
Haddock (Melanogrammus aeglifinus)	caudal vertebrae	unknown	3
Halibut (Hippoglossus hippoglossus)	caudal vertebrae	unknown	6
Indeterminat mammal	indeterminant	canine	2

	rib	canine	1
Total			**15**

Table 119 Skonsvika Pit 2 SU 46 Fragmentation.

Fragmentation (SU 46)	TNF	% TNF
Less than 1 cm	479.00	49.95
1 to 2 cm	213.00	22.21
2 to 5 cm	214.00	22.31
5 to 10 cm	52.00	5.42
Greater than 10 cm	1.00	0.10
Total	**959.00**	**100.00**

Table 120 Skonsvika Pit 3 SU 46 Butchery.

Taxon-butchery (SU 46)	Skeletal Element	Butchery-mark	Frequency
Halibut (Hippoglossus hippoglossus)	caudal vertebrae	slice	1
Fish indeterminant	indeterminant	slice	3
Total			**4**

Table 121 Skonsvika Pit 3 SU 46 Gnawing.

Taxon-gnawing (SU 46)	Skeletal Element	Gnaw-mark	Frequency
Halibut (Hippoglossus hippoglossus)	caudal vertebrae	canine	3
	precaudal vertebrae	canine	1
	caudal vertebrae	canine/unknown	9

Total	**13**

Table 122 Skonsvika Pit 3 SU 46 Fragmentation.

Fragmentation (SU 46)	**TNF**	**%TNF**
Less than 1 cm	59.00	12.29
1 to 2 cm	106.00	22.08
2 to 5 cm	256.00	53.33
5 to 10 cm	57.00	11.88
Greater than 10 cm	2.00	0.42
Total	**480.00**	**100.00**

Table 123 Skonsvika Pits 2 and 3 SU 14 TNF.

Taxon	**Pit 2 TNF (S.U. 14)**	**Pit 2 %TNF (S.U. 14)**	**Pit 3 TNF (S.U. 14)**	**Pit 3 %TNF (S.U. 14)**
Fish	12.00	100.00	339.00	80.71
Wild mammals				
small to medium			1.00	0.24
medium to large			3.00	0.71
Sea mammals				
medium to large			11.00	2.62
Birds			3.00	0.71
Mollusca			33.00	7.86
Indeterimant mammal			8.00	1.90

Indeterimant			22.00	5.24
Total	**12.00**	**100.00**	**420.00**	**100.00**

Table 124 Skonsvika Pits 2 and 3 SU 14 NISP.

Taxon	Pit 2 NISP (S.U. 14)	Pit 2 %NISP (S.U. 14)	Pit 3 NISP (S.U. 14)	Pit 3 %NISP (S.U. 14)
Fish				
Atlantic Cod (Gadus morhua L.)			45.00	27.61
Haddock (Melanogrammus aeglifinus)			67.00	41.10
Halibut (Hippoglossus hippoglossus)	12.00	100.00	20.00	12.27
Saithe (Pollachius virens)			1.00	0.61
Cusk (Bromse brosme)			2.00	1.23
Wolffish (Anarhichas lupus)			1.00	0.61
Flatfish (Pleuronectidae)			1.00	0.61
Terrestrial mammals				
Reindeer (Rangifer tarandus)			3.00	1.84
Arctic fox (Alopex lagopus)			1.00	0.61
Marine mammals				
Cetacea			11.00	6.75

Mollusca				
Periwinkle (Littorina littorina)			3.00	1.84
Blue mussel (Mytilus edilus)			5.00	3.07
Pectinoidae, e.g. scallop			2.00	1.23
Ocean Quahog (Arctica islandica)			1.00	0.61
Total	**12.00**	**100.00**	**163.00**	**100.00**

Table 125 Skonsvika Pit 3 SU 14 Butchery.

Taxon-butchery (SU 14)	**Skeletal Element**	**Butchery-mark**	**Frequency**
Atlantic Cod (Gadus morhua L.)	supracleithrum	slice	1
Haddock (Melanogrammus aeglifinus)	cleithrum	slice	1
Fish indeterminant	indeterminant	slice	2
Reindeer (Rangifer tarandus)	cervical vertebrae	chop/puncture	1
Total			**5**

Table 126 Skonsvika Pit 3 SU 14 Gnawing.

Taxon-gnawing (SU 14)	**Skeletal Element**	**Gnaw-mark**	**Frequency**
Haddock (Melanogrammus	caudal vertebrae	unknown	1

aeglifinus)	
Total	**1**

Table 127 Skonsvika Pit 3 SU 14 Fragmentation.

Fragmentation (SU 14)	**TNF**	**%TNF**
Less than 1 cm	123.00	29.29
1 to 2 cm	132.00	31.43
2 to 5 cm	143.00	34.05
5 to 10 cm	20.00	4.76
Greater than 10 cm	2.00	0.48
Total	**420.00**	**100.00**

Table 128 Skonsvika Pits 8 and 9 TNF.

Taxon	**Pit 8 TNF**	**Pit 8 %TNF**	**Pit 9 TNF**	**Pit 9 %TNF**
Fish	192	86.10	144	82.29
Domestic mammals				
small to medium			2	1.14
Wild mammals				
small to medium	2	0.90		
medium to large	1	0.45	3	1.71
Sea mammals				
small to medium	3	1.35	2	1.14
medium to			1	0.57

large				
Birds	1	0.45	5	2.86
Indeterimant mammal	16	7.17	14	8.00
Indeterimant	8	3.59	4	2.29
Total	**223**	**100.00**	**175**	**100.00**

Table 129 Skonsvika Pits 8 and 9 NISP.

Taxon	**Pit 8 NISP**	**Pit 8 %NISP**	**Pit 9 NISP**	**Pit 9 %NISP**
Fish				
Atlantic Cod (Gadus morhua L.)	33	32.04	28	47.46
Haddock (Melanogrammus aeglifinus)	45	43.69	8	13.56
Halibut (Hippoglossus hippoglossus)	13	12.62	4	6.78
Saithe (Pollachius virens)	5	4.85		
Cusk (Bromse brosme)			5	8.47
Terrestrial mammals				
Bovidea (sheep/goat)	2	1.94	2	3.39
Reindeer (Rangifer tarandus)	1	0.97	3	5.08
Marine mammals				
Phocidae	3	2.91	2	3.39
Cetacea			1	1.69

Birds				
Falconidae			1	1.69
Bird Indeterminant	1	0.97	5	8.47
Total	**103**	**100.00**	**59**	**100.00**

Table 130 Skonsvika Canine Skeletal Distribution SU 12.

Context	Species	Element
	Arctic fox (Alopex lagopus)	Metapodial No. 2
	Arctic fox (Alopex lagopus)	Metapodial No. 3
	Canidae	Rib
Associated with Oven	Vulpinae	Femur
	Vulpinae	Lumbar vertebrae
	Arctic fox (Alopex lagopus)	Molar
Associated with Oven	Vulpinae	Tarsel
Associated with Oven	Vulpinae	Tarsel
Associated with Oven	Vulpinae	Metatarsle No. 4
Associated with Oven	Vulpinae	Metatarsel No. 3
Associated with Oven	Vulpinae	Caudal vertebrae
Associated with Oven	Vulpinae	Sternum

Table 131 Kongshavn Room 5 TNF.

Taxon	TNF	%TNF
Fish	2685.00	82.79
Domestic mammals		
small to medium	11.00	0.34
medium to large	1.00	0.03
Wild mammals		
very small to small	2.00	0.06
small to medium	1.00	0.03

Sea mammals		
small to medium	4.00	0.12
medium to large	47.00	1.45
Birds	93.00	2.87
Mollusca	37.00	1.14
Indeterimant mammal	166.00	5.12
Indeterimant	196.00	6.04
TNF	**3243.00**	**100.00**

Table 132 Kongshavn Room 5 NISP.

Taxon	**NISP**	**%NISP**
Fish		
Atlantic Cod (Gadus morhua L.)	859.00	63.21
Haddock (Melanogrammus aeglifinus)	176.00	12.95
Halibut (Hippoglossus hippoglossus)	196.00	14.42
Saithe (Pollachius virens)	6.00	0.44
Cusk (Bromse brosme)	6.00	0.44
Flatfish (Pleuronectidae)	1.00	0.07
Terrestrial mammals		
Pig (Sus scrofa)	11.00	0.81
Cow (Bos taurus)	1.00	0.07
Rodentia	2.00	0.15
Vulpinae	1.00	0.07
Marine mammals		
Phocidae	4.00	0.29
Cetacea	47.00	3.46
Birds		
Eider Duck (Somateria mollissima)	1.00	0.07
Razor bill (Alca torda)	2.00	0.15
Black Gullimot (Cepphus grylle)	1.00	0.07

Laridae	4.00	0.29
Alicidae	2.00	0.15
Anserinae	1.00	0.07
Puffin (Fratercula arctica)	1.00	0.07
Herring gull (Larus argentatus)	10.00	0.74
Black-headed gull (Larus ridibundus)	7.00	0.52
Phalacrocoracidae (Cormorant/Shag sps.)	2.00	0.15
Mollusca		
Periwinkle (Littorina littorina)	17.00	1.25
Ocean Quahog (Arctica islandica)	1.00	0.07
Total	**1359.00**	**100.00**

Table 133 Kongshavn Room 5 Cod Elemental Distribution.

COD-ELEMENT DISTRIBUTION	**MAU**	**% MAU**
Olfactory	36.00	8.78
Occipital	7.00	1.71
Otic	5.50	1.34
Investing	15.00	3.66
Lateral	153.00	37.30
Opercular	43.00	10.48
Mandicular	45.00	10.97
Hyoid Arch	53.50	13.04
Branchial Arch	10.46	2.55
Pectoral Girdle	23.50	5.73
Pelvic Girdle	1.00	0.24
Vertebral Column	15.09	3.68
Caudal Skeleton	2.14	0.52
Total	**410.19**	**100.00**

COD	MAU	% MAU
Head & Jaws	368.46	92.30
Pectoral girdle	23.50	5.89
Thoracic vert	3.25	0.81
Precaudal vert	1.84	0.46
Caudal vert	2.14	0.54

Total	**399.19**	**100.00**

COD	MAU	% MAU
Thoracic	3.25	44.92
Precaudal	1.84	25.46
Caudal	2.14	29.62
Total	**7.23**	**100.00**

COD	MAU	% MAU
Premaxilla	34.00	73.91
Posttemporal	10.00	21.74
Cleithrum	2.00	4.35
Total	**46.00**	**100.00**

Table 134 Kongshavn Room 5 Haddock Elemental Distribution.

HADDOCK-ELEMENT DISTRIBUTION	MAU	% MAU
Olfactory	2.00	3.28
Occipital	0.50	0.82
Otic	1.00	1.64
Investing	1.00	1.64
Lateral	7.00	11.50
Opercular	4.75	7.80
Mandicular	0.50	0.82
Hyoid Arch	7.50	12.32
Branchial Arch	2.50	4.11
Pectoral Girdle	27.00	44.34
Pelvic Girdle	0.00	0.00
Vertebral Column	2.21	3.63
Caudal Skeleton	4.93	8.09
Total	**60.89**	**100.00**

HADDOCK	MAU	% MAU
Head & Jaws	26.75	43.93
Pectoral girdle	27.00	44.34
Thoracic vert	1.00	1.64
Precaudal vert	1.21	1.99
Caudal vert	4.93	8.09
Total	**60.89**	**100.00**

HADDOCK	MAU	% MAU
Thoracic	1.00	14.01
Precaudal	1.21	16.96
Caudal	4.93	69.04
Total	**7.14**	**100.00**

HADDOCK	MAU	% MAU
Premaxilla	0.00	0.00
Posttemporal	4.00	17.02
Cleithrum	19.50	82.98
Total	**23.50**	**100.00**

Table 135 Kongshavn Room 5 Halibut Elemental Distribution.

HALIBUT-ELEMENT DISTRIBUTION	**MAU**	**% MAU**
Olfactory	1.00	2.59
Occipital	0.00	0.00
Otic	0.00	0.00
Investing	0.00	0.00
Lateral	15.00	38.92
Opercular	0.00	0.00
Mandicular	7.50	19.46
Hyoid Arch	3.50	9.08
Branchial Arch	0.42	1.08

Pectoral Girdle	2.00	5.19
Pelvic Girdle	0.00	0.00
Vertebral Column	2.26	5.87
Caudal Skeleton	6.86	17.79
Total	**38.54**	**100.00**

HALIBUT	MAU	% MAU
Head & Jaws	27.42	77.15
Pectoral girdle	2.00	5.63
Thoracic vert	2.00	5.63
Precaudal vert	0.26	0.74
Caudal vert	3.86	10.85
Total	**35.54**	**100.00**

HALIBUT	MAU	% MAU
Thoracic	2.00	32.68
Precaudal	0.26	4.30
Caudal	3.86	63.02
Total	**6.12**	**100.00**

HALIBUT	MAU	% MAU
Premaxilla	2.50	83.33
Posttemporal	0.00	0.00
Cleithrum	0.50	16.67
Total	**3.00**	**100.00**

Table 136 Kongshavn Room 5 Butchery.

Taxon-butchery	**Skeletal Element**	**Butchery-mark**	**Frequency**
Cod family (Gadidae)	subopercular	slice	4
	cleithrum	slice	1

	dentary	knife	1
Atlantic Cod (Gadus morhua L.)	maxilla	slice	17
	premaxilla	slice	12
	dentary	slice	43
	opercular	slice	1
	palatine	slice	2
	posttemporal	slice	2
	subopercular	slice	7
	dentary	knife	1
	preopercular	knife	1
	pharnygeal plate	knife	2
	lachrymal	knife	1
	maxilla	knife	4
	palatine	knife	2
	posttemporal	knife	2
	subopercular	knife	1
	premaxilla	cut and snap	2
Haddock (Melanogrammus aeglifinus)	cleithrum	knife	1
Halibut (Hippoglossus hippoglossus)	rib	slice	1
	angular	slice	1
	preopercular	slice	1
	dentary	slice	1
	premaxilla	slice	2
	caudal vertebrae	chop	1
	caudal vertebrae	knife	4
	angular	knife	1
Fish indeterminant	rib	slice	36
	indeterminant	slice	2

Pig (Sus scrofa)	skull	knife/chope	1
Cetacea	indeterminant	worked	20
	indeterminant	chop	1
	indeterminant	knife	1
Indeterminant mammal bone	indeterminant	worked	2
	indeterminant	knife	3
	indeterminant	slice	2
Total			**187**

Table 137 Kongshavn Room 5 Gnawing.

Taxon-gnawing	Skeletal Element	Gnaw-mark	Frequency
Phocidae	indeterminant	canine	1
Saithe (Pollachius virens)	precaudal vertebrae	unknown	1
Total			**2**

Table 138 Kongshavn Room 5 Fragmentation.

Fragmentation	TNF	% TNF
Less than 1 cm	520.00	15.91
1 to 2 cm	1030.00	31.52
2 to 5 cm	1555.00	47.58
5 to 10 cm	151.00	4.62
Greater than 10 cm	12.00	0.37
Total	**3268.00**	**100.00**

Table 139 Kongshavn Room 4 TNF.

Taxon	TNF	%TNF
Fish	797.00	91.61

Domestic mammals		
medium to large	2.00	0.23
Sea mammals		
medium to large	16.00	1.84
Birds	5.00	0.57
Mollusca	2.00	0.23
Indeterimant mammal	6.00	0.69
Indeterimant	42.00	4.83
Total	**870.00**	**100.00**

Table 140 Kongshavn Room 4 NISP.

Taxon	**NISP**	**%NISP**
Fish		
Atlantic Cod (Gadus morhua L.)	258.00	75.22
Haddock (Melanogrammus aeglifinus)	20.00	5.83
Halibut (Hippoglossus hippoglossus)	46.00	13.41
Cusk (Bromse brosme)	1.00	0.29
Terrestrial mammals		
Bovidae (sheep/goat)	2.00	0.58
Marine mammals		
Cetacea	16.00	4.66
Total	**343.00**	**100.00**

Table 141 Kongshavn Room 4 Cod Elemental Distribution.

COD-ELEMENT DISTRIBUTION

	MAU	%MAU
Olfactory	16.00	13.82
Occipital	3.00	2.59

Otic	3.00	2.59
Investing	6.00	5.18
Lateral	27.50	23.75
Opercular	15.88	13.71
Mandicular	12.50	10.80
Hyoid Arch	13.00	11.23
Branchial Arch	6.17	5.33
Pectoral Girdle	5.50	4.75
Pelvic Girdle	0.00	0.00
Vertebral Column	6.01	5.19
Caudal Skeleton	1.21	1.05
Total	**115.77**	**100.00**

COD	MAU	%MAU
Head & Jaws	103.04	91.37
Pectoral girdle	5.50	4.88
Thoracic vert	1.75	1.55
Precaudal vert	1.26	1.12
Caudal vert	1.21	1.08
Total	**112.77**	**100.00**

COD-Vertebral Units	MAU	%MAU
Thoracic	1.75	41.40
Precaudal	1.26	29.88
Caudal	1.21	28.72
Total	**4.23**	**100.00**

COD	MAU	%MAU
Premaxilla	4.00	53.33
Posttemporal	1.50	20.00
Cleithrum	2.00	26.67
Total	**7.50**	**100.00**

Table 142 Kongshavn Room 4 Butchery.

Taxon-butchery	Skeletal Element	Butchery-mark	Frequency
Cod family (Gadidae)	subopercular	slice	1
Atlantic Cod (Gadus morhua L.)	dentary	slice	7
	subopercular	slice	4
	premaxilla	slice	7
Haddock (Melanogrammus aeglifinus)	precaudal	slice	2
Halibut (Hippoglossus hippoglossus)	maxilla	slice	1
	dentary	slice	1
	angular	slice	1
	cleithrum	knife	1
Fish Indeterminant	rib	slice	35
Cetacea	indeterminant	knife	1
Indeterminant bone	indeterminant	work	1
Total			**62**

Table 143 Kongshavn Room 4 Fragmentation.

Fragmentation	TNF	%TNF
Less than 1 cm	89.00	10.16
1 to 2 cm	314.00	35.84
2 to 5 cm	425.00	48.52

5 to 10 cm	47.00	5.37
Greater than 10 cm	1.00	0.11
Total	**876.00**	**100.00**

Table 144 Nordmansett TNF.

Taxon	**TNF**	**%TNF**
Fish	107.00	75.89
Domestic mammals		
small to medium	3.00	2.13
Wild mammals		
medium to large	3.00	2.13
Birds	3.00	2.13
Indeterimant mammal	8.00	5.67
Indeterimant	17.00	12.06
Total	**141.00**	**100.00**

Table 145 Nordmansett NISP.

Taxon	**NISP**	**%NISP**
Fish		
Atlantic Cod (Gadus morhua L.)	28	70.00
Haddock (Melanogrammus aeglifinus)	3	7.50
Halibut (Hippoglossus hippoglossus)	3	7.50
Terrestrial mammals		
Pig (Sus scrofa)	3	7.50
Reindeer (Rangifer tarandus)	3	7.50
Total	**40**	**100.00**

Table 146 Nordmannsett Butchery.

Taxon-butchery	Skeletal Element	Butchery-mark	Frequency
Atlantic Cod (Gadus morhua L.)	dentary	slice	1
	maxilla	slice	1
	subopercular	slice	2
Halibut (Hippoglossus hippoglossus)	angular	slice	1
Total			**5**

Table 147 Nordmansett Fragmentation.

Fragmentation	TNF	%TNF
Less than 1 cm	17	12.14
1 to 2 cm	40	28.57
2 to 5 cm	63	45.00
5 to 10 cm	19	13.57
Greater than 10 cm	1	0.71
Total	**140**	**100.00**

Table 148 Butchery-marks across the North Atlantic.

Site name	Location	Date/Period	Ethnicity	NISP	Butchery	Style
	North Norway, East Finnmark					
Vardøhus	Vardø Municipality	Late Medieval	Norwegian	N/A	absent	
Vadsøya	Vadsø Municipality	Late Medieval to Early Modern	Norwegian	N/A	present	slicing
Karlebotn	Nesseby Municipality	Late Medieval	Saami	N/A	absent	
Saggusnjar'ga	Nesseby Municipality	Late Medieval	Saami	N/A	present	slicing
Gæccevajnjarga	Nesseby Municipality	Late Medieval	Saami	N/A	absent	
Div. Sami boplassen	Nesseby Municipality	Late Medieval	Saami	N/A	absent	
Laukvika	Berlevåg Municipality	Early Modern	unknown	N/A	present	slicing
Skonsvika	Berlevåg Municipality	Late Medieval	unknown	11, 114	present	slicing
Kongshavn	Berlevåg Municipality	Late Medieval to Early Modern	unknown	16,983	present	slicing
Nordmannsett	Berlevåg Municipality	Early Modern	unknown	40	present	slicing
	North Norway, West Finnmark					
Forsøl	Hammerfest Municipality	Late Medieval	unknown	N/A	absent	
Værbukta	Måsøy Municipality	Early Modern	unknown	12,000	absent	
Måsøy	Måsøy Municipality	Late Medieval to Early Modern	Norwegian	N/A	absent	
	North Norway,					

	North Troms				
Helgøy	Helgøy Municipality	AD 1300	Norwegian	7,441	absent
Helgøy	Helgøy Municipality	AD 1400	Norwegian	8,135	absent
Helgøy	Helgøy Municipality	AD 1600	Norwegian	24,286	absent
Rødgammen	Helgøy Municipality	AD 1550	Norwegian	10,374	absent
Nordskar	Helgøy Municipality	AD 1550	Norwegian	74,909	absent
Grunnfjor	Helgøy Municipality	AD 1550	Norwegian	21,146	absent
Vannareid	Helgøy Municipality	AD 1450	Norwegian	1,868	absent
	North Norway, Nordland				
Storvågan	Lofoten Municipality	AD 1200	Norwegian	4,907	absent
Storvågan	Lofoten Municipality	AD 1300	Norwegian	283	absent
Storvågan	Lofoten Municipality	AD 1450	Norwegian	1270	absent
Storvågan	Lofoten Municipality	AD 1500	Norwegian	377	absent
Storvågan	Lofoten Municipality	AD 1600-1700	Norwegian	330	absent
	Iceland, Northwest				
Akurvík	Strandasýsla County	Late Medieval	Icelandic	150,000	absent
Gjögur	Strandasýsla County	Late Medieval	Icelandic	ca. 19,000	absent
Gásir	Akureyri County	Late Medieval	Icelandic	4,389	?
Miðbaer	Breiðafjörður, Akureyri County	Late Medieval to Early Modern	Icelandic	8,541	absent
	Iceland, Southwest				
Tjarnargata 3c	Reykjavík County	Early Modern	Icelandic	ca. 67,000	absent

	Scotland					
Unst	Shetland Islands	Late Medieval	Norse	N/A	present	knife-marks
Pool 8	Orkney	Viking Age to Medieval	Norse	4,325	present	mixed
St. Boniface 8	Orkney	Medieval	Norse	9,248	present	mixed
Burnside/Studio	Orkney	Medieval	Norse	12,340	present	mixed
Earl's Bu	Orkney	Medieval	Norse	6,688	present	knife-marks
Robert's Haven	Caithness	Medieval	Norse	15,948	present	mixed
Freswick	Caithness	Medieval to Early Modern	Norse	N/A	present	knife-marks

FIGURES

Figure 1 Multi-room houses of Finnmark, Norway.

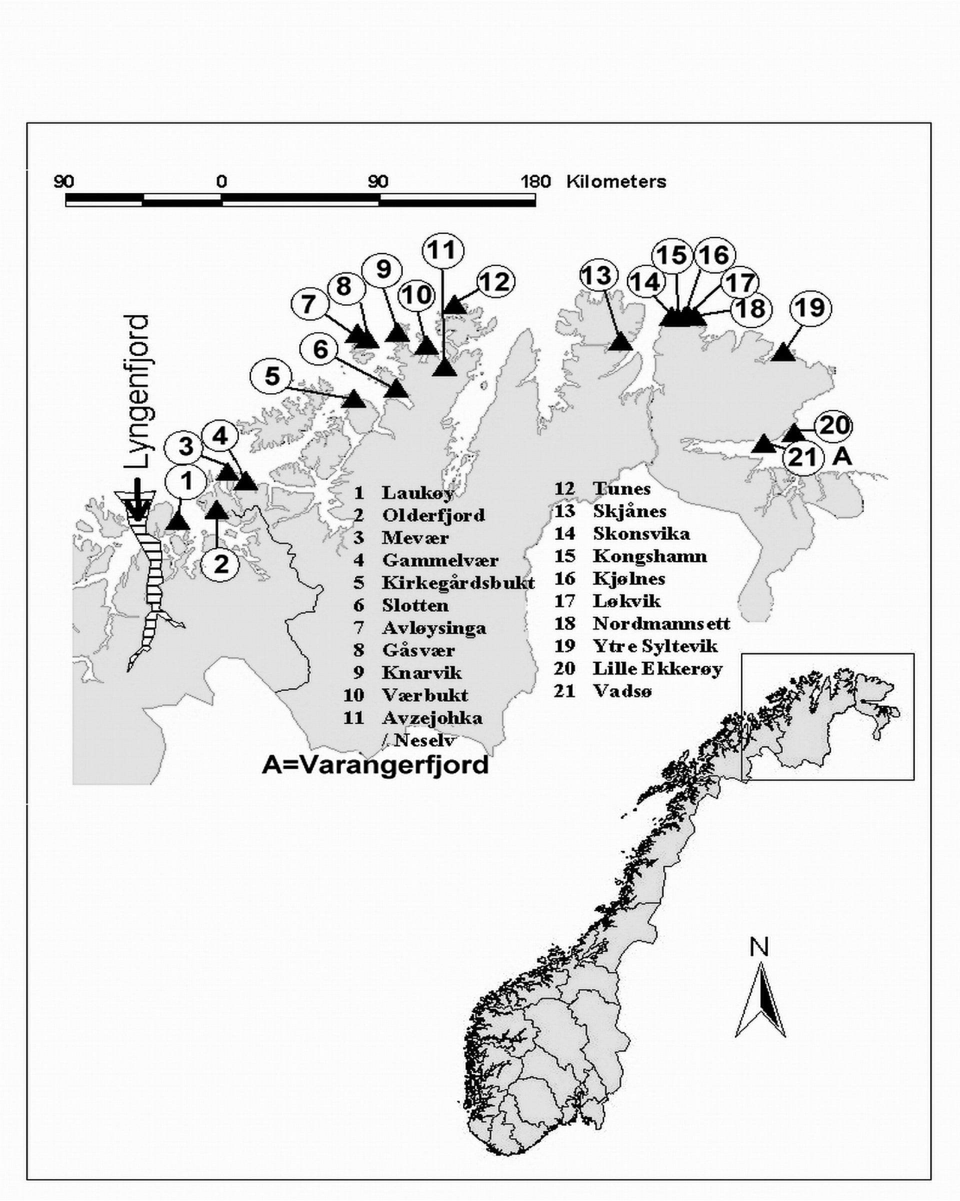
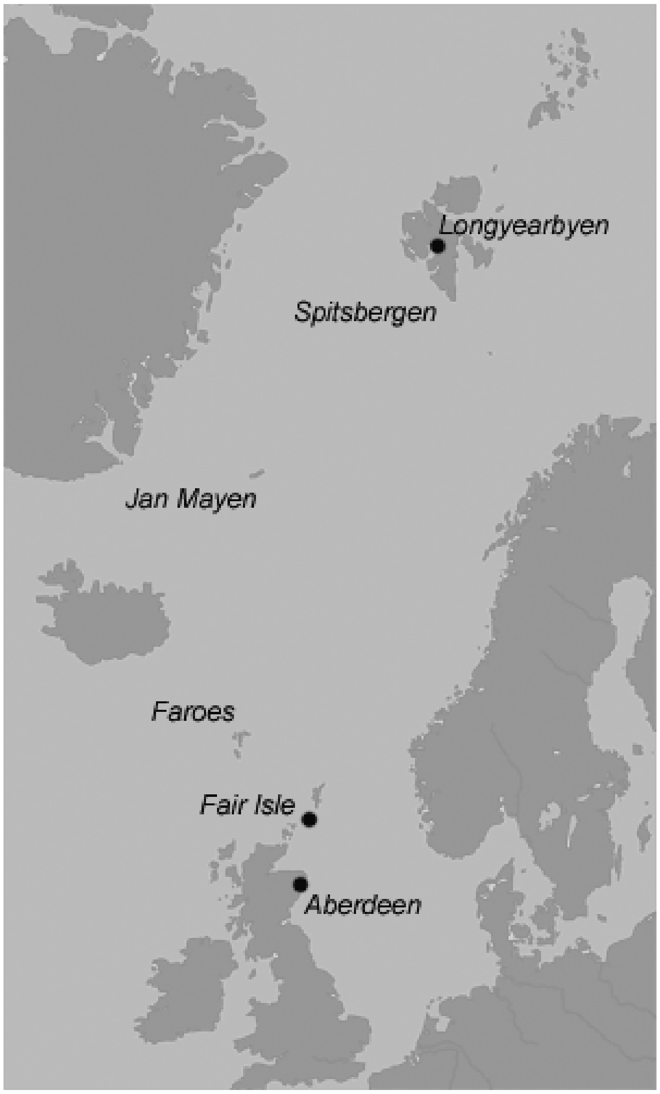


Figure 2 The North Atlantic Region.



(The Travelling Naturalist 2006)

Figure 3 Multi-room house radio-carbon dates.

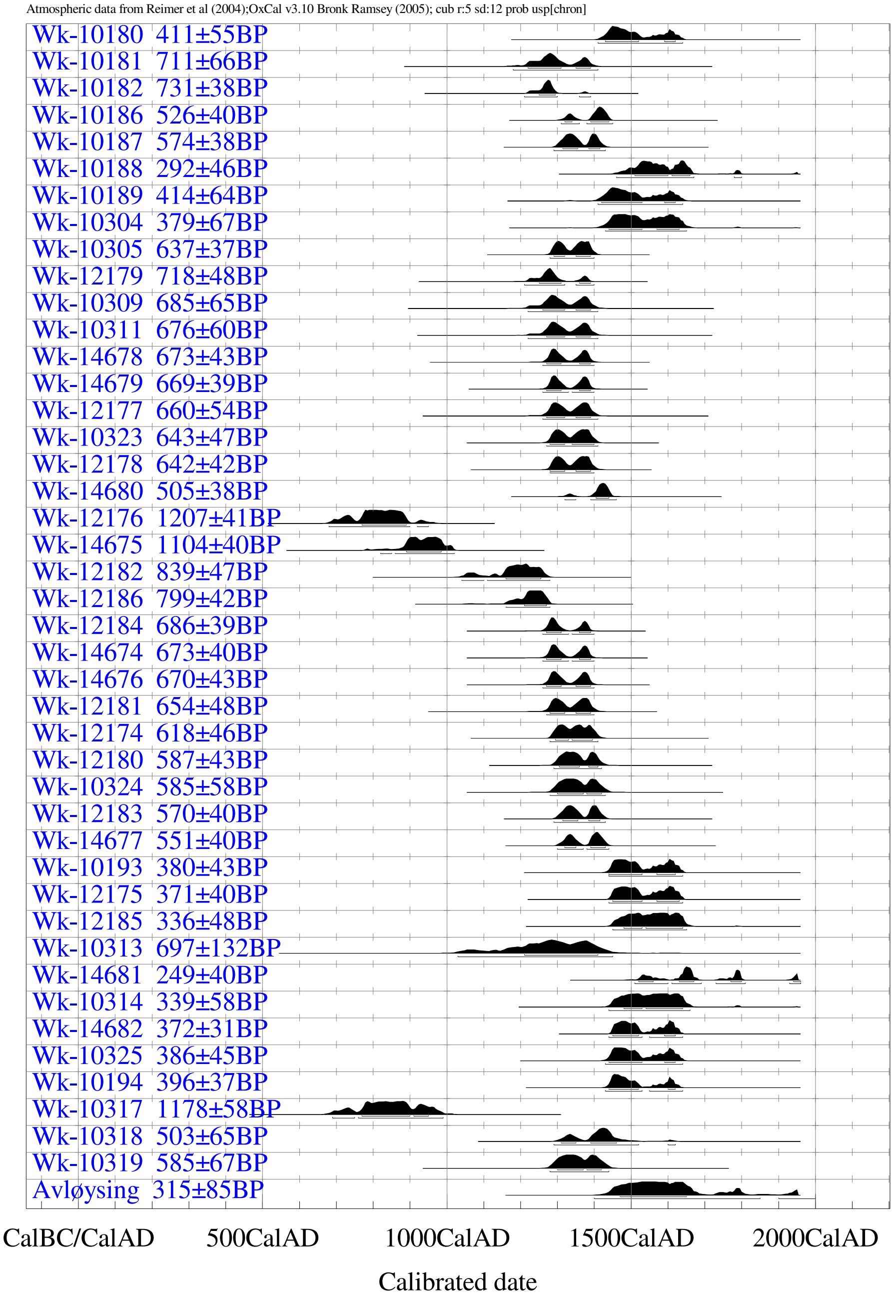


Figure 4 Cultural landscape.

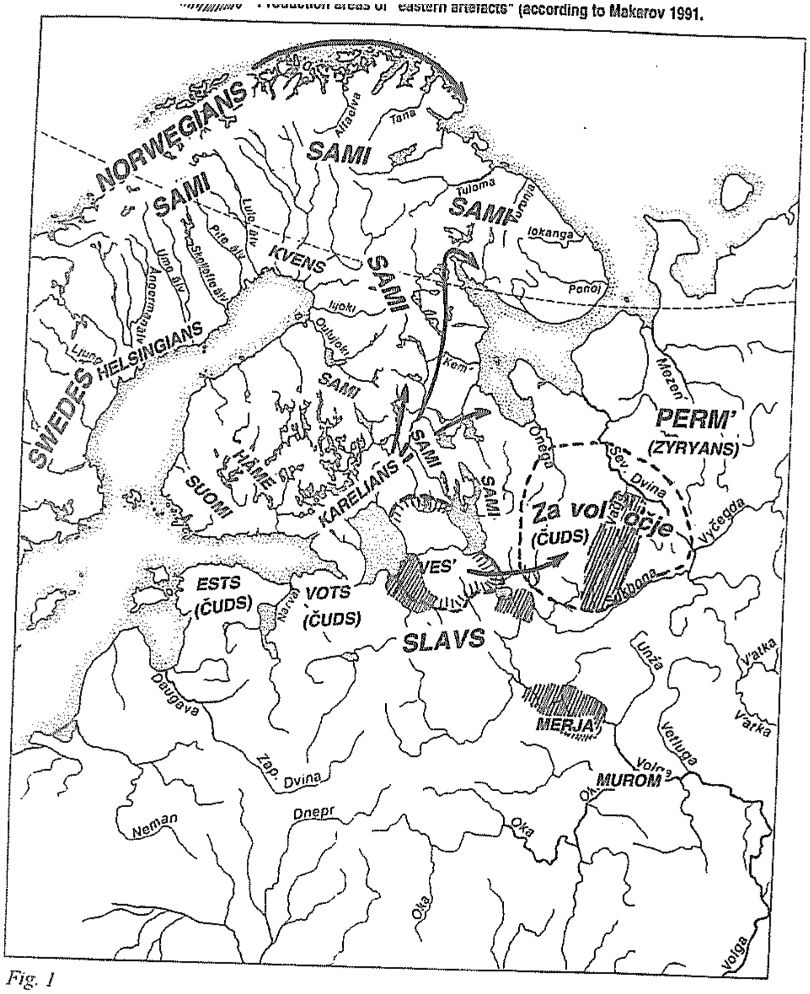


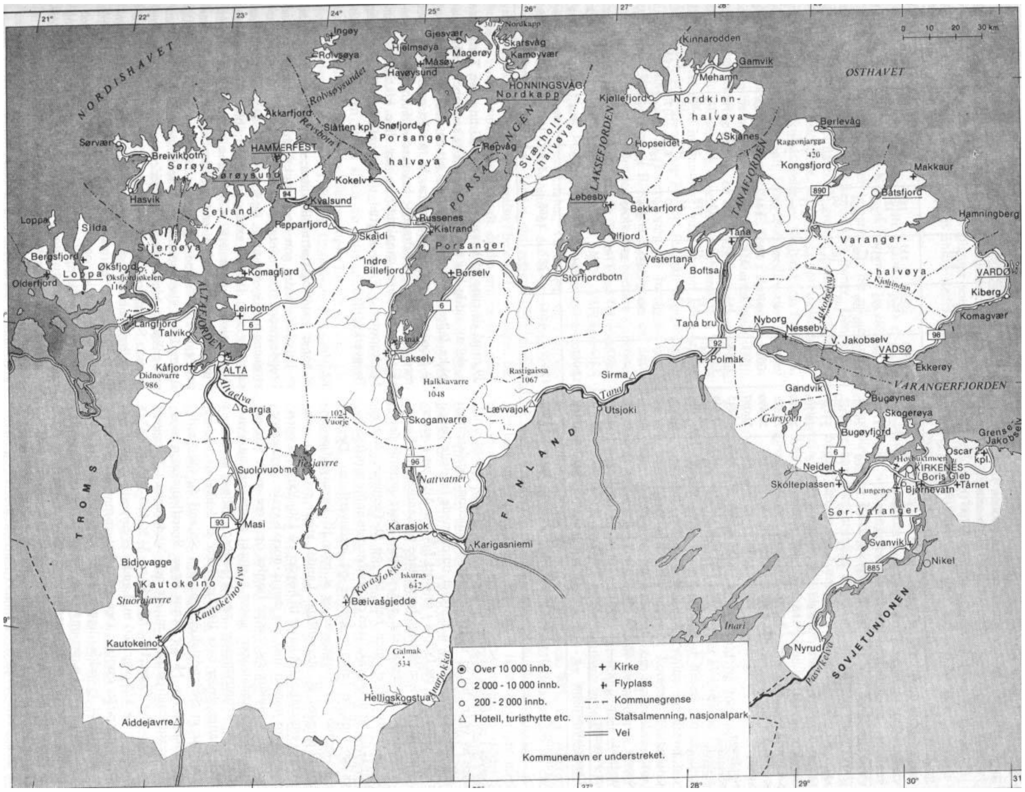
Fig. 1

(Hansen 1996:36)

Figure 5 Modern Karelia.

(Wikipedia 2008a)

Figure 6 Finnmark.

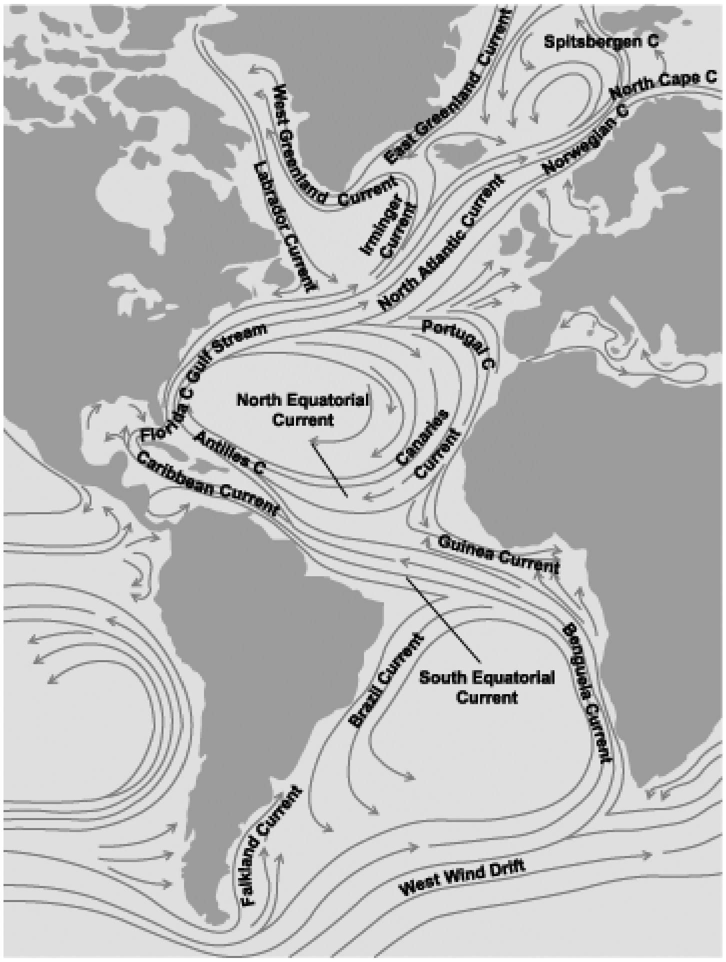


(Finnmark Novelty Map n.d.)

Figure 7 North and South Atlantic.

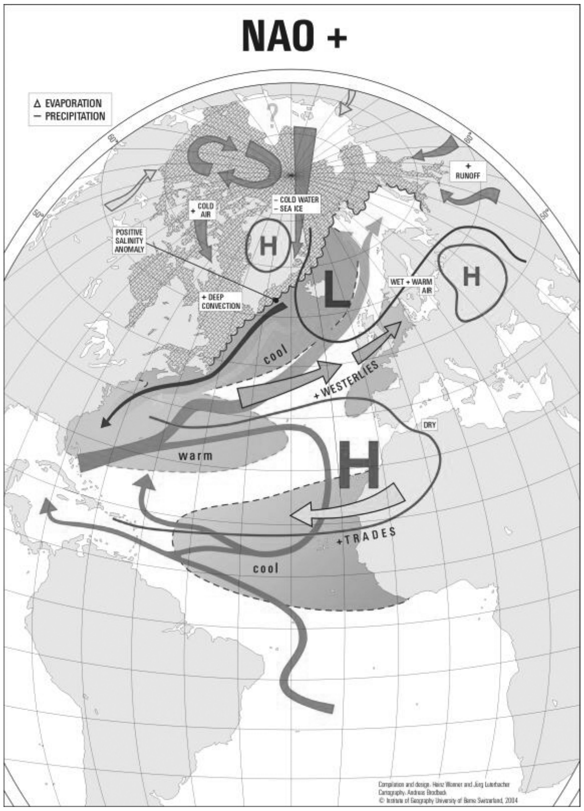
(Map at the Oceans n.d.)

Figure 8 North Atlantic Currents.



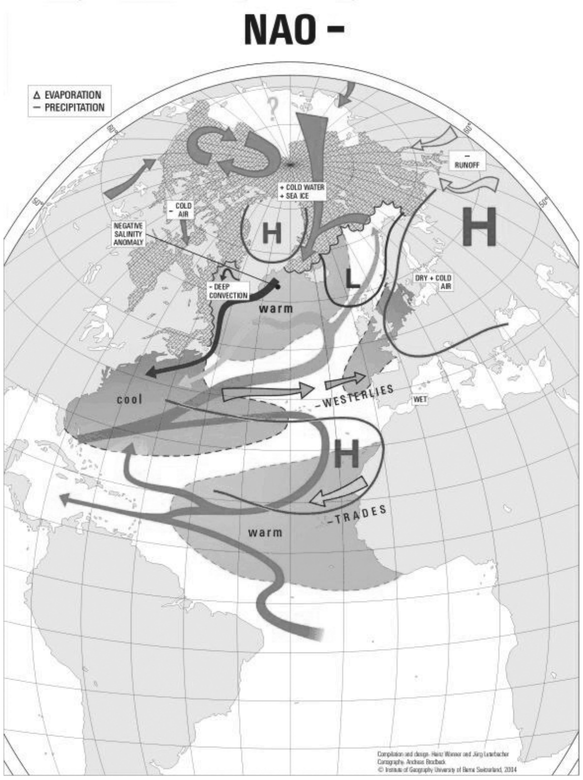
(Wikepedia 2008)

Figure 9 NAO positive.



(North Atlantic Oscillation 2004)

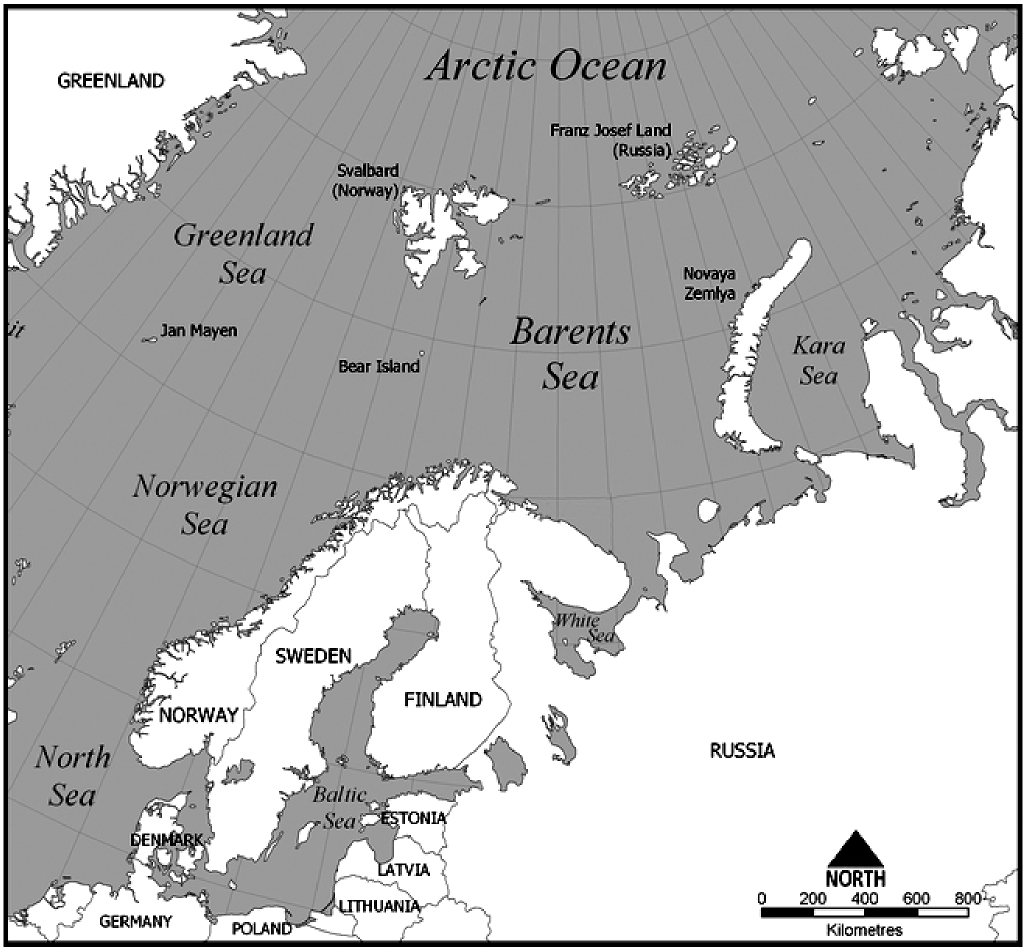
Figure 10 NAO negative.



Compilation and design: Heinz Wanner and Jürg Luterbacher
Cartography: Andreas Brodbeck
© Institute of Geography University of Berne Switzerland, 2004

(North Atlantic Oscillation 2004)

Figure 11 Barents Sea.



(Wikipedia 2008b)

Figure 12 Processing vs. Habitation site Full Elemental Distribution.

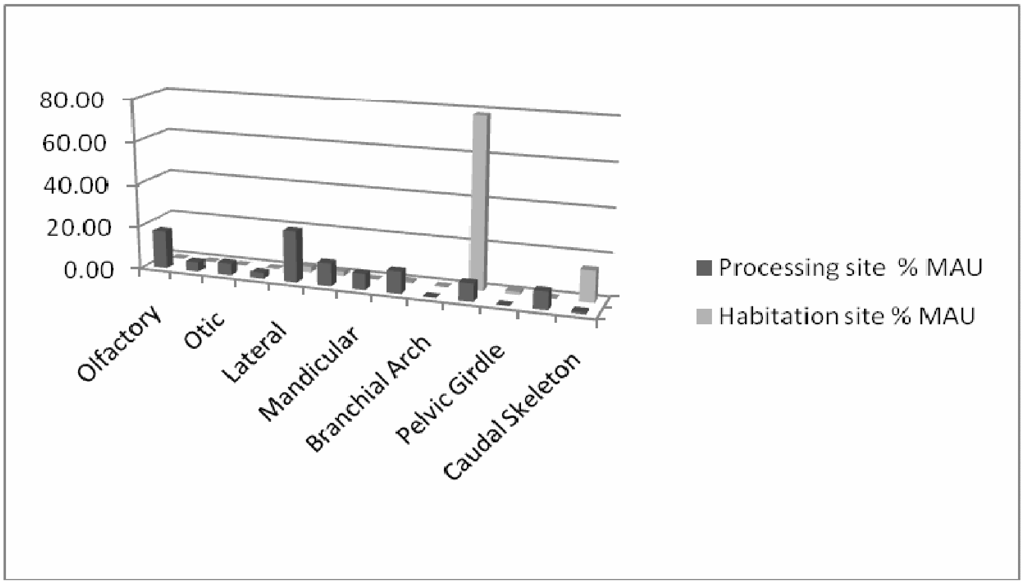


Figure 13 Processing vs. Habitation site Partial Elemental Distribution.

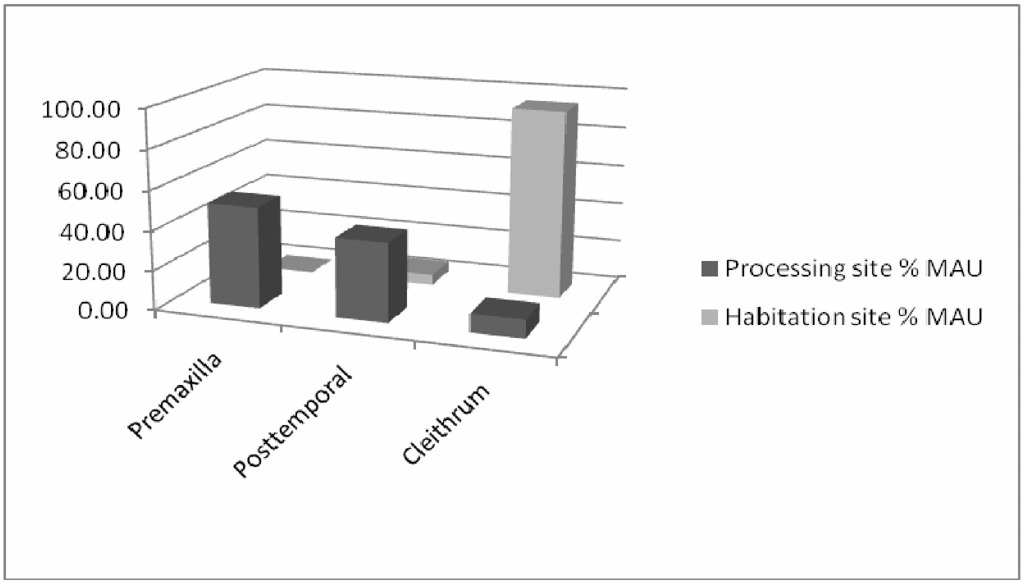


Figure 14 Processing vs. Habitation site Vertebral Series.

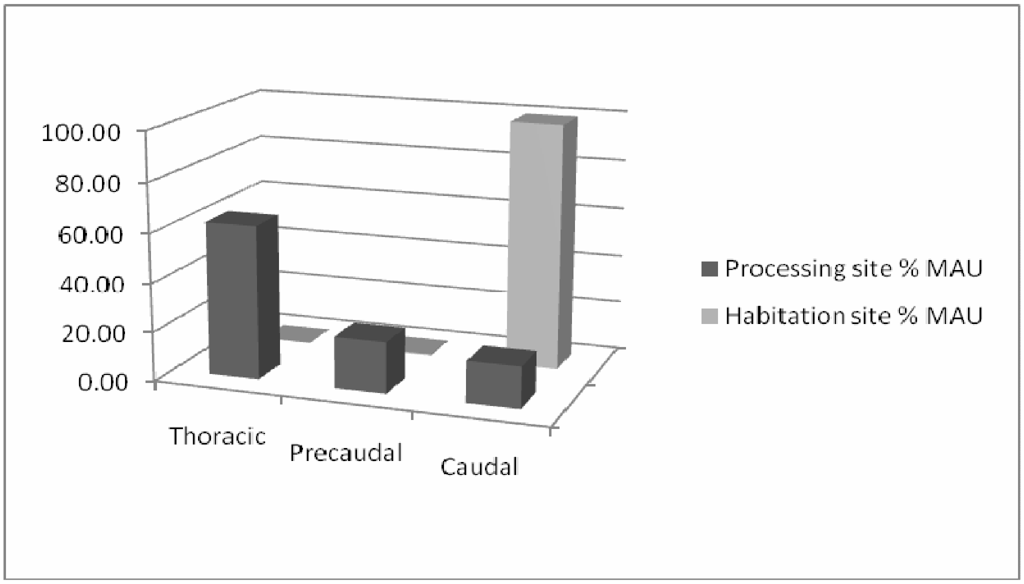
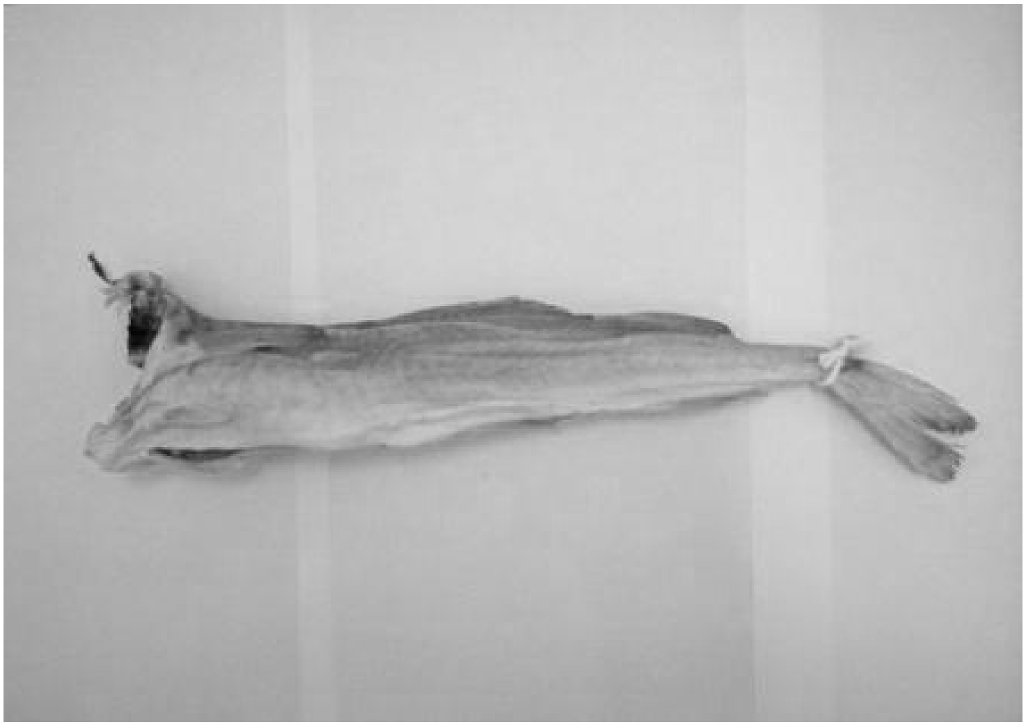
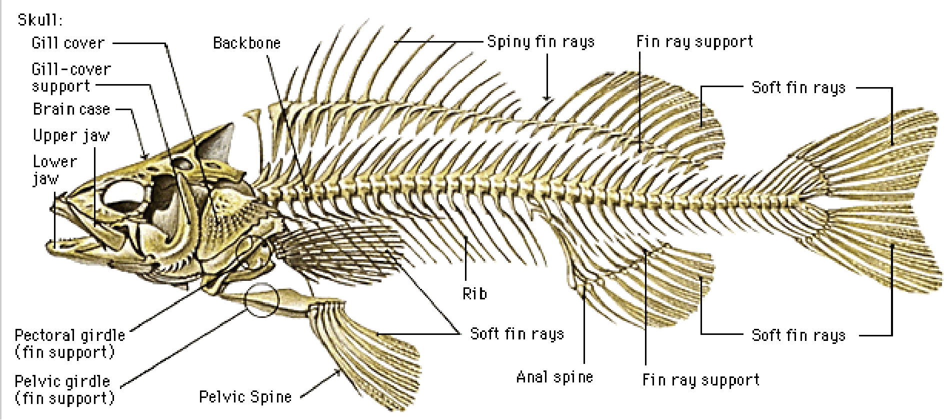


Figure 15 Processed cod "stockfish".



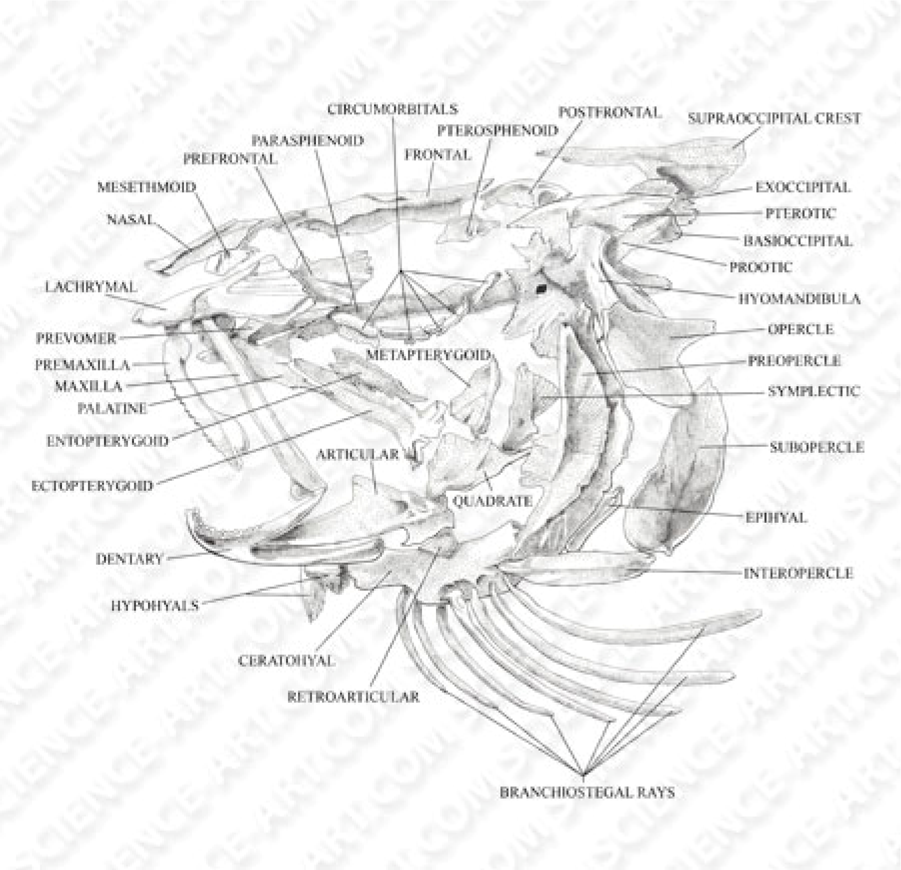
(Stockfish 2006)

Figure 16 Fish Skeleton.



(Fish 2008)

Figure 17 Cod Skull.



(Sullivan 2008)

Figure 18 Butchery marks supracleithrum (cod).

(Photo Adnan Isagic 2007)

Figure 19 Butchery marks cleithrum (cod).

(Photo Adnan Isagic 2007)

Figure 20 Butchery marks dentary (cod).

(Photo Adnan Isagic 2007)

Figure 21 Gammelvaer House 1.

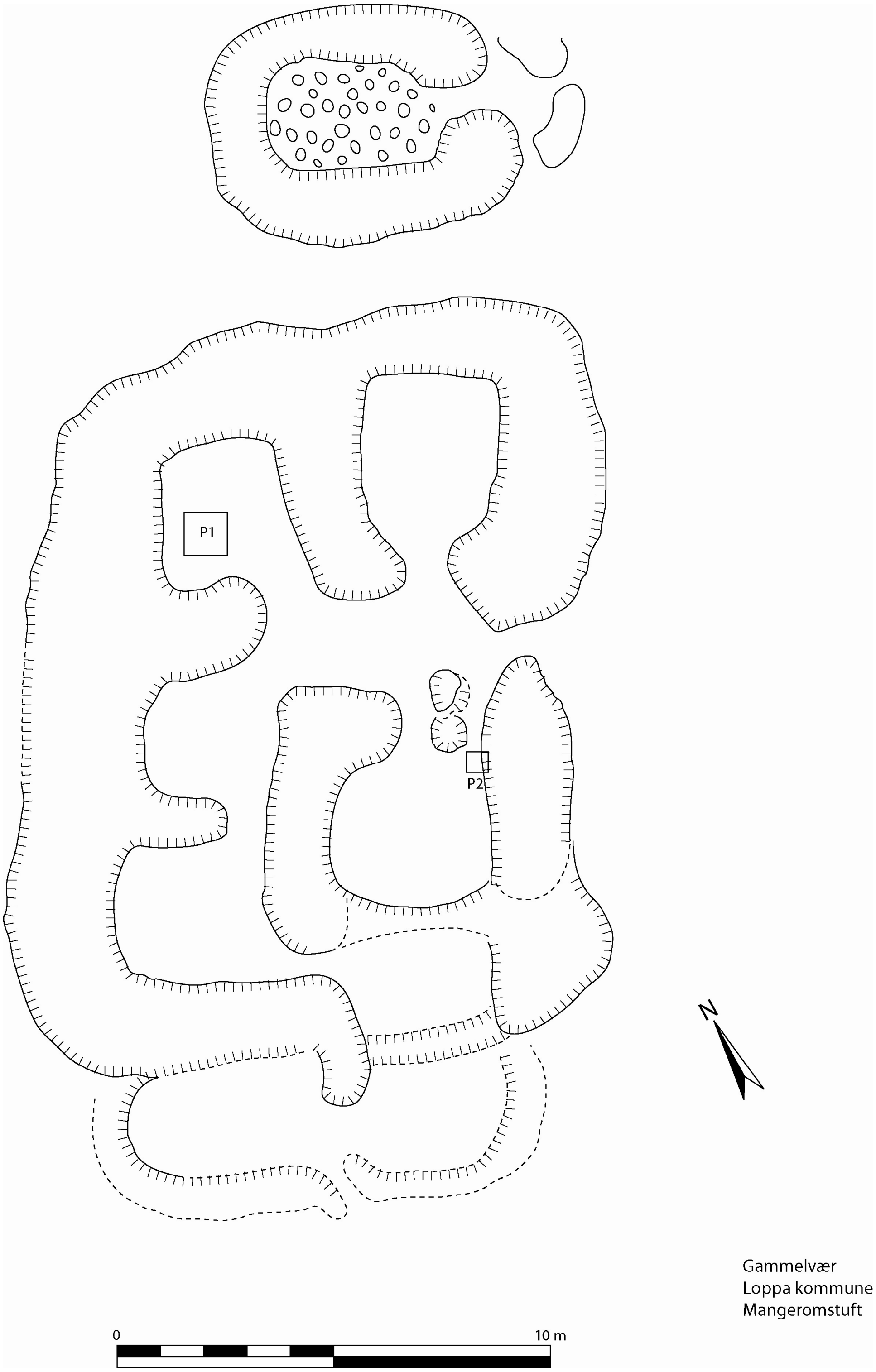


Figure 22 Gammelvaer House 2.

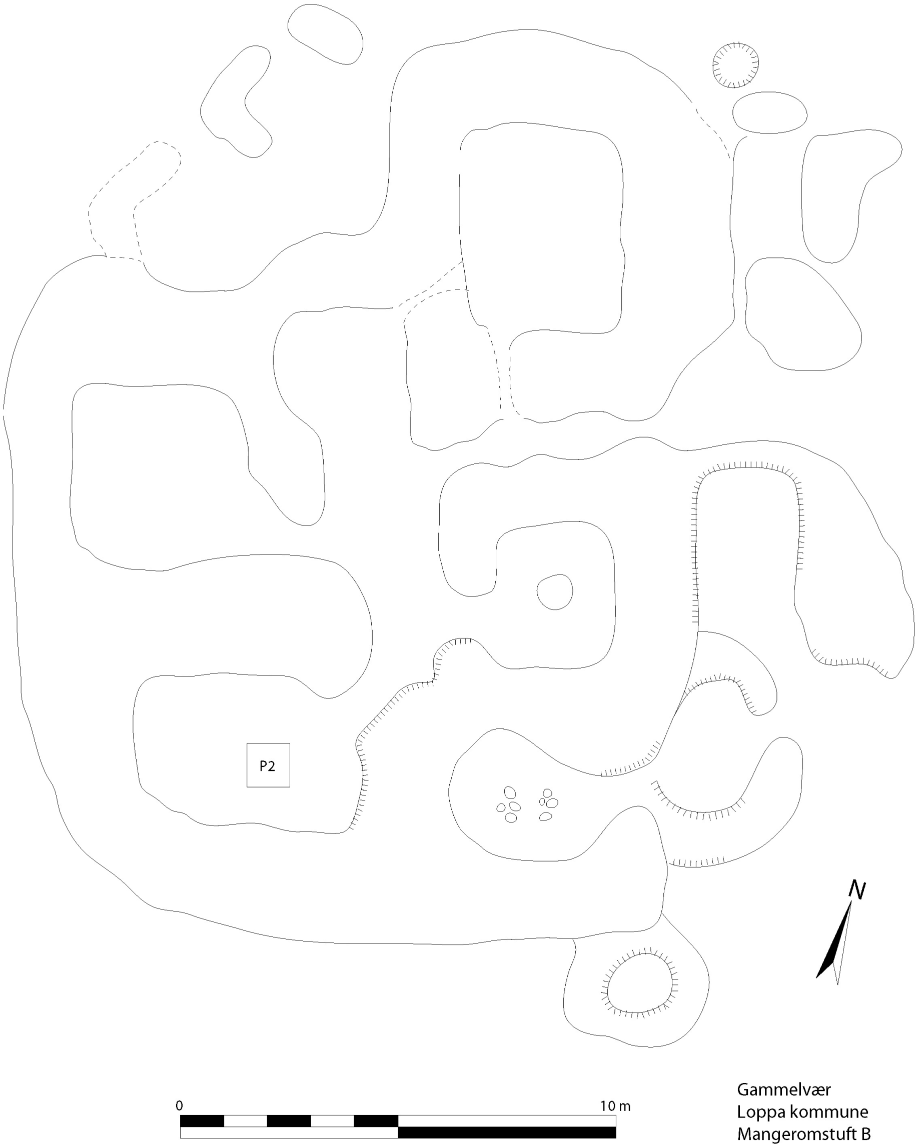


Figure 23 Neselev House 1.

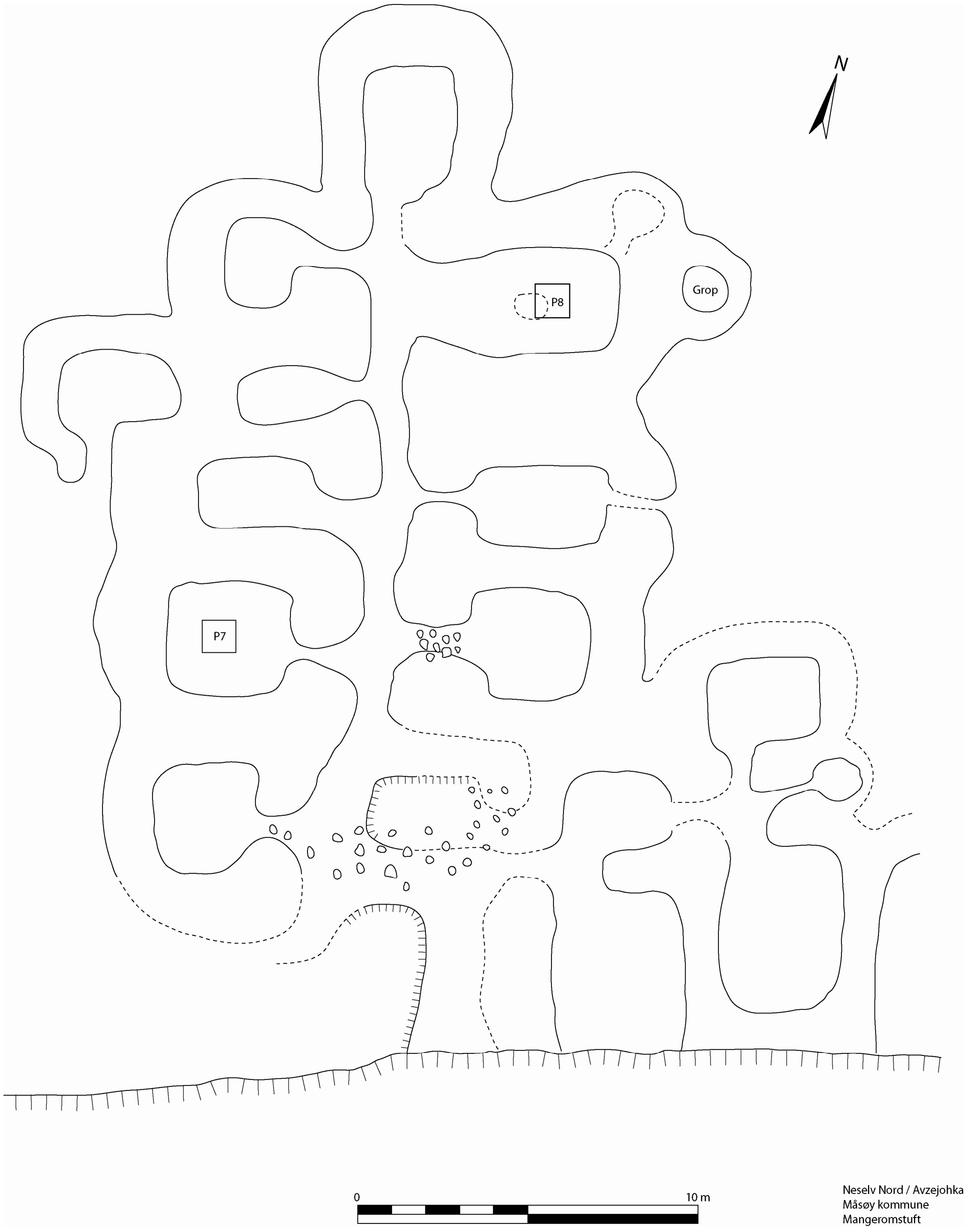


Figure 24 Neselev House 2 and 3.

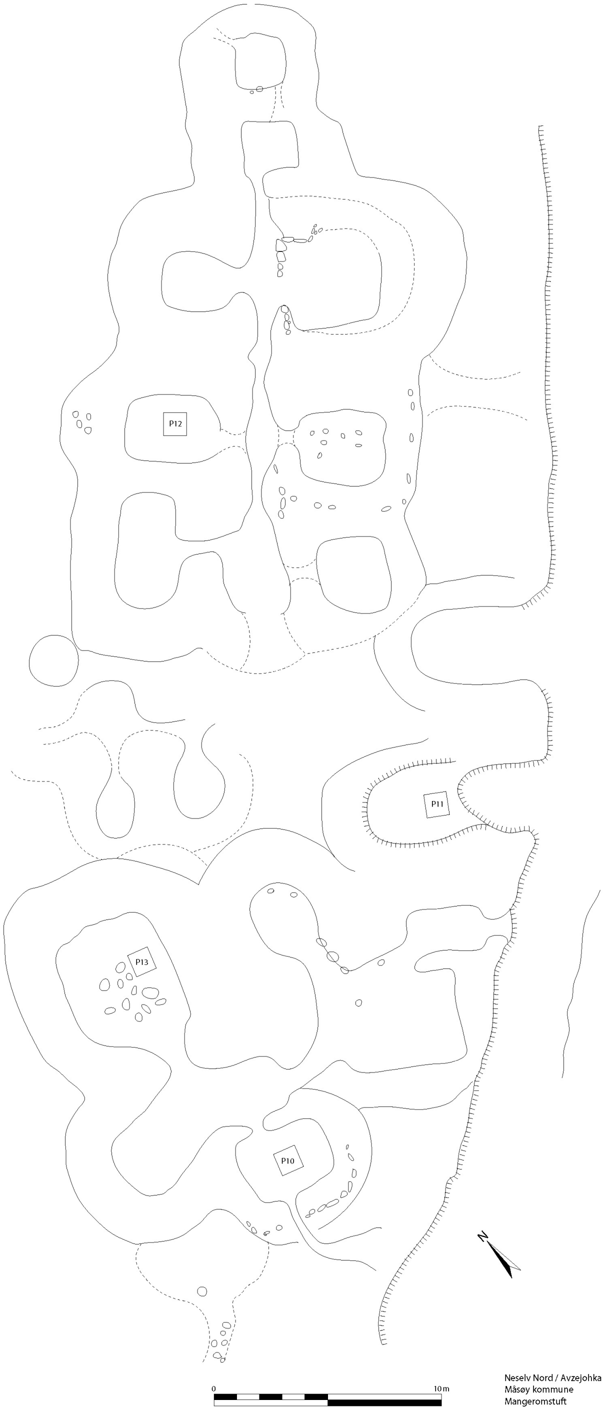


Figure 25 Værbukta

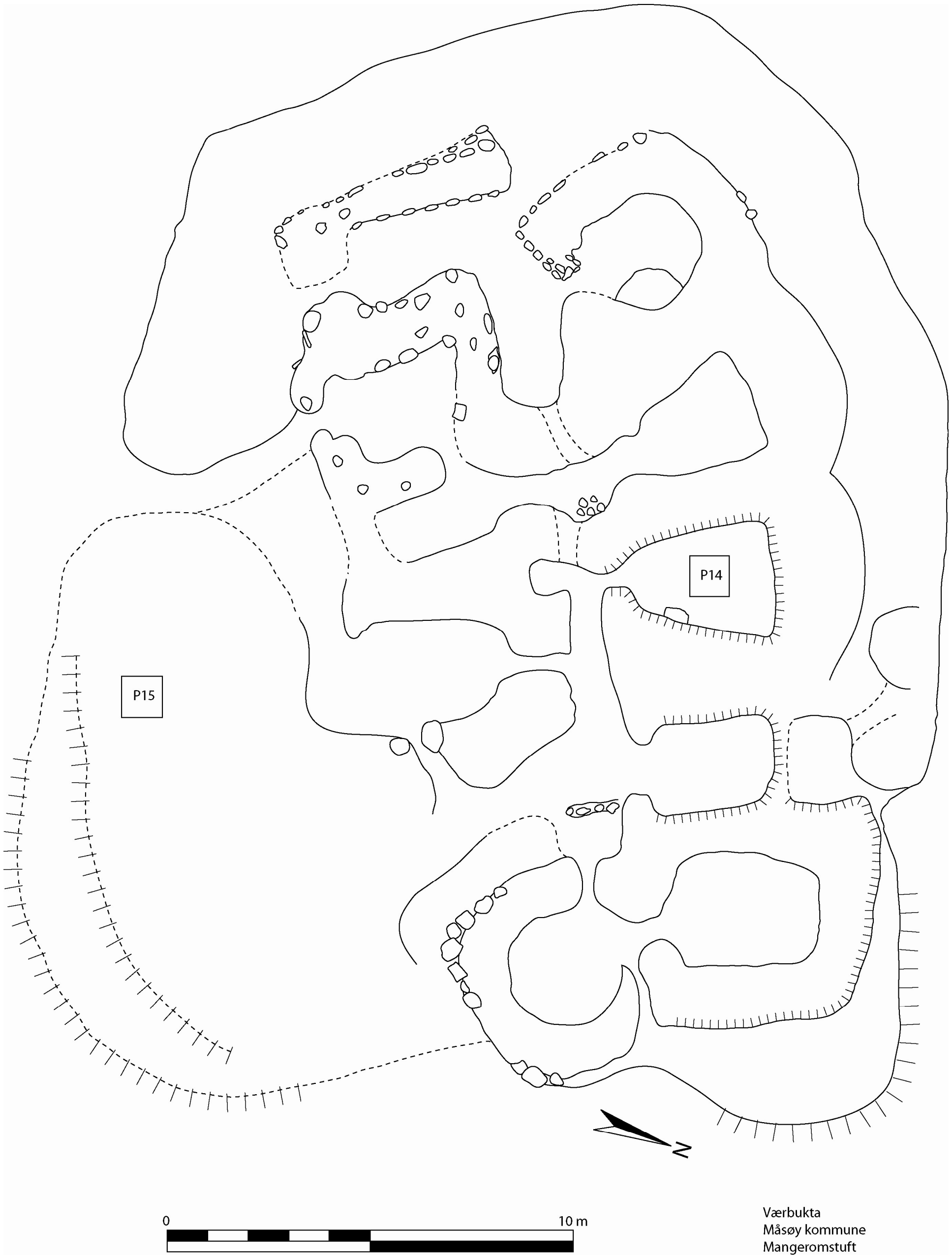


Figure 26 Skonsvika House 1.

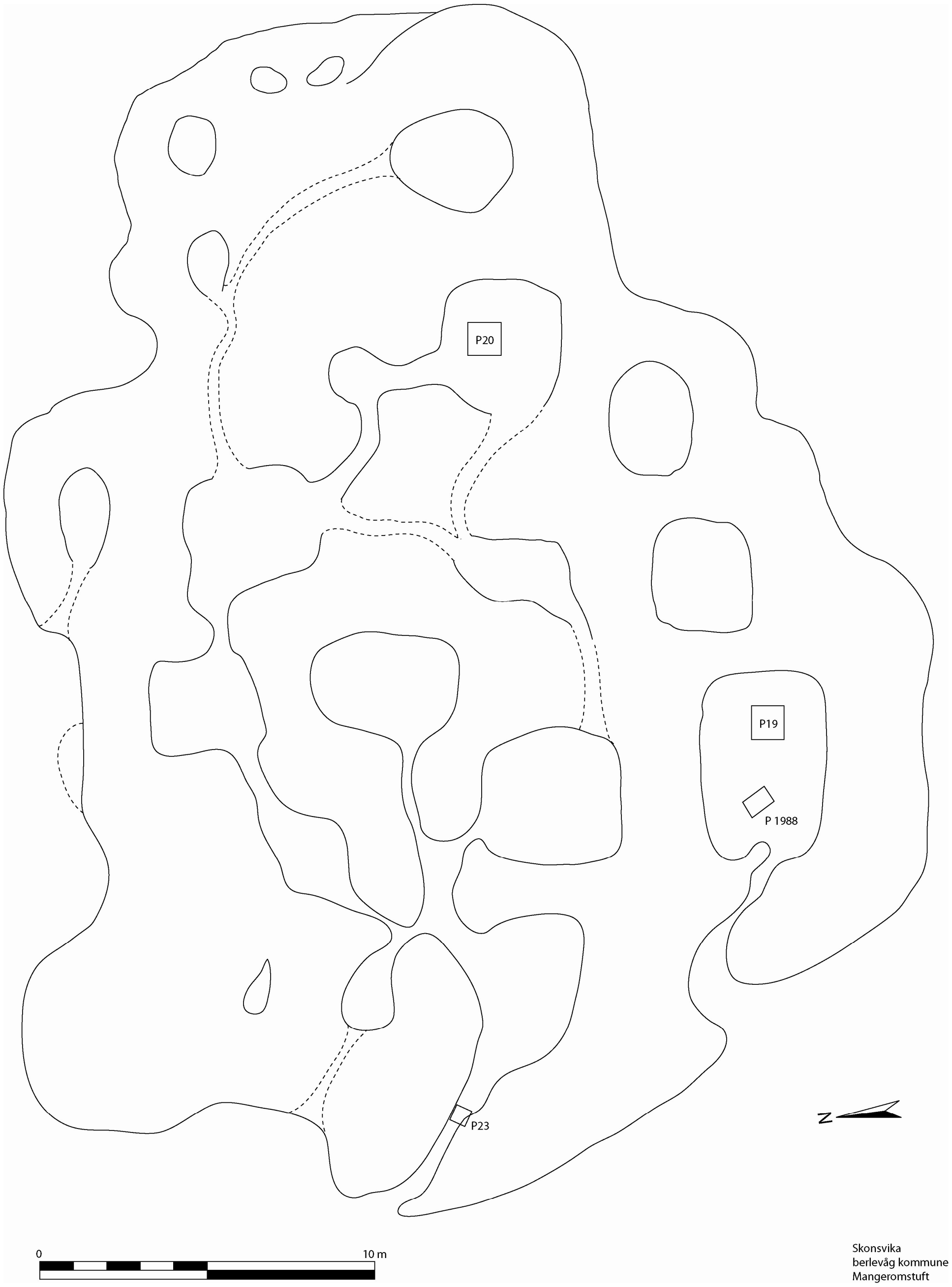


Figure 27 Skonsvika House 2.

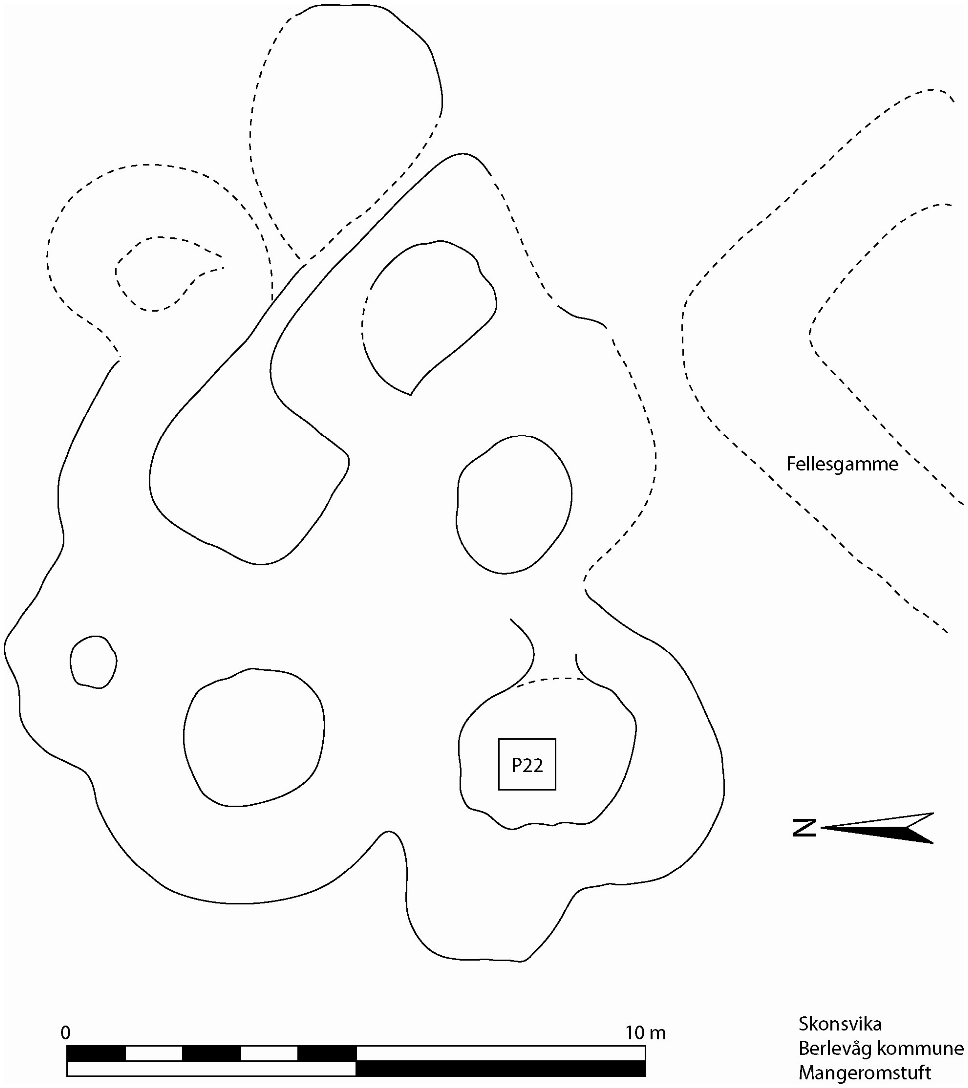


Figure 28 Kongshavn.

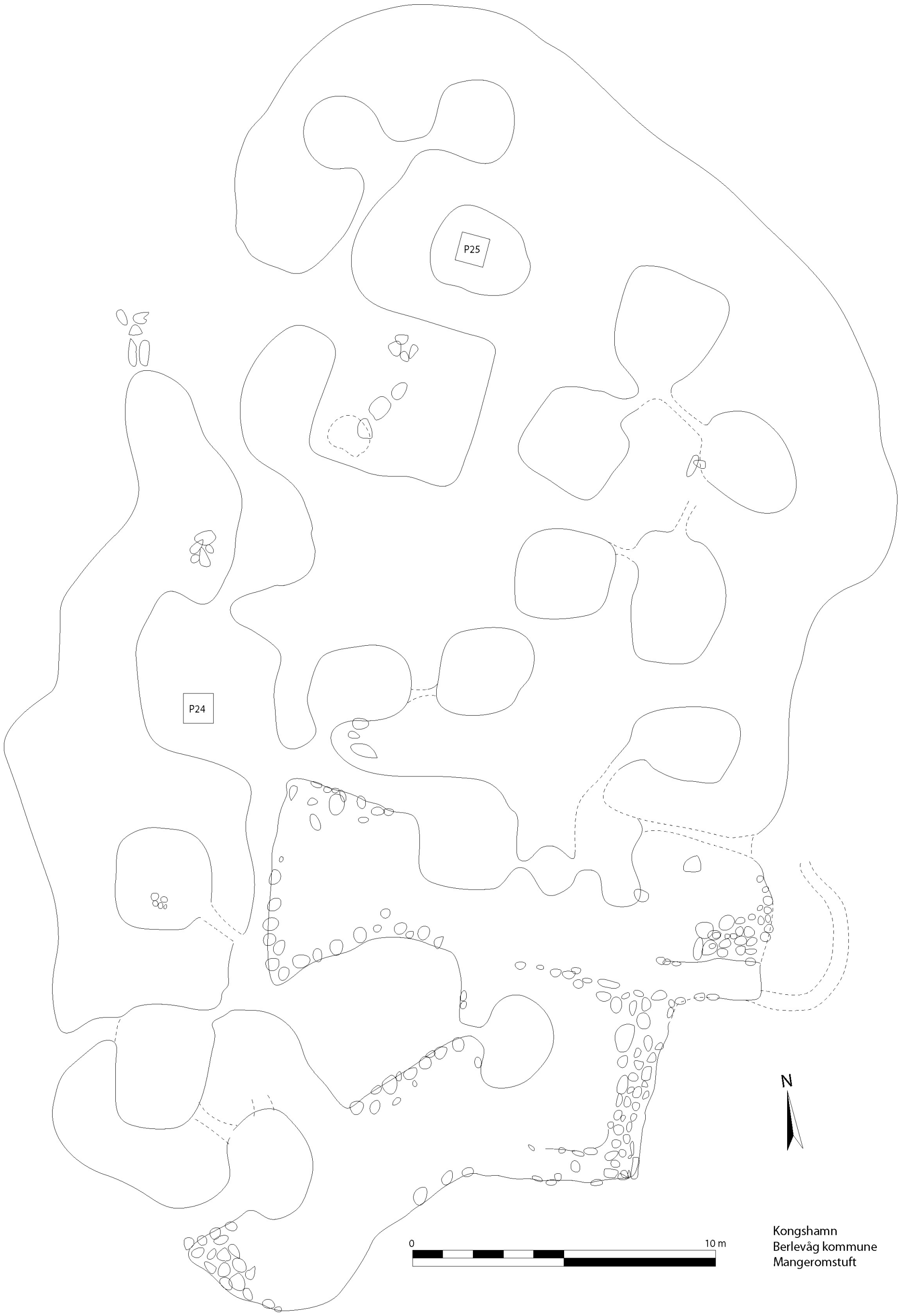


Figure 29 Kjølnes.

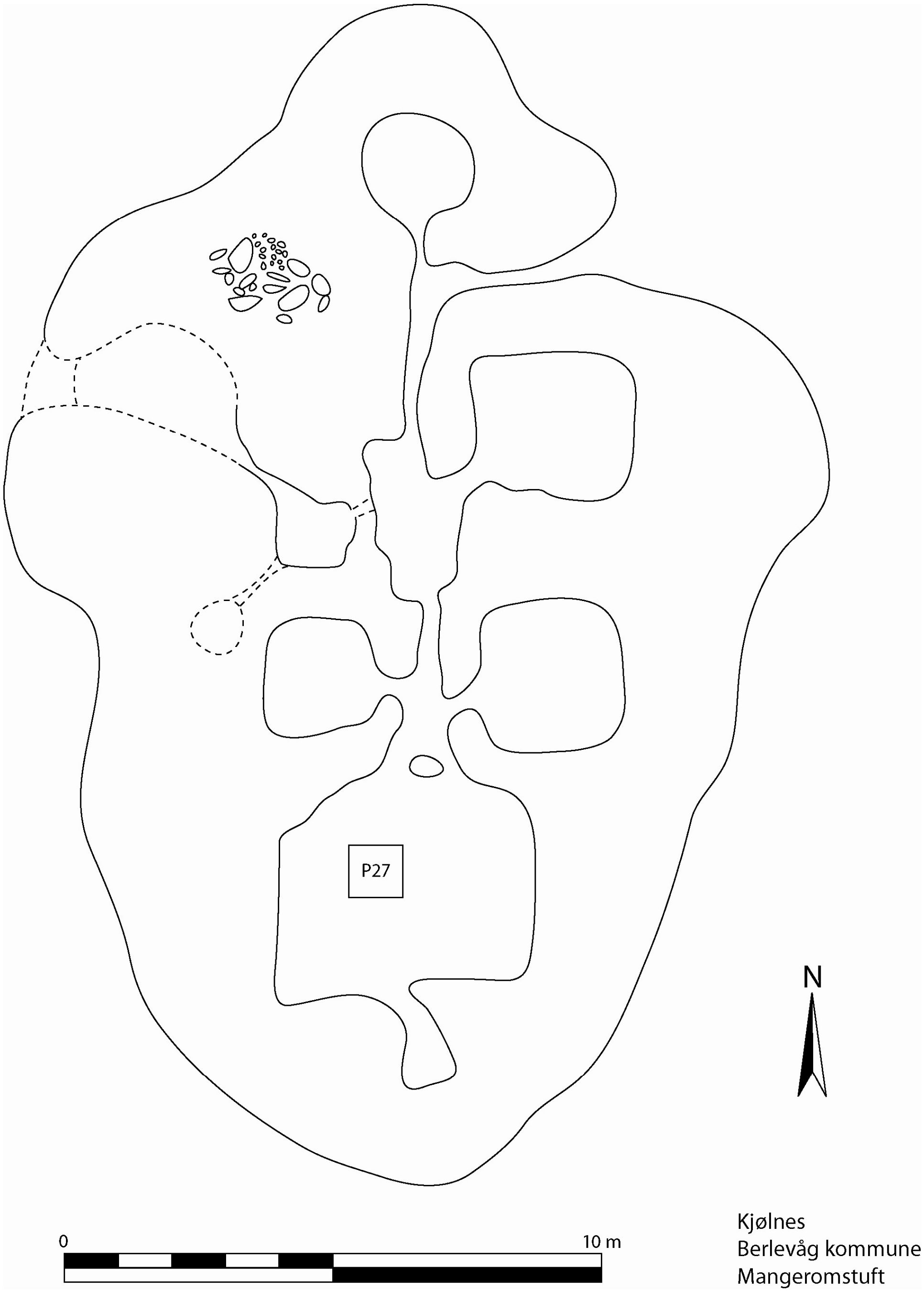


Figure 30 Laukvika.

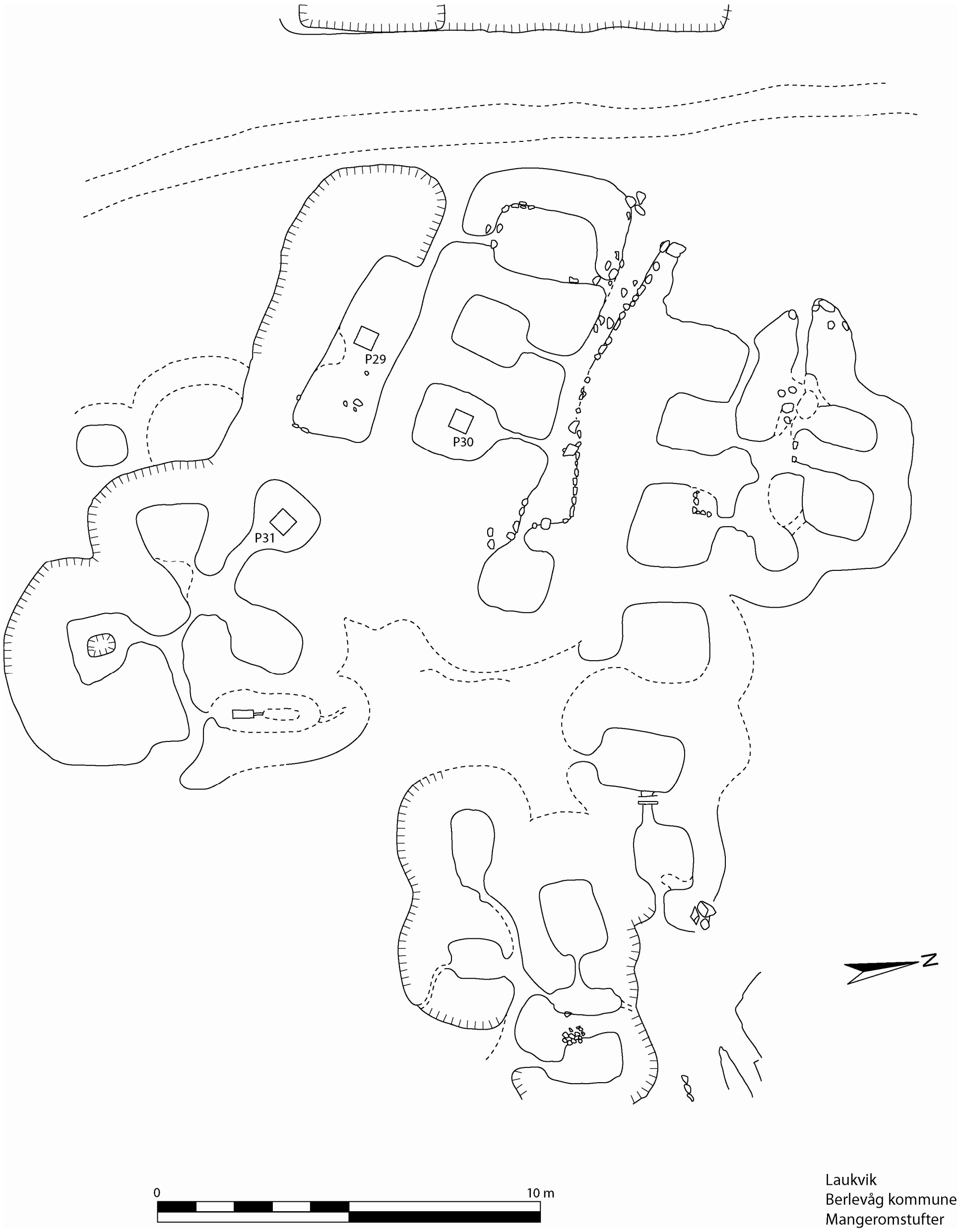


Figure 31 Nordmannsett.

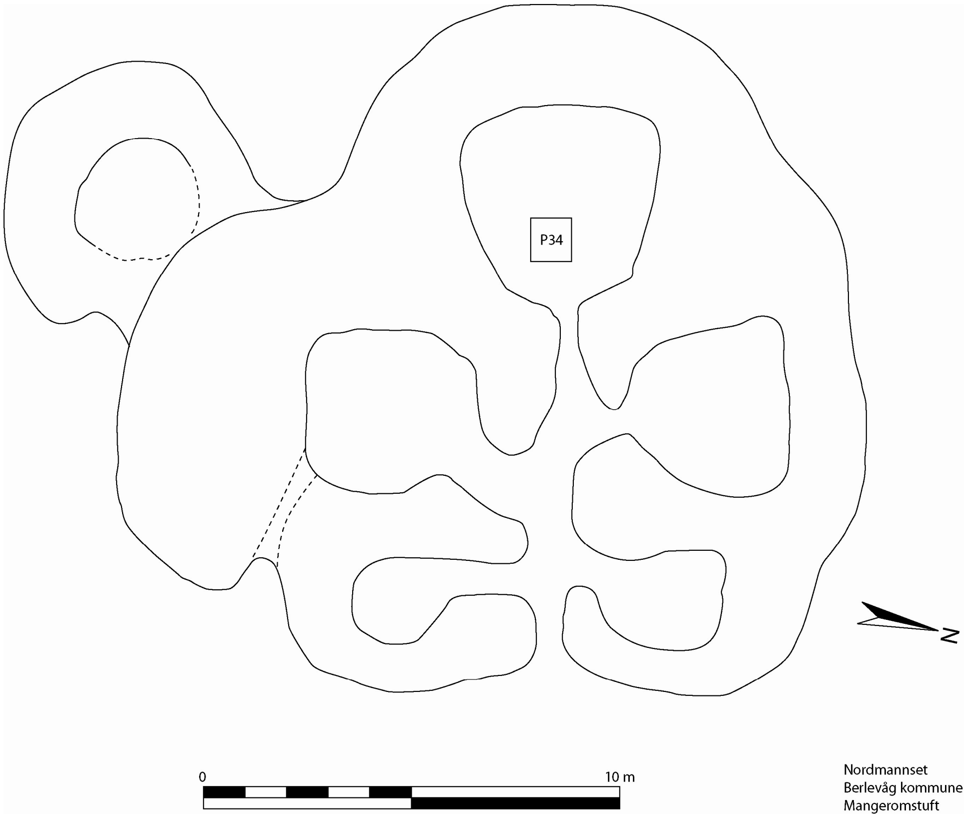


Figure 32 Vadsøya.

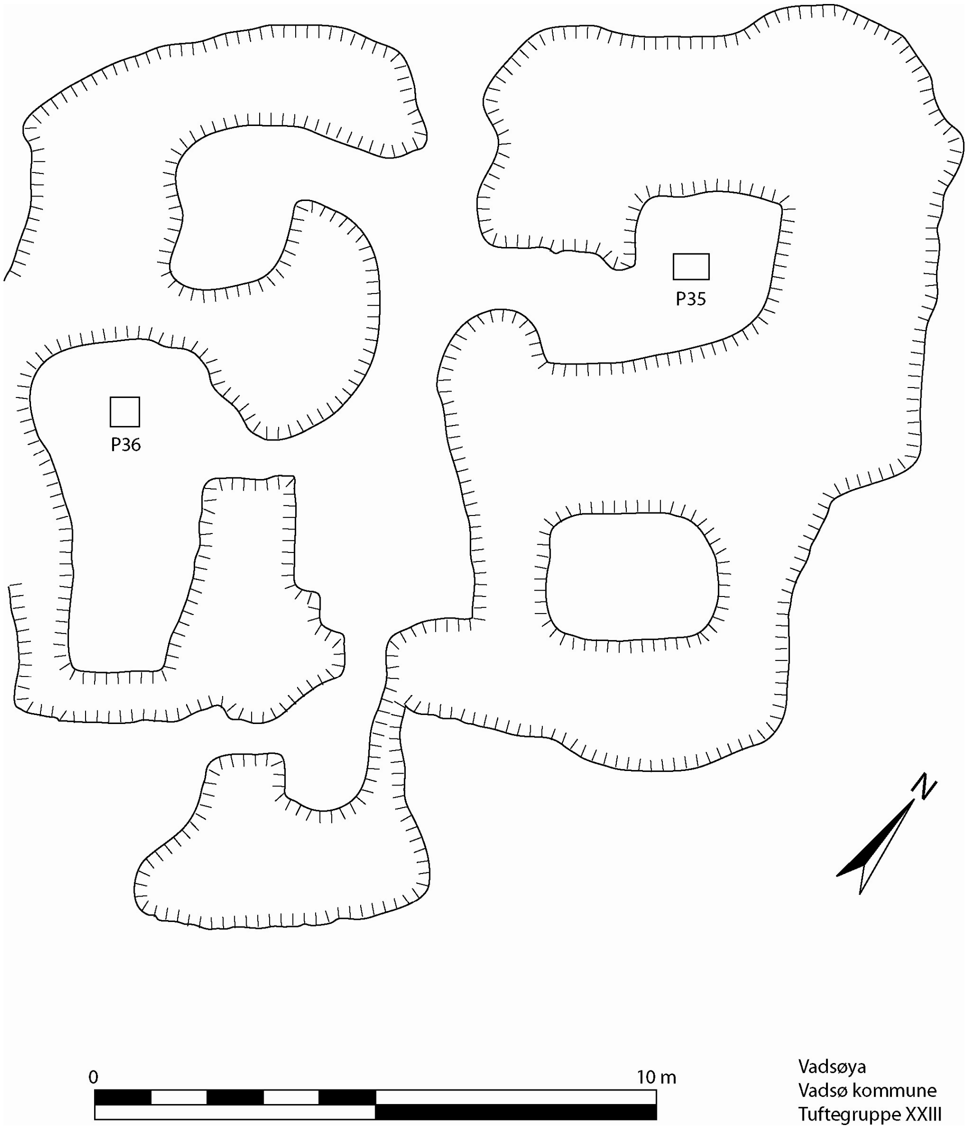


Figure 33 Kongshavn Room 1 Fish Full Elemental Distribution.

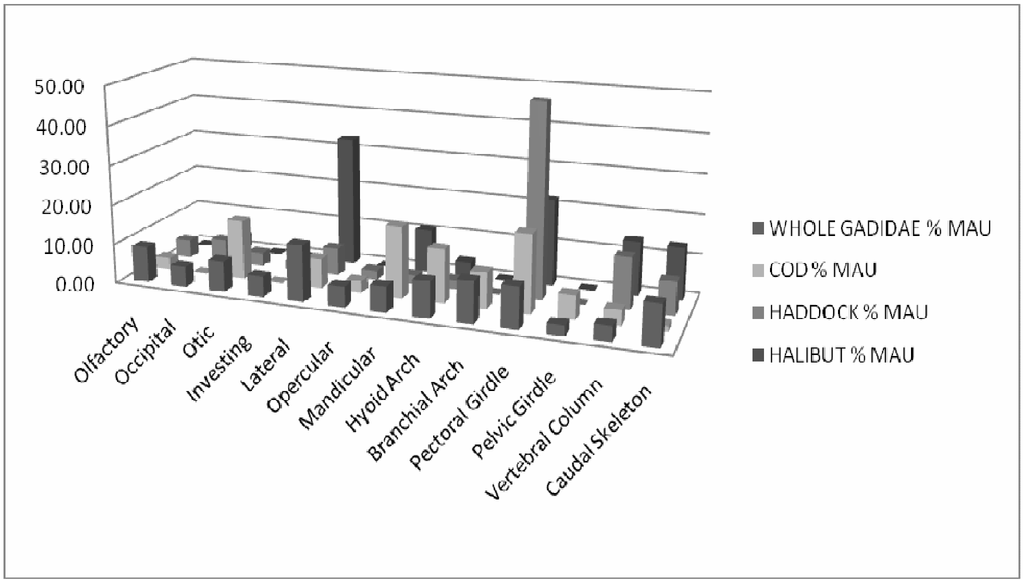


Figure 34 Kongshavn Room 1 Fish Partial Elemental Distribution.

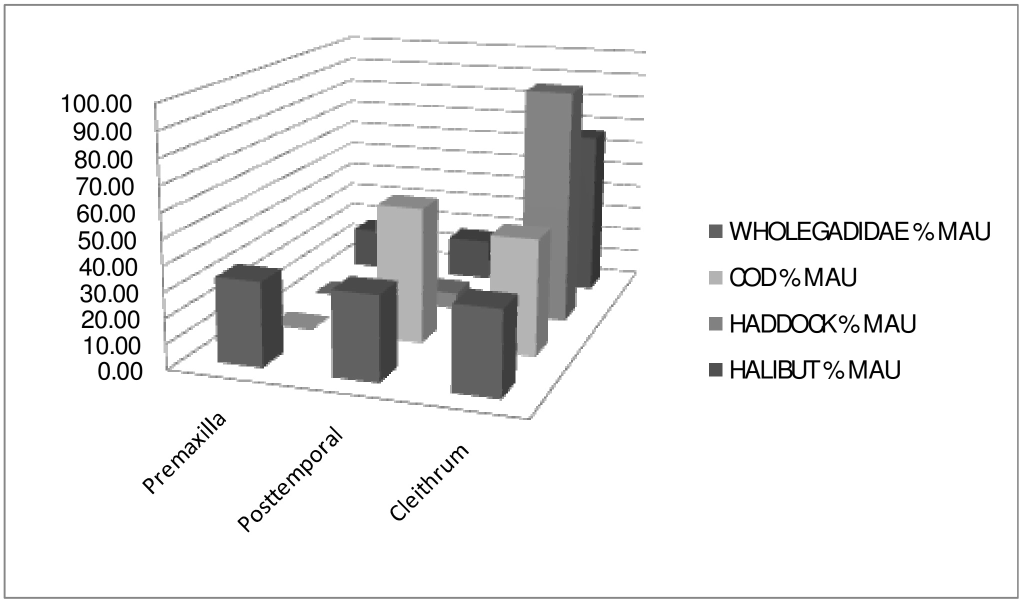


Figure 35 Kongshavn Room 1 Fish Vertebral Series.

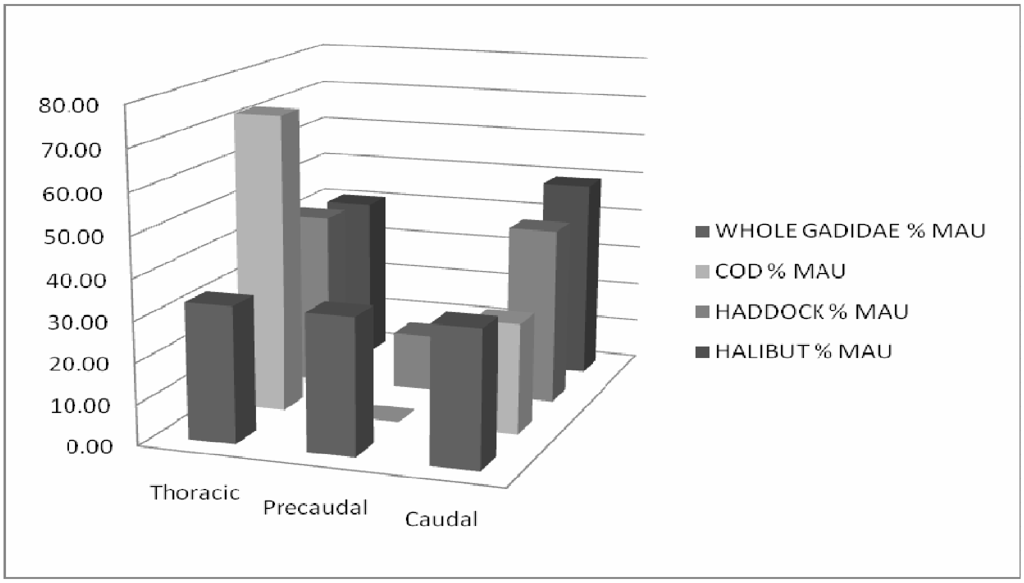


Figure 36 Kongshavn Room 2 Fish Full Elemental Distribution.

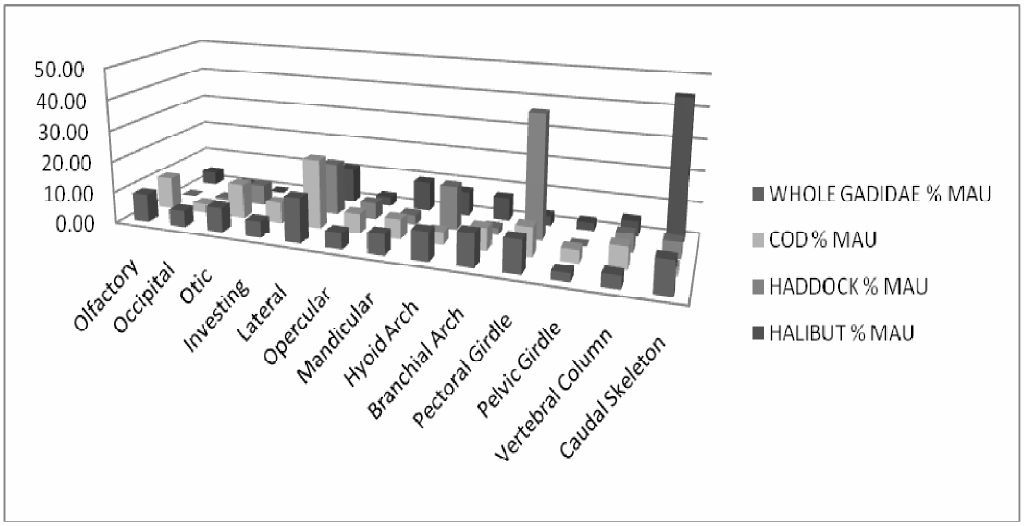


Figure 37 Kongshavn Room 2 Fish Partial Elemental Distribution.

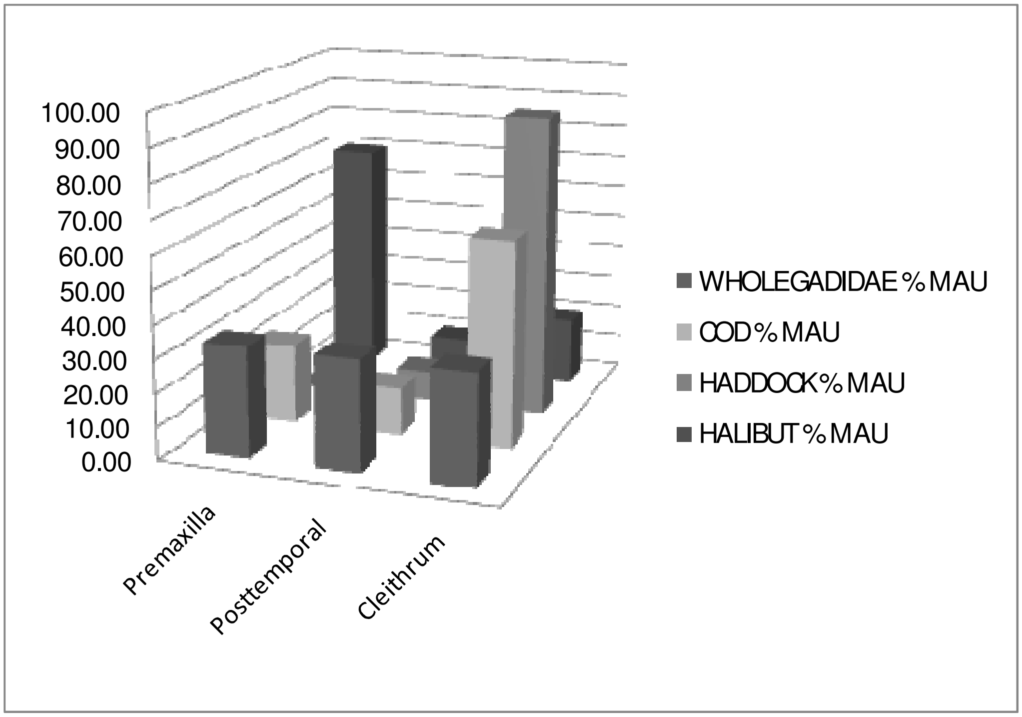


Figure 38 Kongshavn Room 2 Fish Vertebral Series.

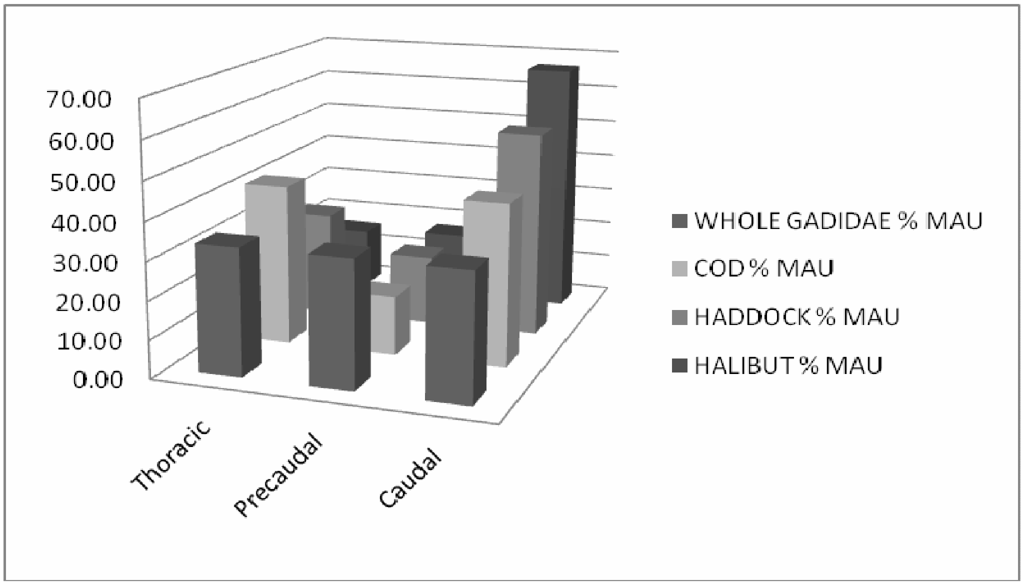


Figure 39 Kongshavn Room 3 Fish Full Elemental Distribution.

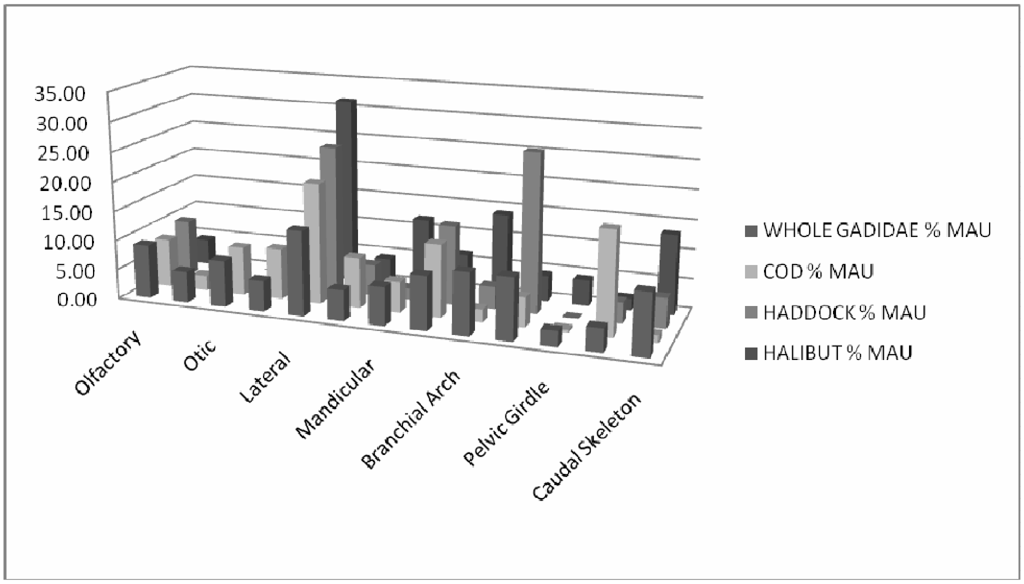


Figure 40 Kongshavn Room 3 Fish Partial Elemental Distribution.

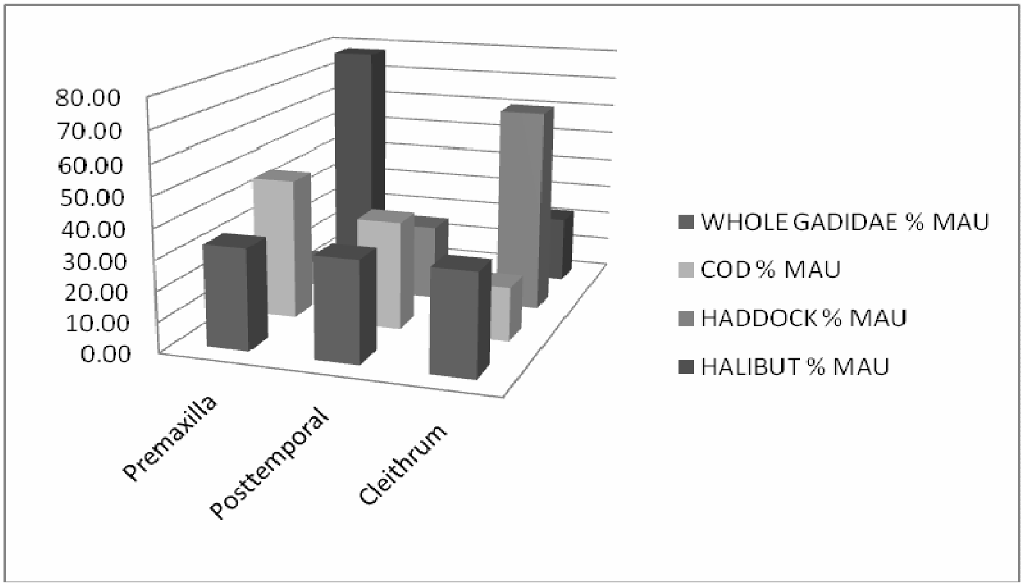


Figure 41 Kongshavn Room 3 Fish Vertebral Series.

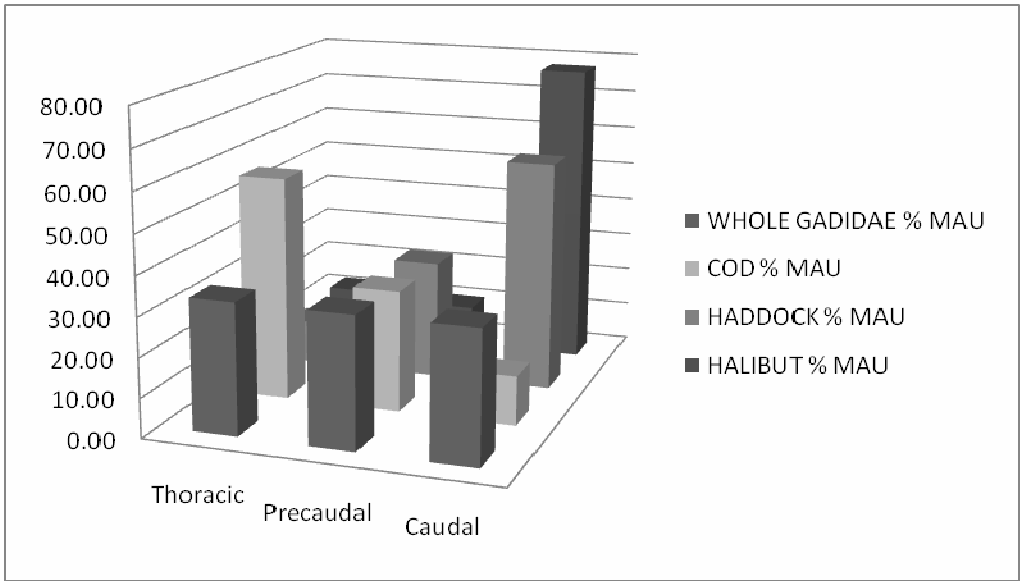


Figure 42 Kongshavn Room 4 Fish Full Elemental Distribution.

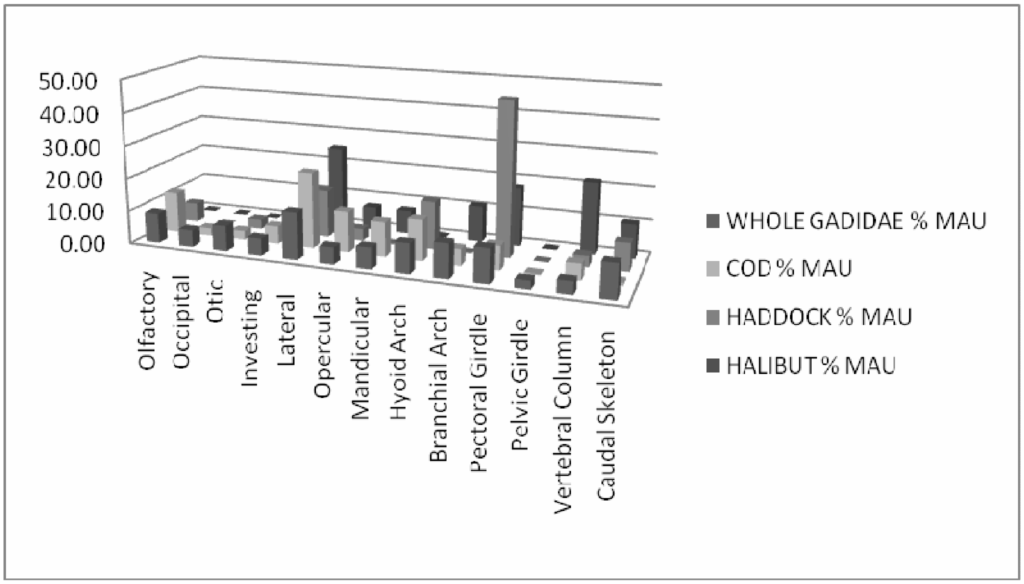


Figure 43 Kongshavn Room 4 Fish Partial Elemental Distribution.

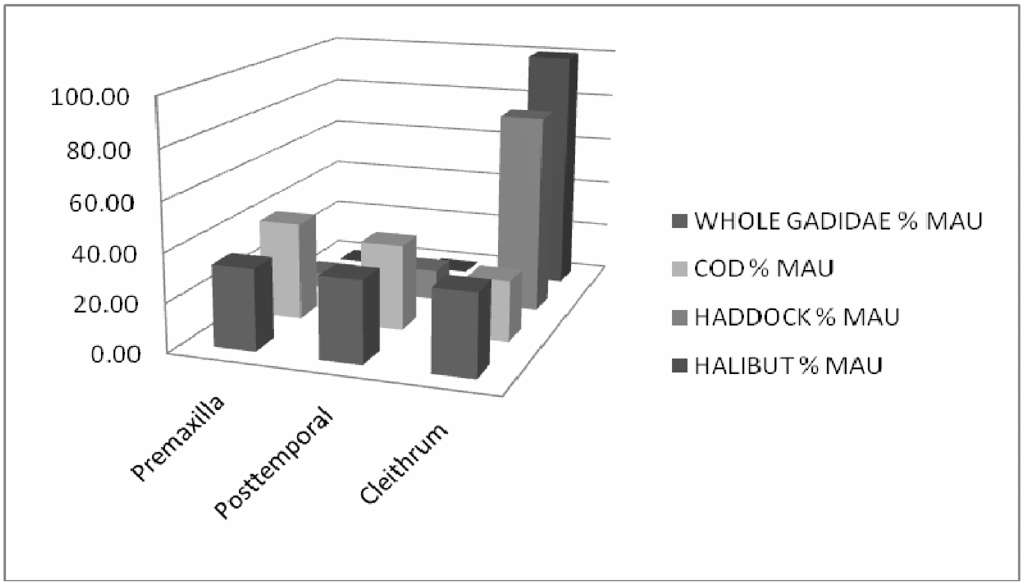


Figure 44 Kongshavn Room 4 Fish Vertebral Series.

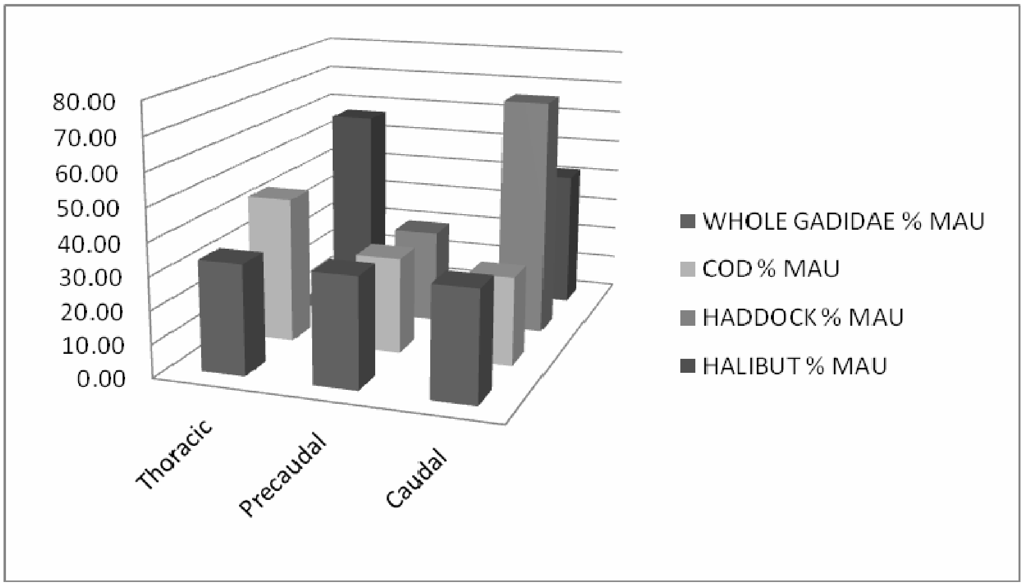


Figure 45 Kongshavn Midden A Reindeer Element Frequncy vs. Food Utility Index.

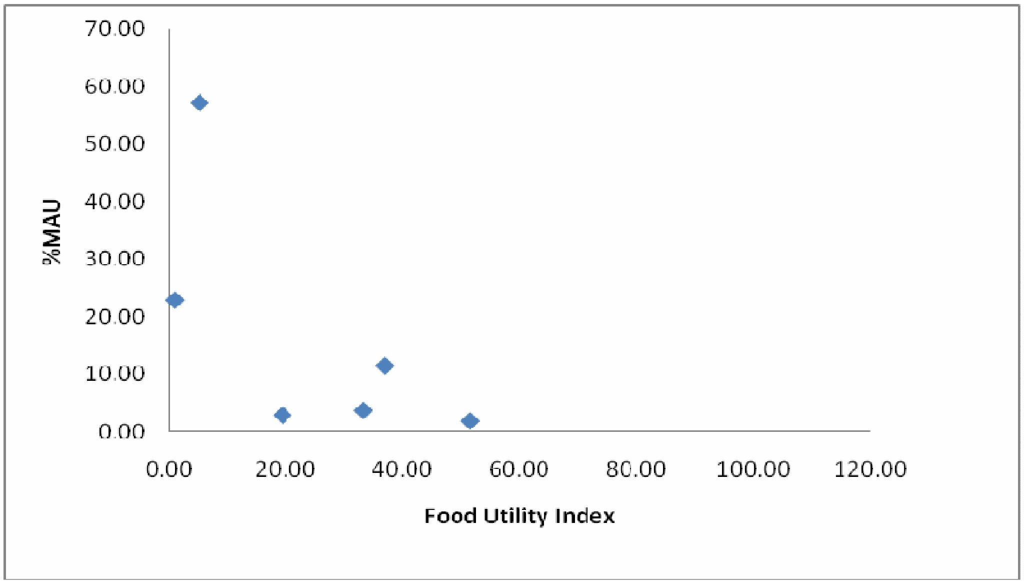


Figure 46 Kongshavn Midden A Reindeer Element Frequency vs. Bone Density.

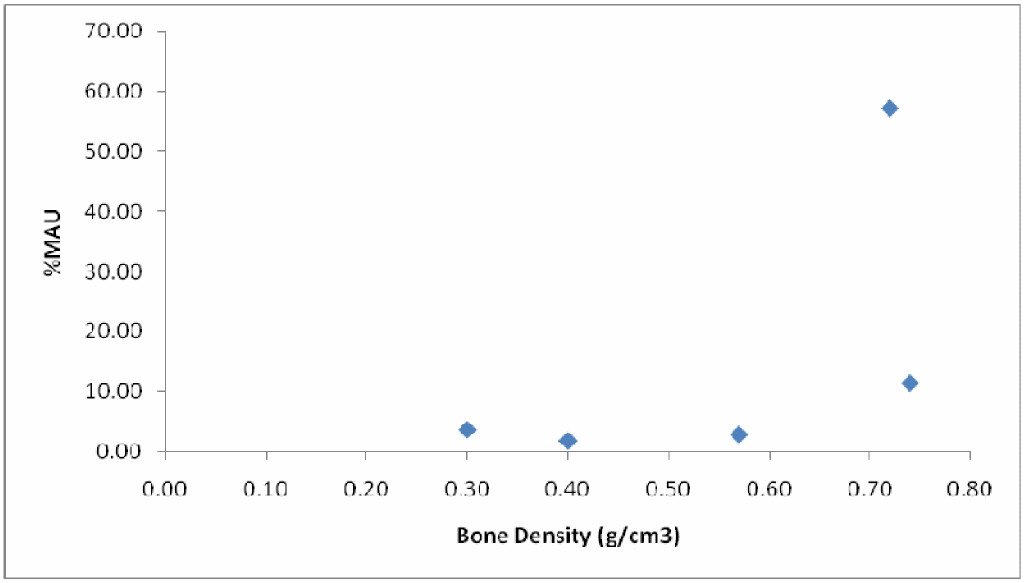


Figure 47 Kongshavn Midden A Fish Full Elemental Distribution.

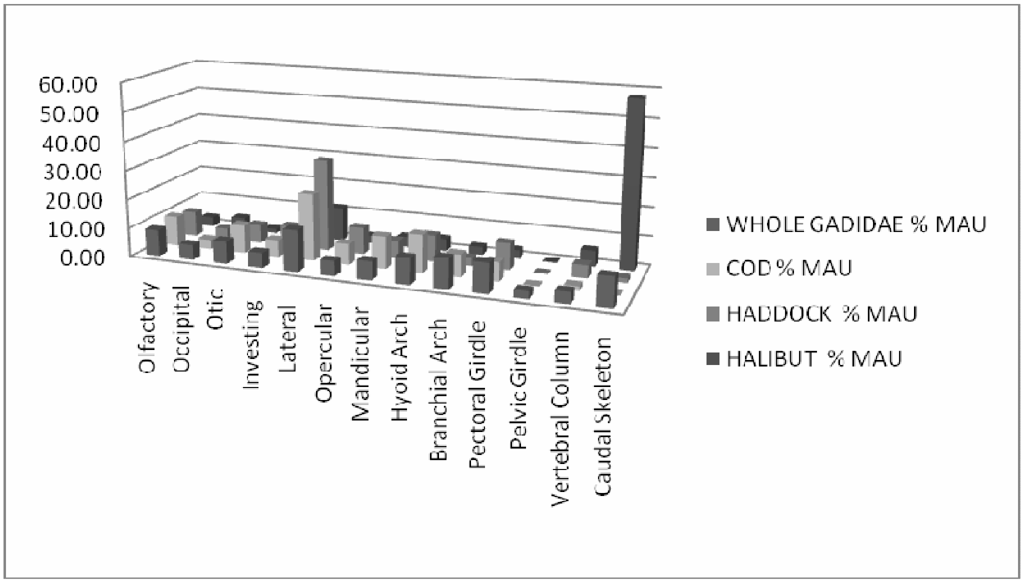


Figure 48 Kongshavn Midden A Fish Partial Elemental Distribution.

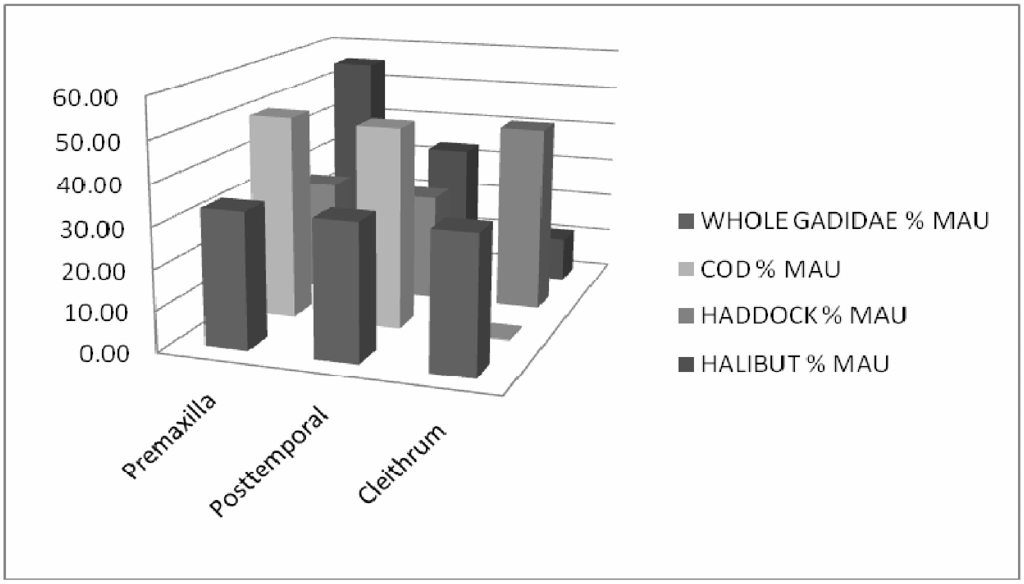


Figure 49 Kongshavn Midden A Fish Vertbral Series.

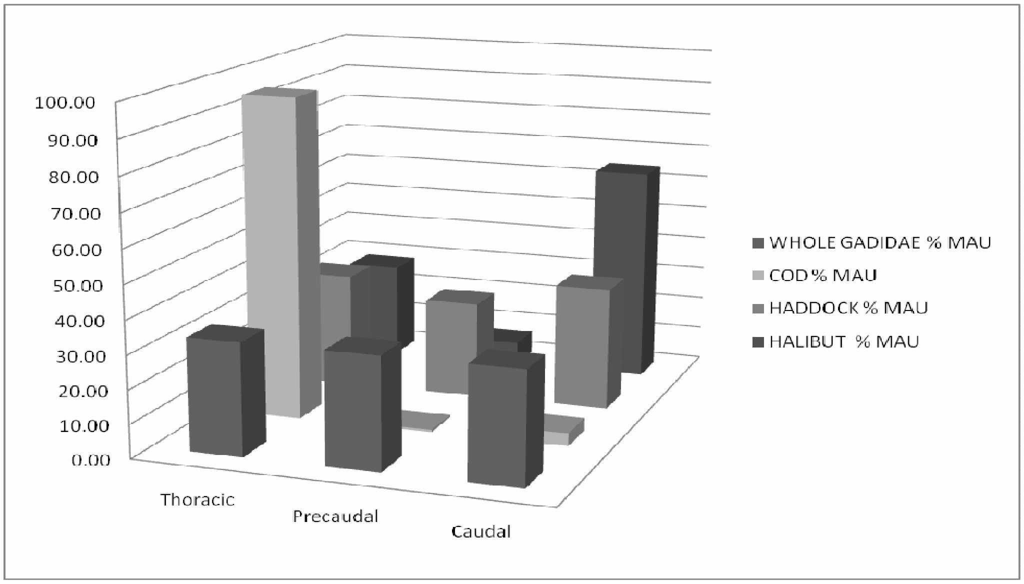


Figure 50 Kongshavn Midden A Cod Total Length Distribution.

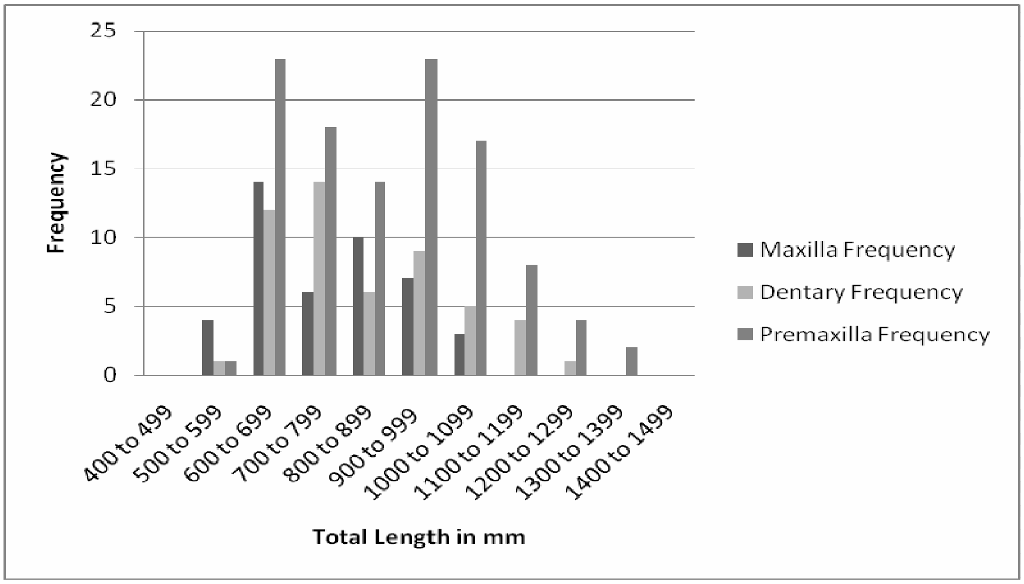


Figure 51 Kongshavn Midden B Reindeer Element Frequncy vs. Food Utility Index.

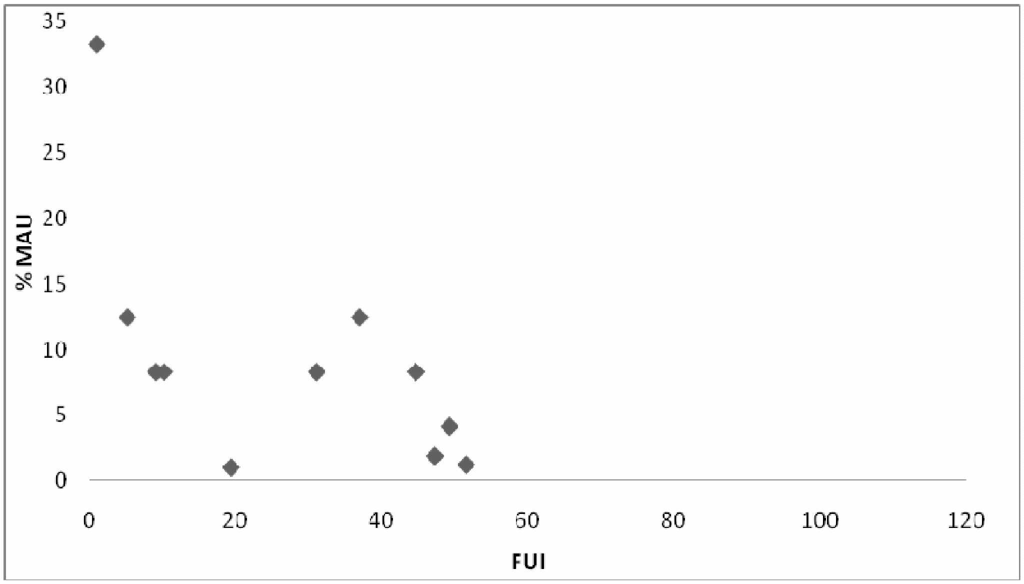


Figure 52 Kongshavn Midden B Reindeer Element Frequncy vs. Bone Density.

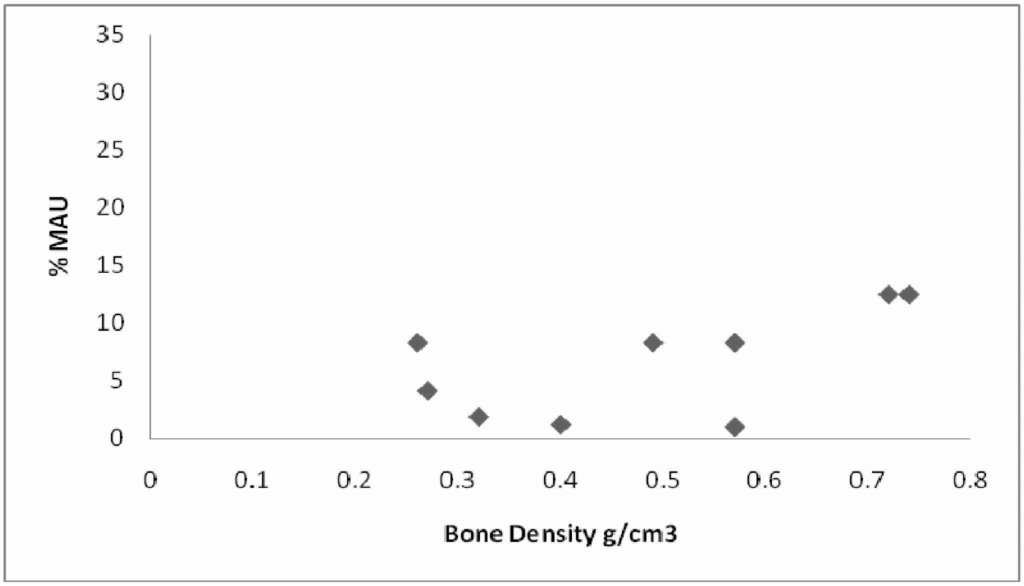


Figure 53 Kongshavn Midden B Fish Full Elemental Distribution.

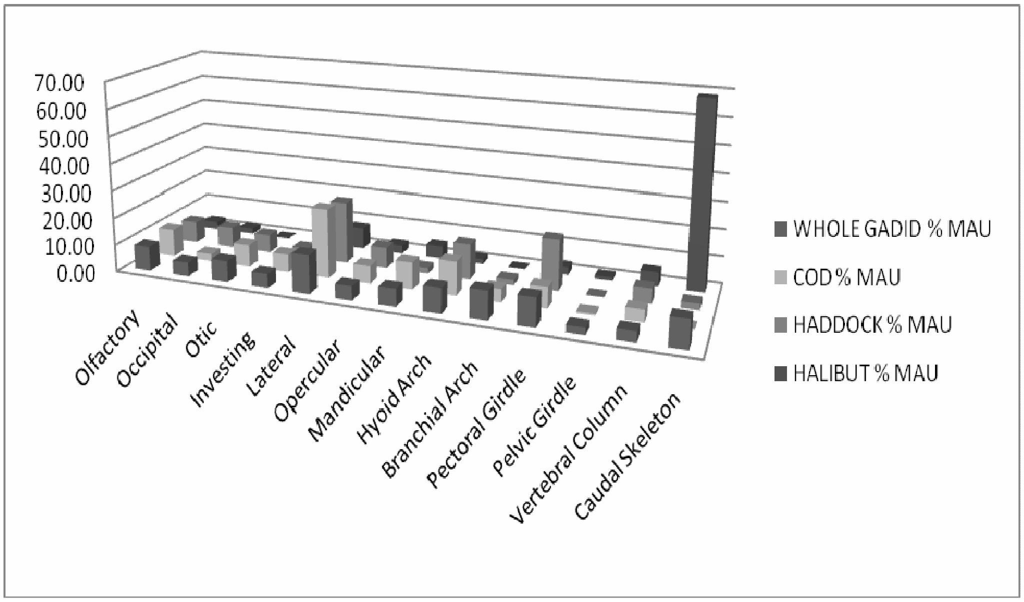


Figure 54 Kongshavn Midden B Partial Elemental Distribution.

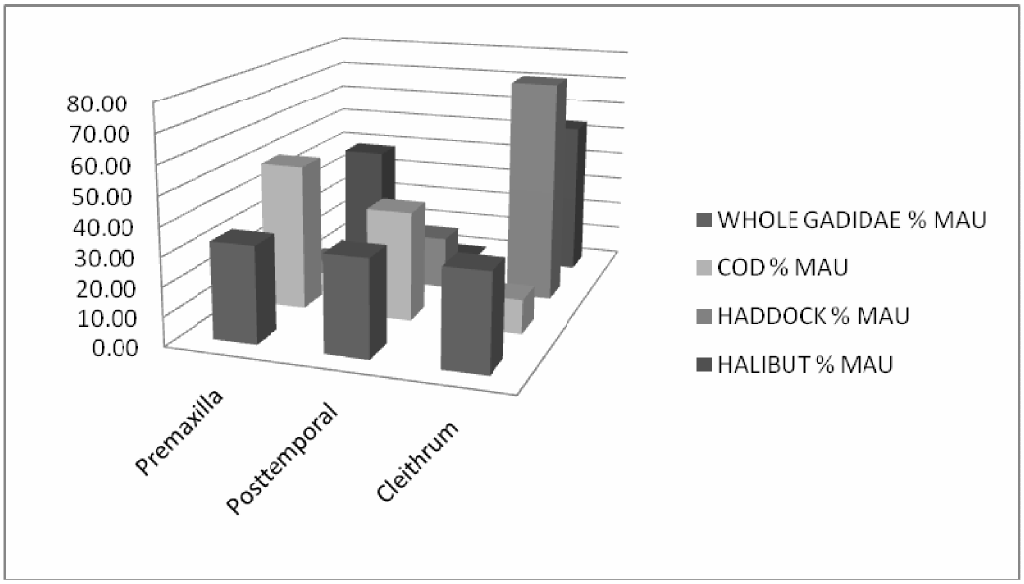


Figure 55 Kongshavn Midden B Fish Vertebral Series.

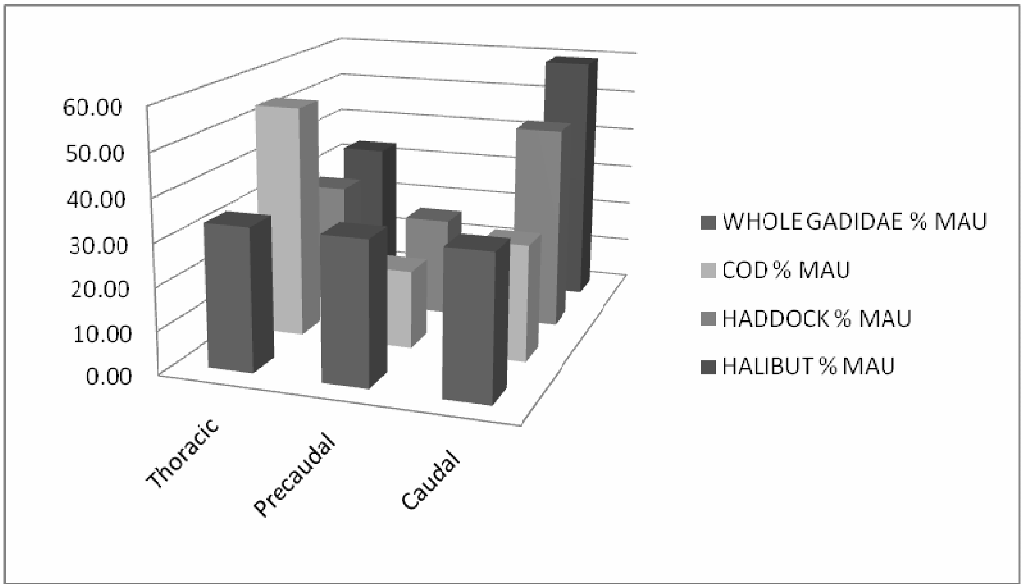


Figure 56 Kongshavn Midden B Cod Total Length Distribution.

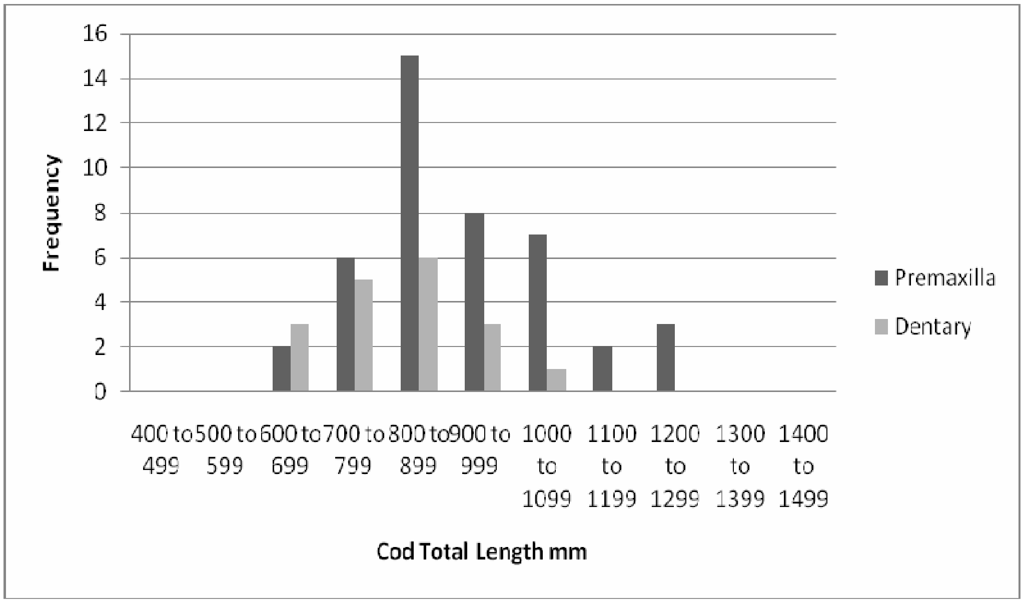


Figure 57 Kongshavn Exterior Midden Pig Element Frequency vs. MGUI.

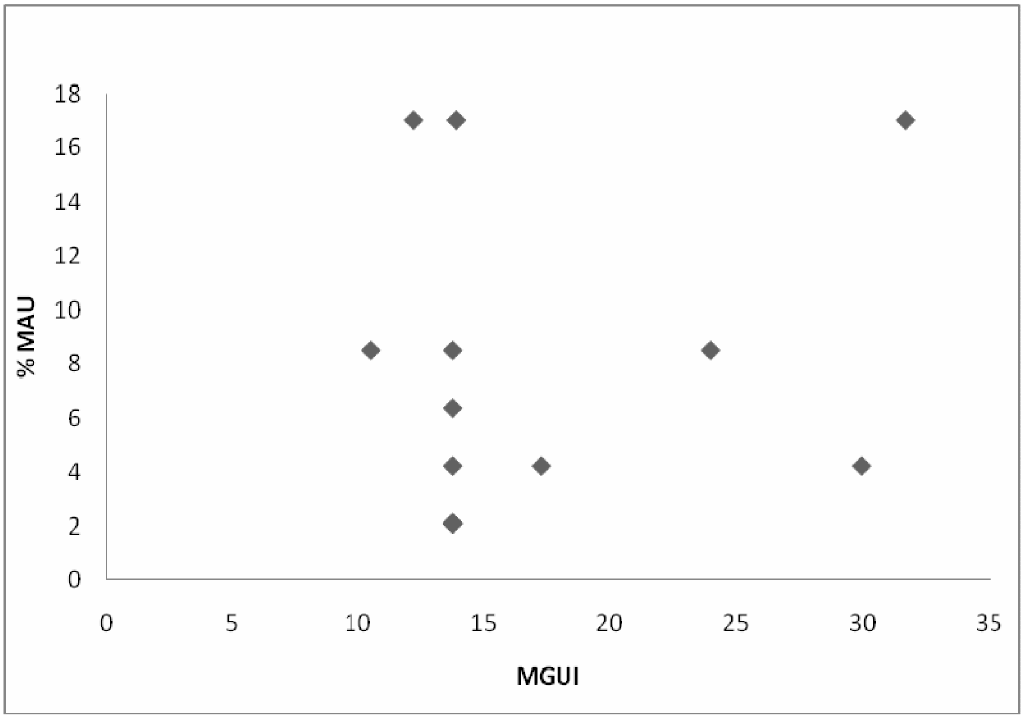


Figure 58 Kongshavn Exterior Midden Pig Element Frequency vs. Bone Density.

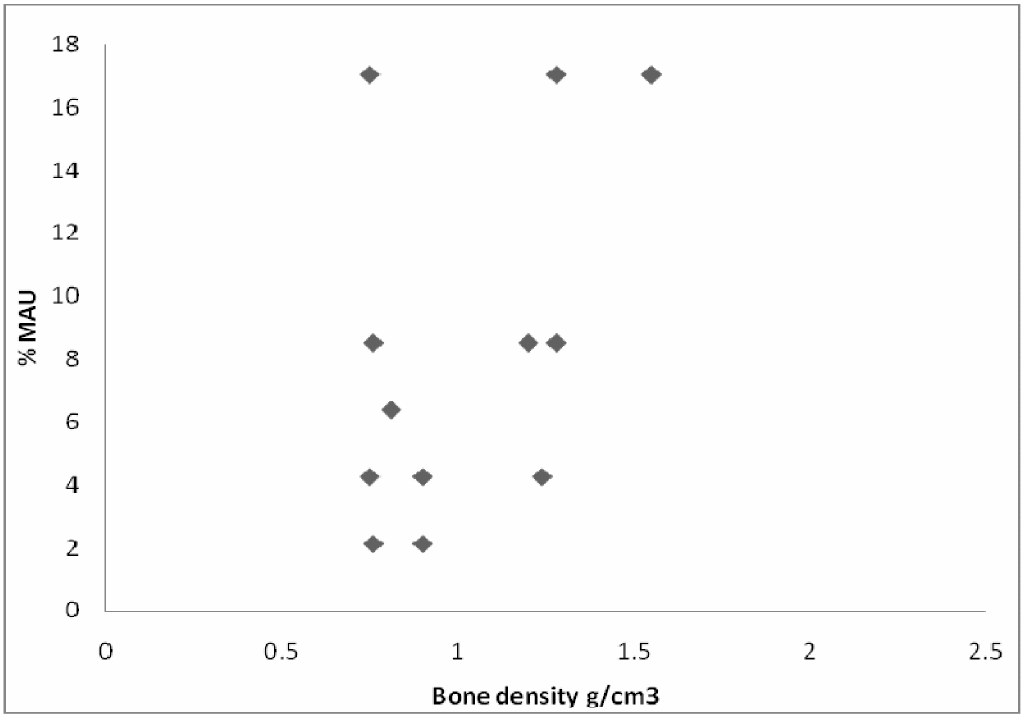


Figure 59 Kongshavn Exterior Midden Fish Full Element Distribution.

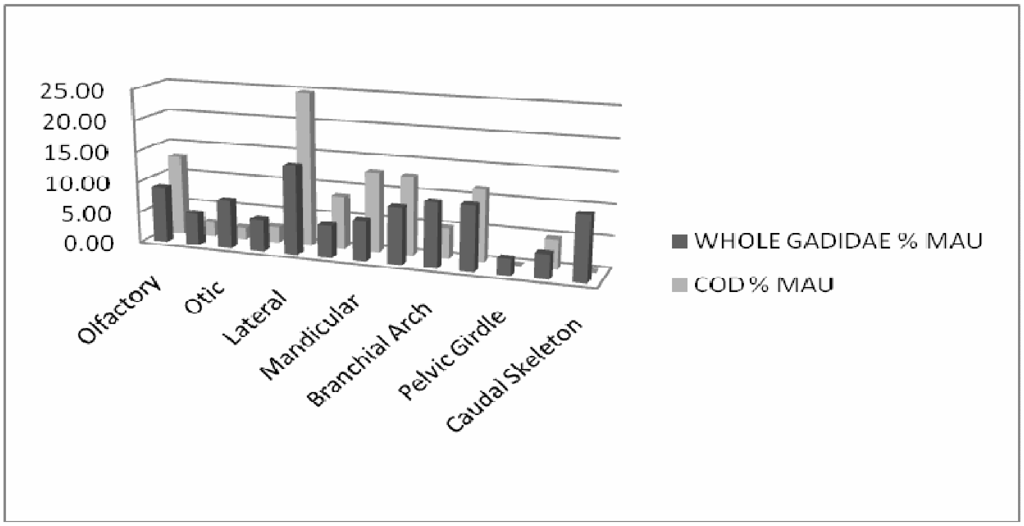


Figure 60 Kongshavn Exterior Midden Fish Partial Element Distribution.

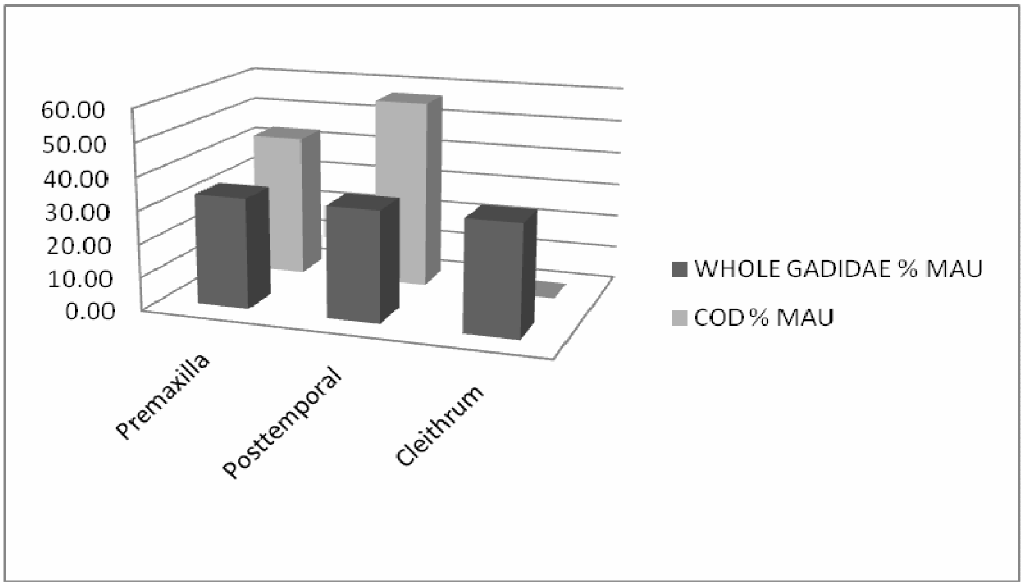


Figure 61 Kongshavn Exterior Midden Fish Vertebral Series.

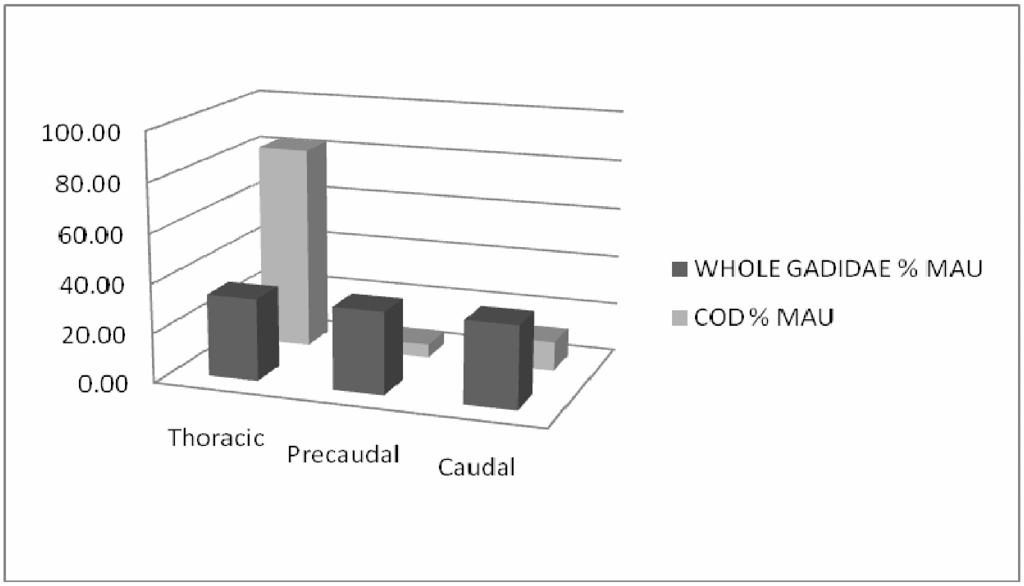


Figure 62 Kongshavn Exterior Midden Cod Total Length Distribution.

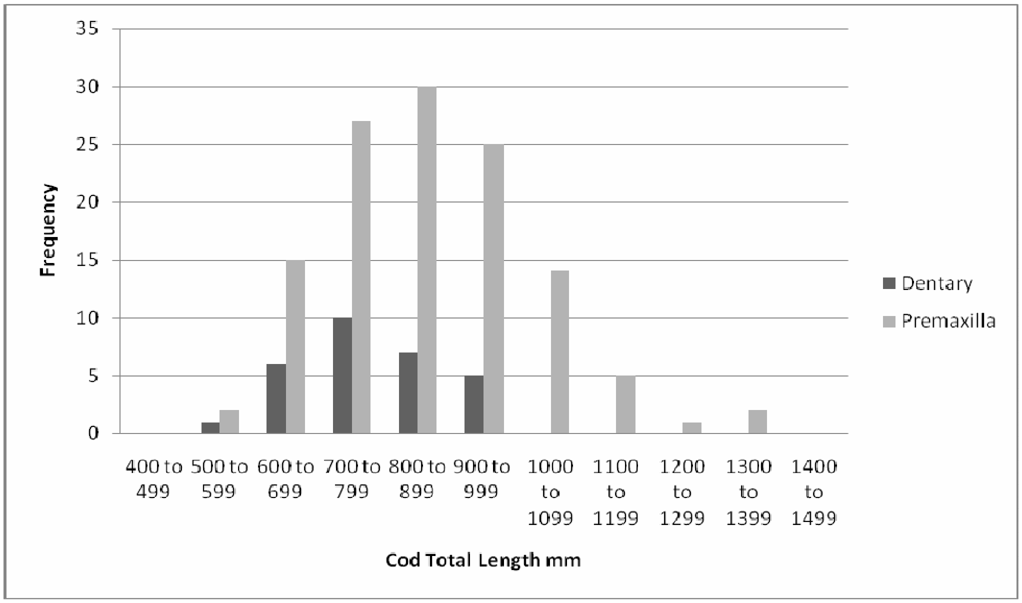


Figure 63 Skonsvika SU 12 Reindeer Element Frequncy vs. Food Utility Index.

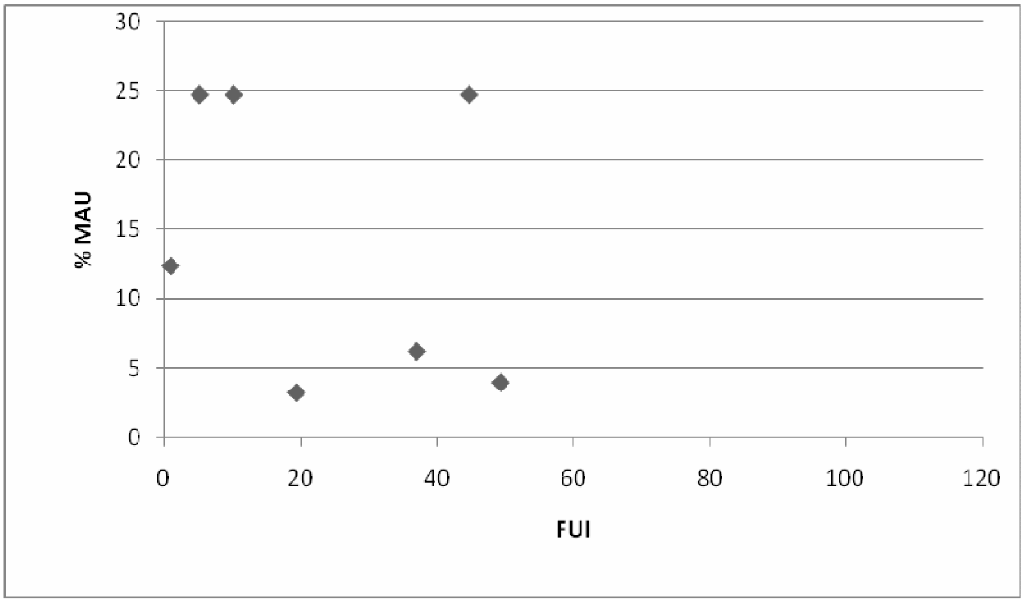


Figure 64 Skonsvika SU 12 Reindeer Element Frequncy vs. Bone Density.

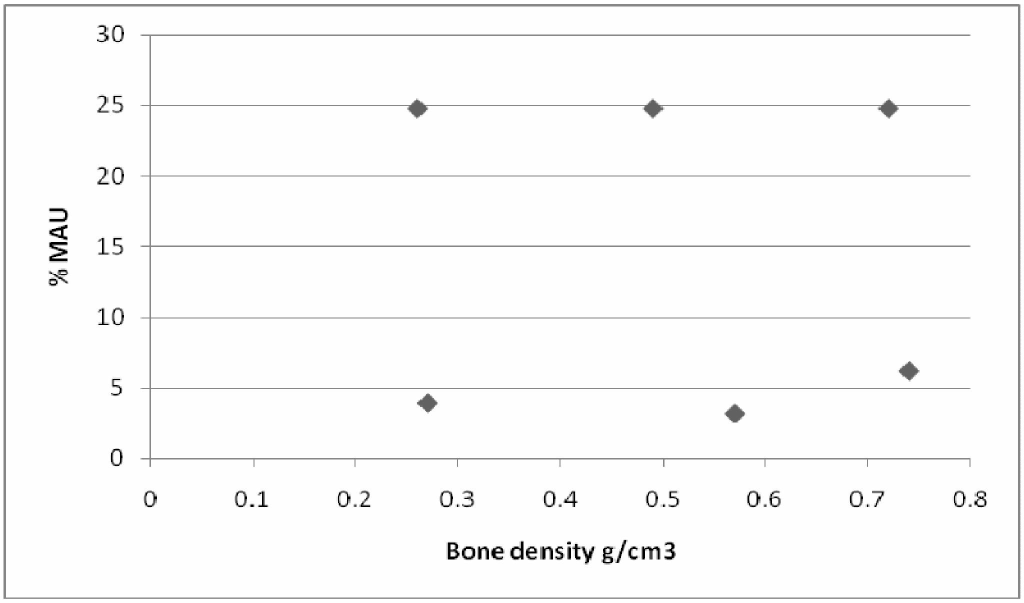


Figure 65 Skonsvika SU 12 Fish Full Elemental Distribution.

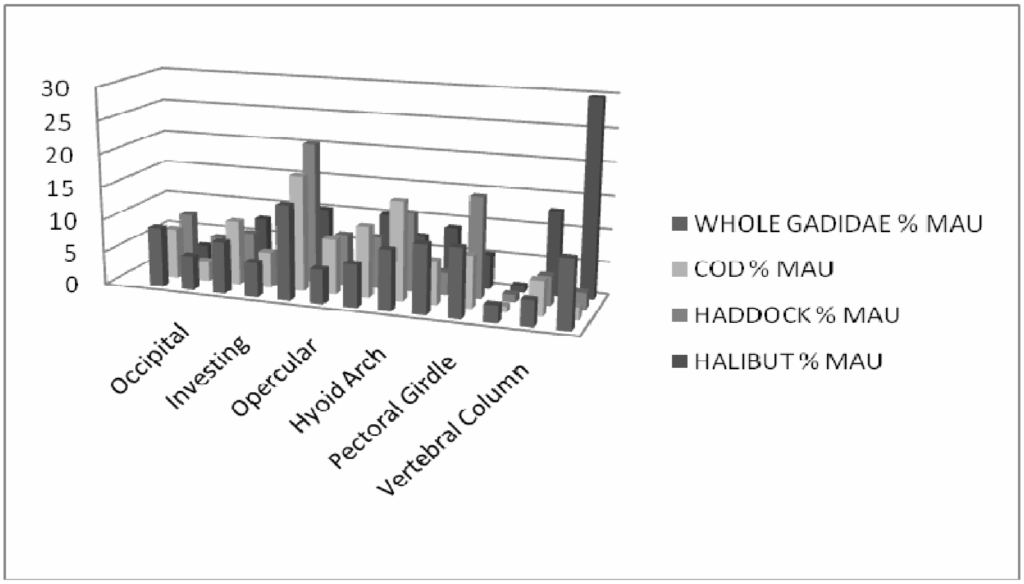


Figure 66 Skonsvika SU 12 Fish Partial Elemental Distribution.

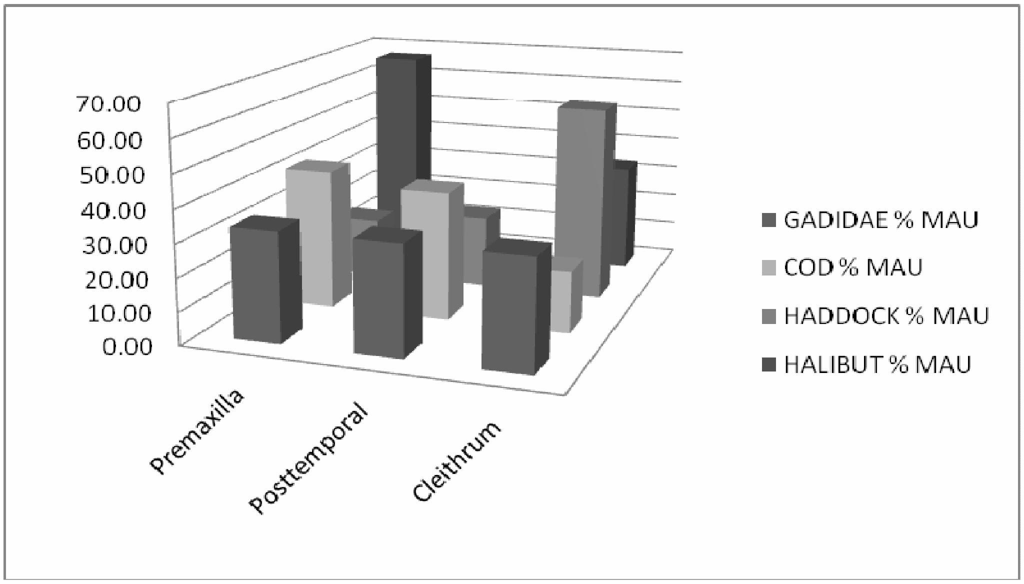


Figure 67 Skonsvika SU 12 Fish Vertebral Series.

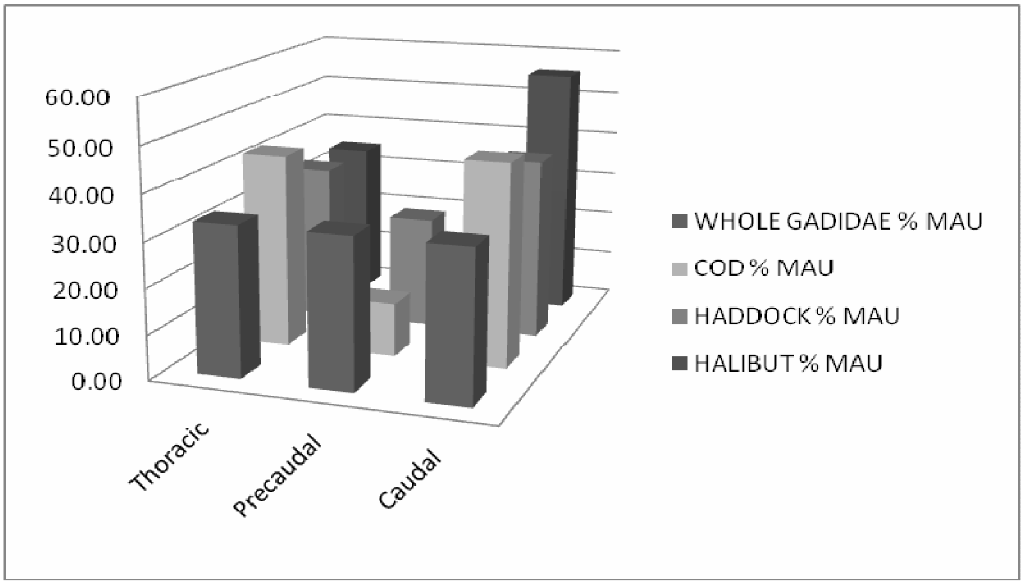


Figure 68 Skonsvika SU 14 Reindeer Element Frequncy vs. Food Utility Index.

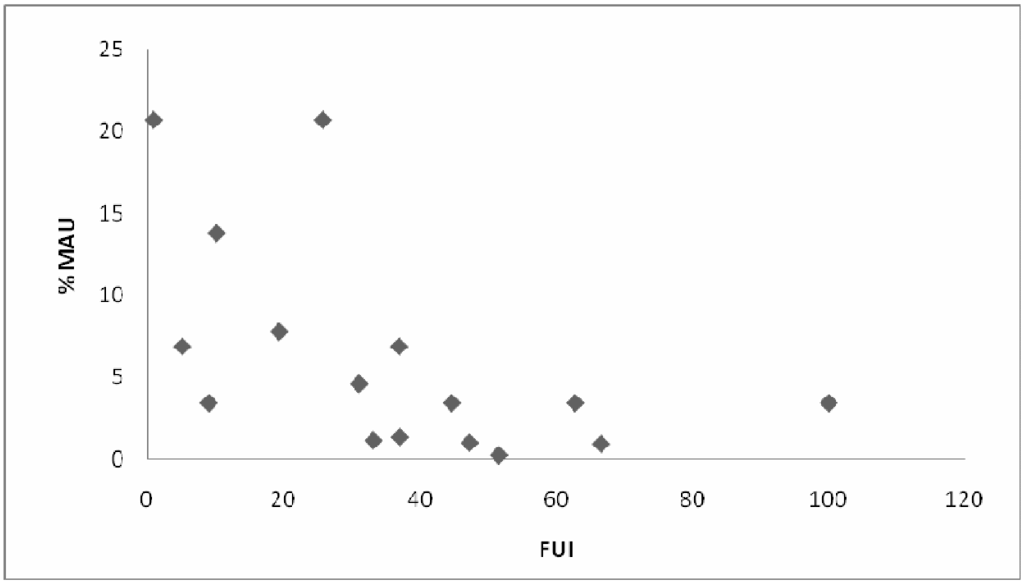


Figure 69 Skonsvika SU 14 Reindeer Element Frequncy vs. Bone Density.

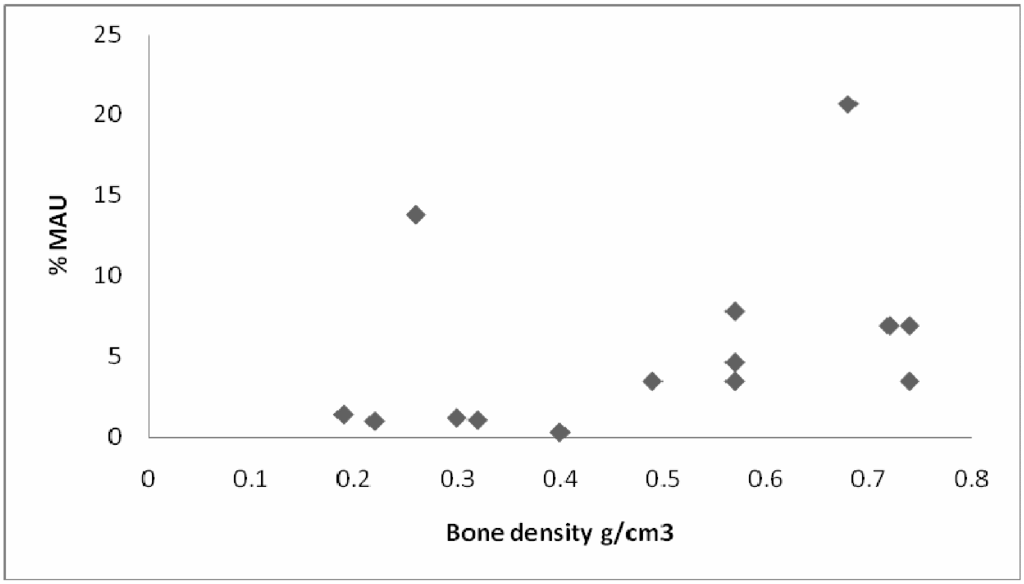


Figure 70 Skonsvika SU 14 Fish Full Element Distribution.

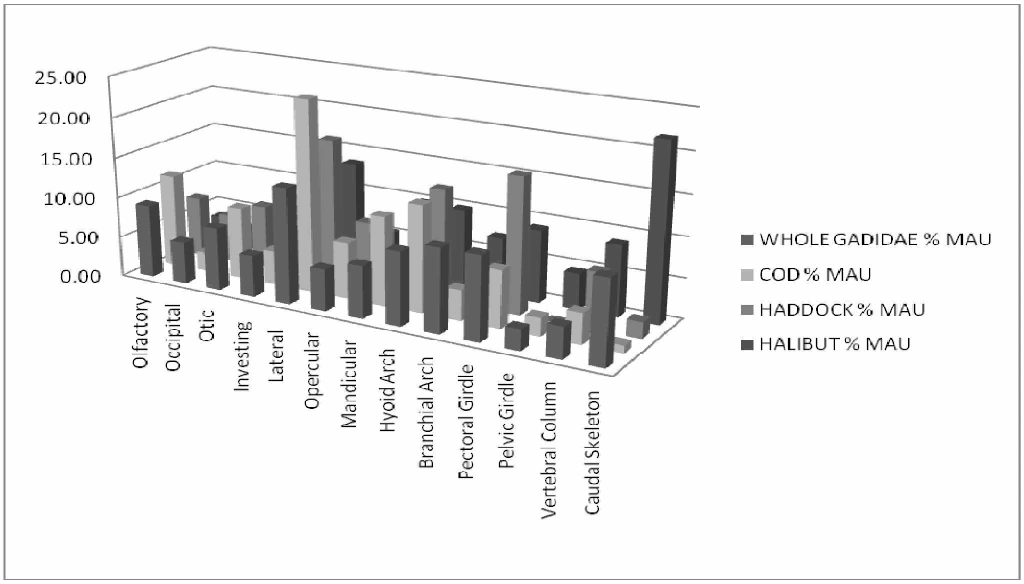


Figure 71 Skonsvika SU 14 Fish Partial Element Distribution.

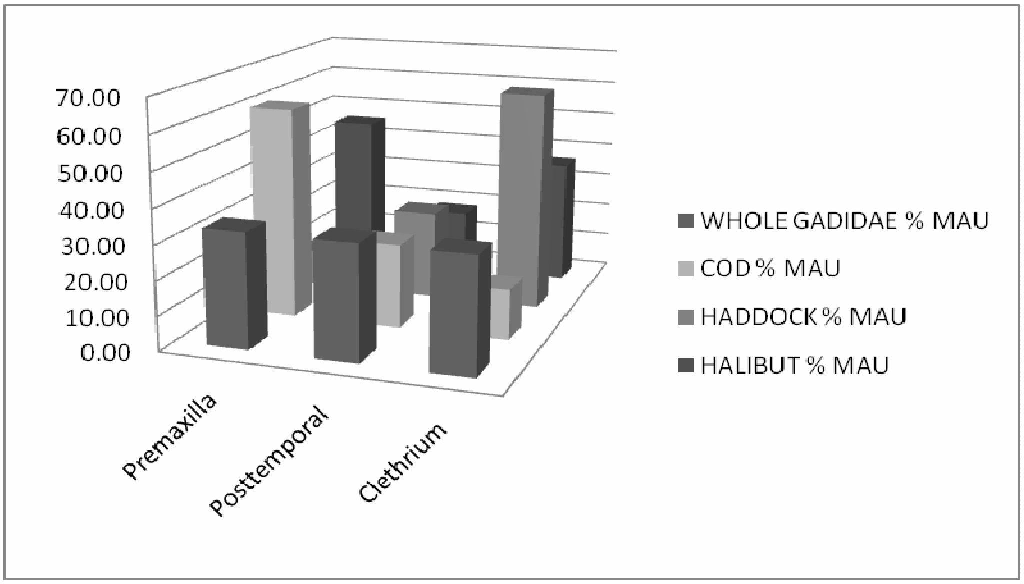


Figure 72 Skonsvika SU 14 Fish Vertebral Series.

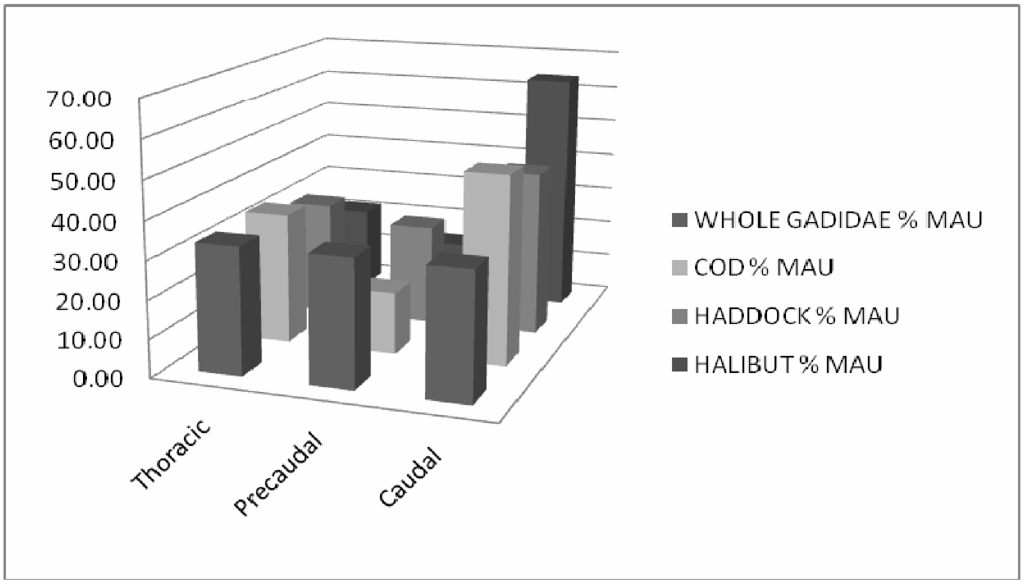


Figure 73 Skonsvika SU 14 Cod Total Length Distribution.

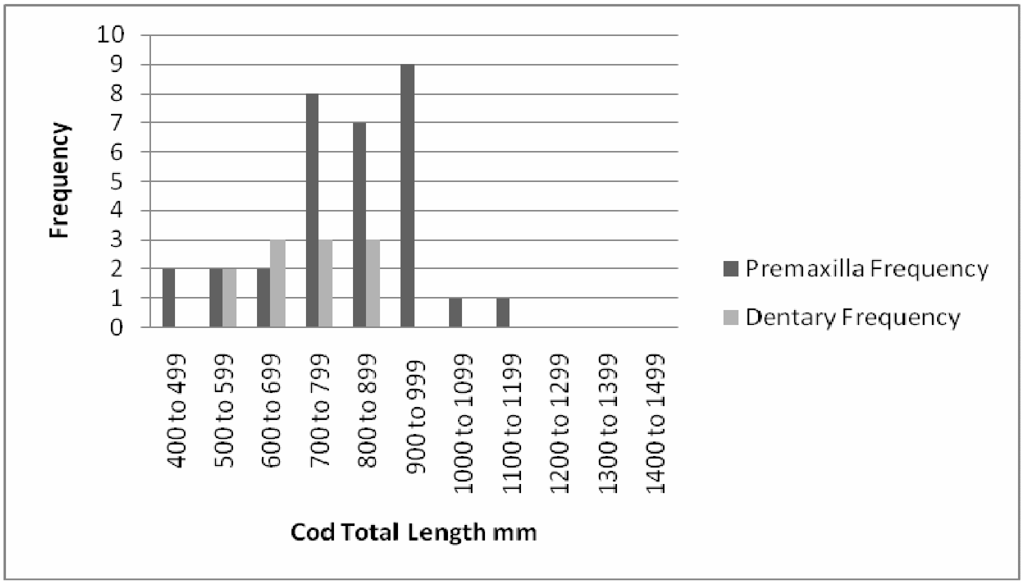


Figure 74 Skonsvika SU 46 Reindeer Element Frequncy vs. FUI.

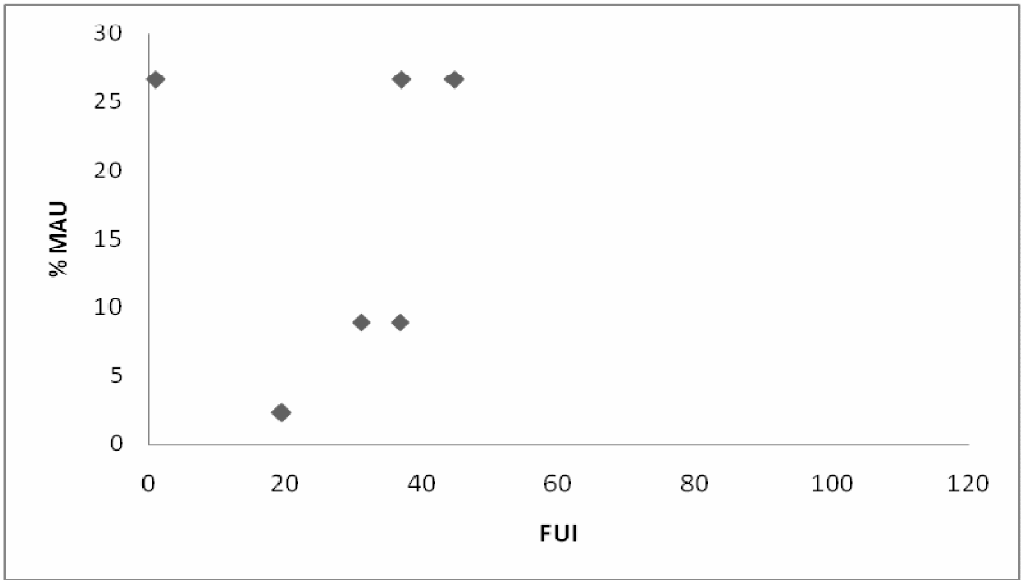


Figure 75 Skonsvika SU 46 Reindeer Element Frequncy vs. Bone Density.

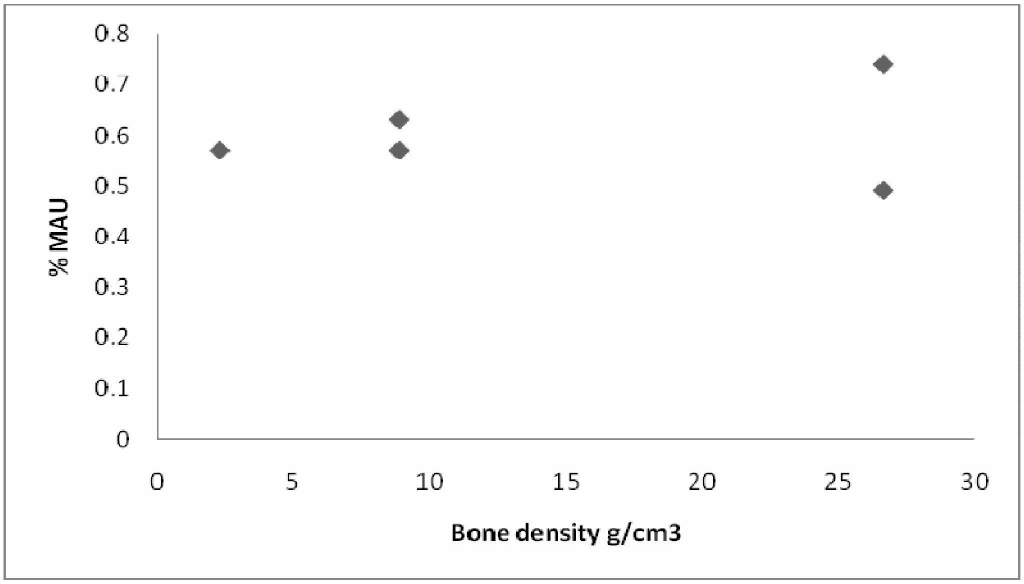


Figure 76 Skonsvika SU 46 Fish Full Elemental Distribution.

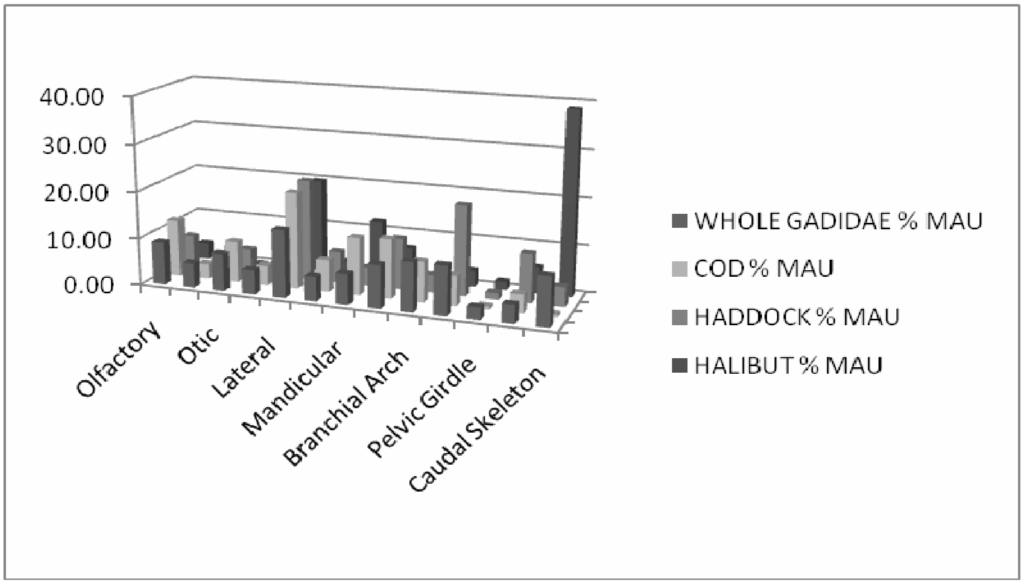


Figure 77 Skonsvika SU 46 Fish Partial Elemental Distribution.

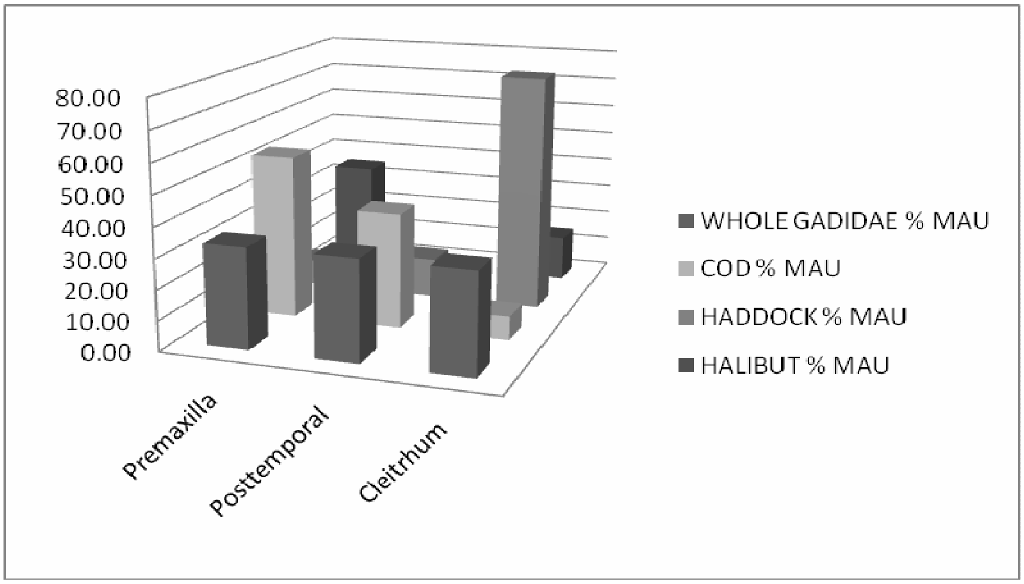


Figure 78 Skonsvika SU 46 Fish Vertebral Series.

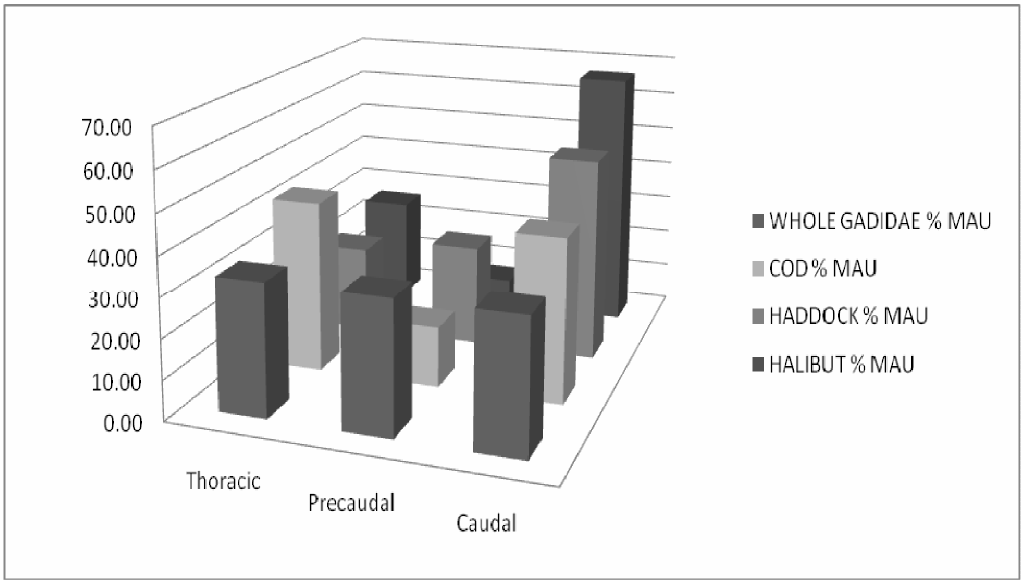


Figure 79 Skonsvika SU 46 Cod Total Length Distribution.

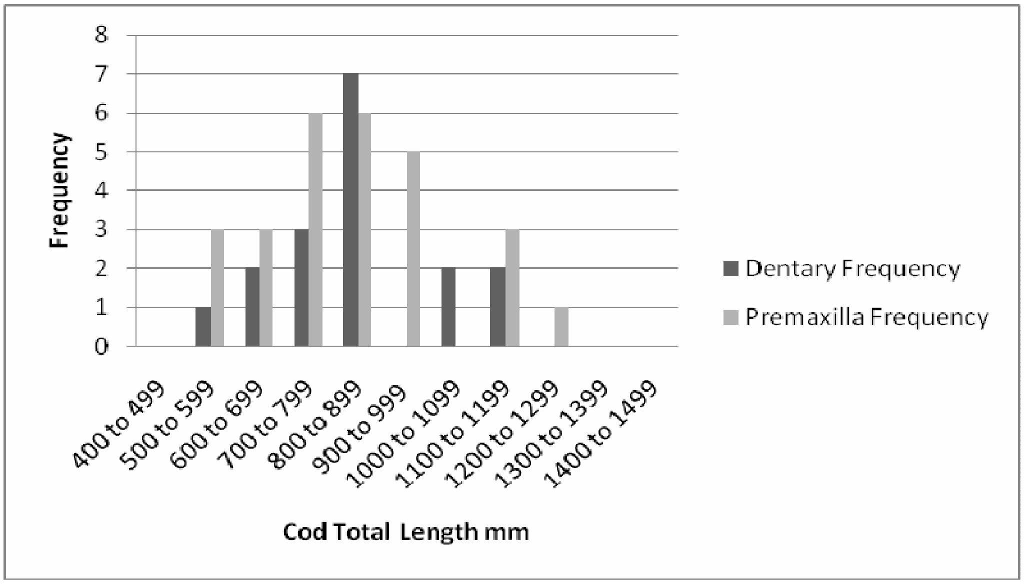


Figure 80 Skonsvika Pit 7 Fish Full Elemental Distribution.

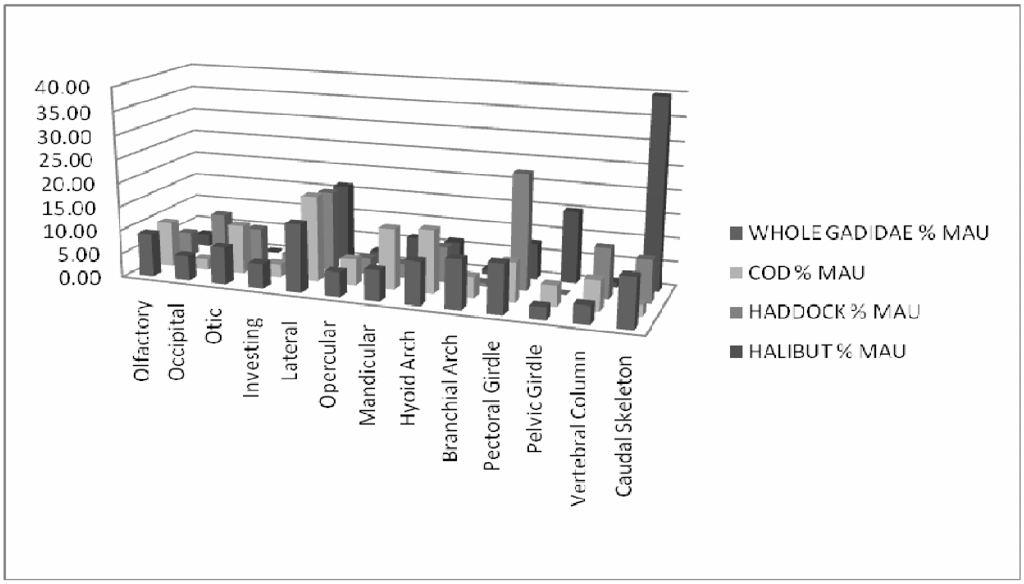


Figure 81 Skonsvika Pit 7 Fish Partial Elemental Distribution.

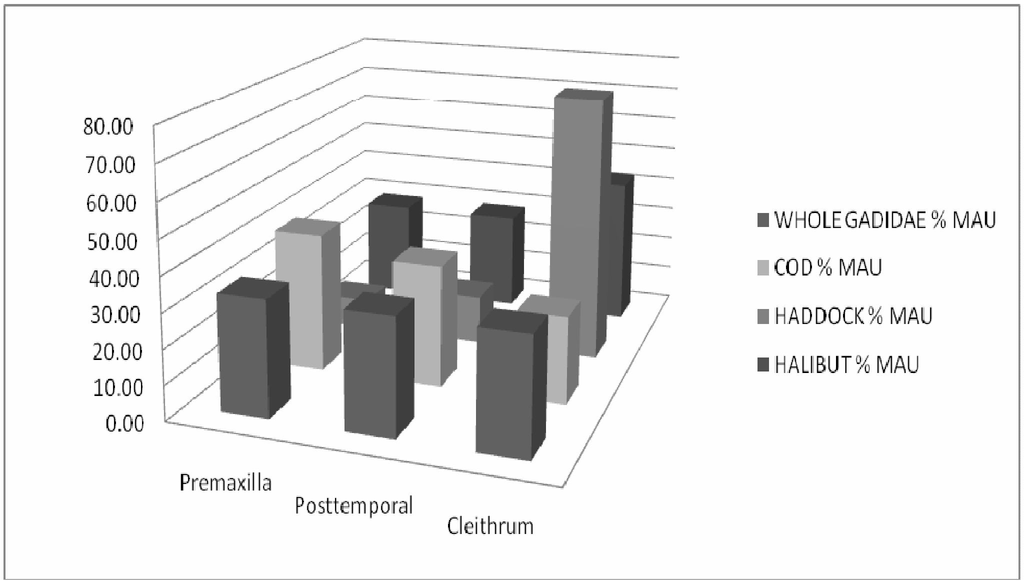


Figure 82 Skonsvika Pit 7 Fish Vertbral Series.

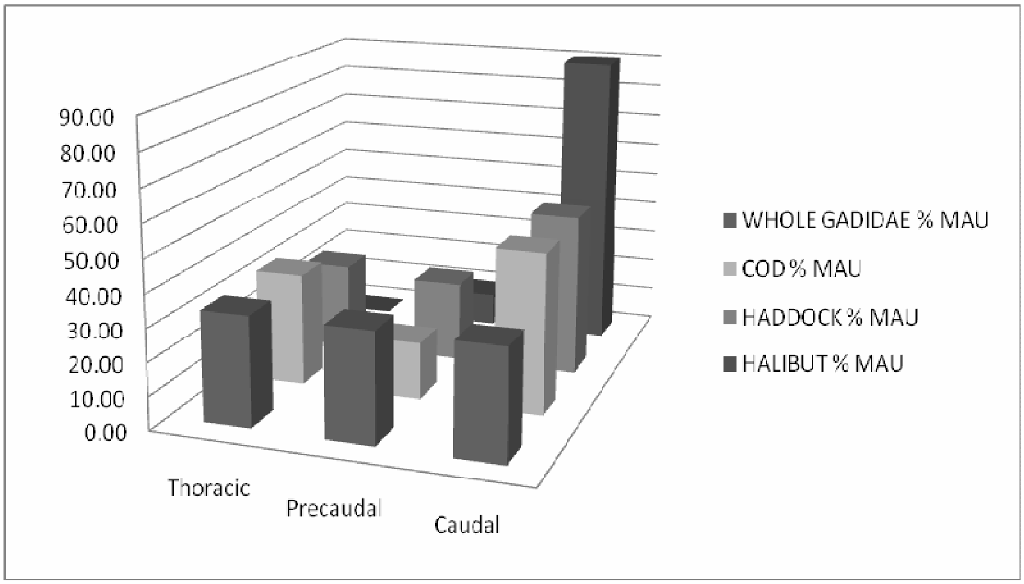


Figure 83 Skonsvika Pit 2 Fish Full Elemental Distribution.

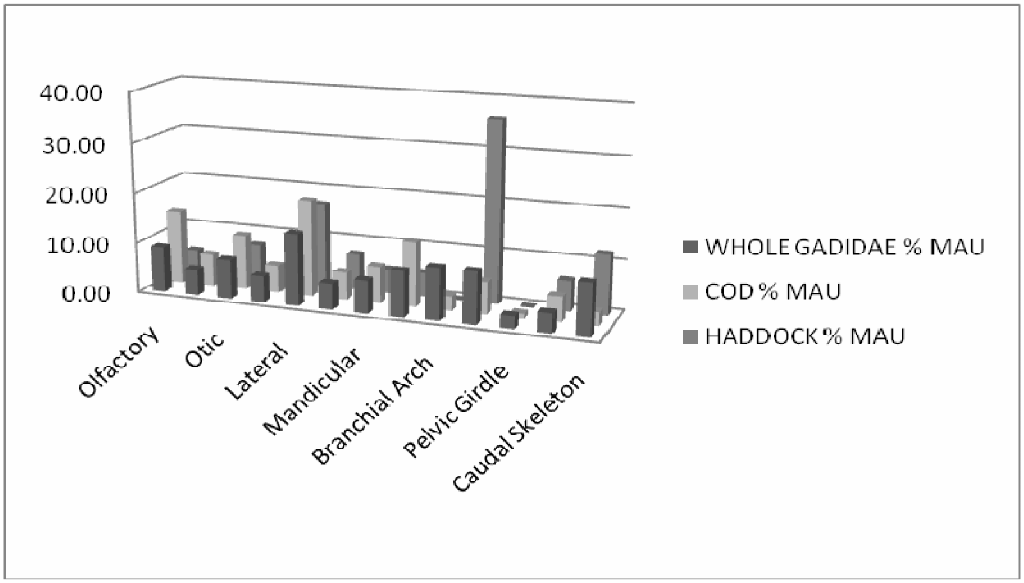


Figure 84 Skonsvika Pit 2 Fish Partial Elemental Distribution.

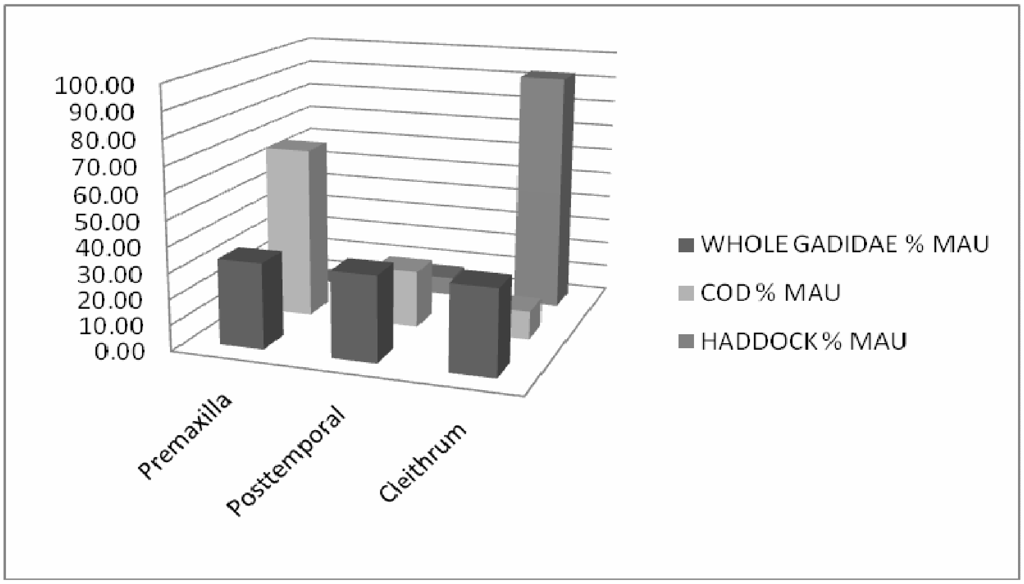


Figure 85 Skonsvika Pit 2 Fish Vertebral Series.

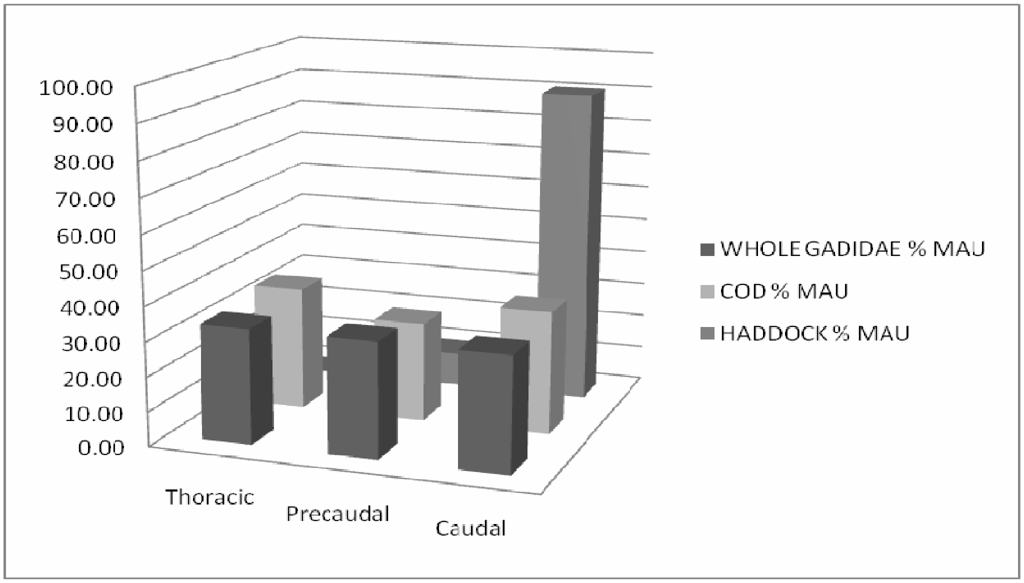


Figure 86 Kongshavn Room 5 Fish Full Elemental Distribution.

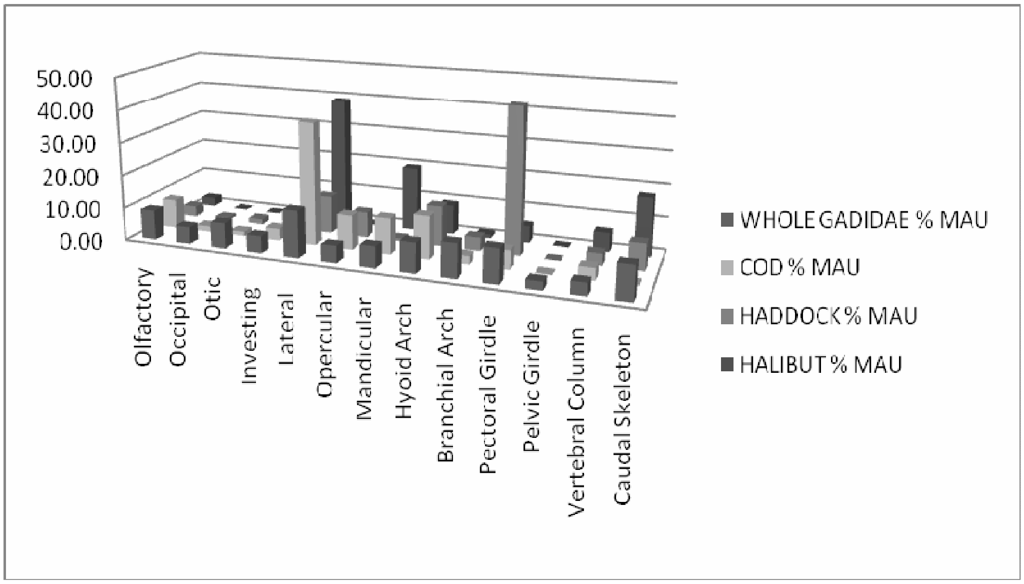


Figure 87 Kongshavn Room 5 Fish Partial Elemental Distribution.

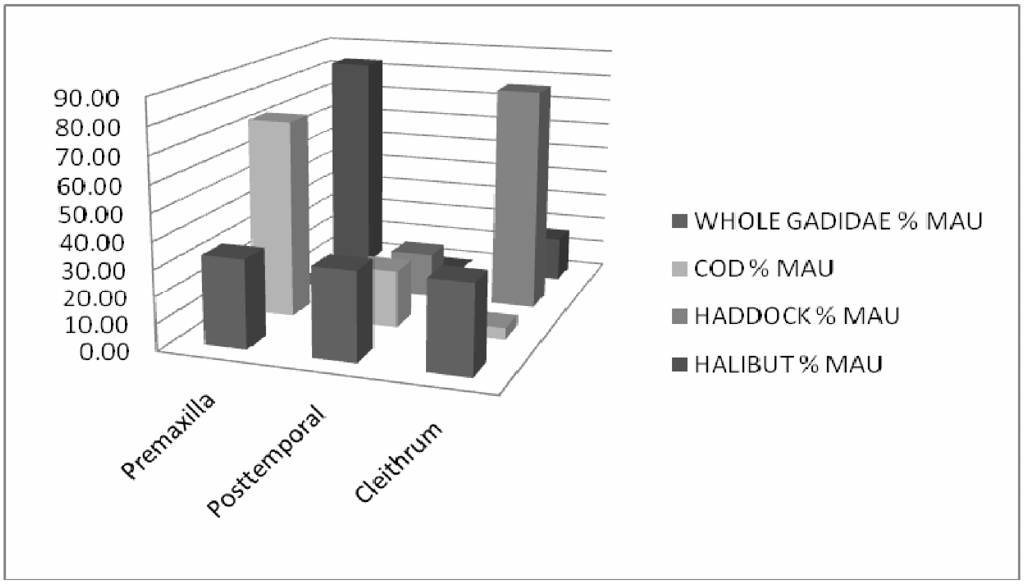


Figure 88 Kongshavn Room 5 Fish Vertebral Series.

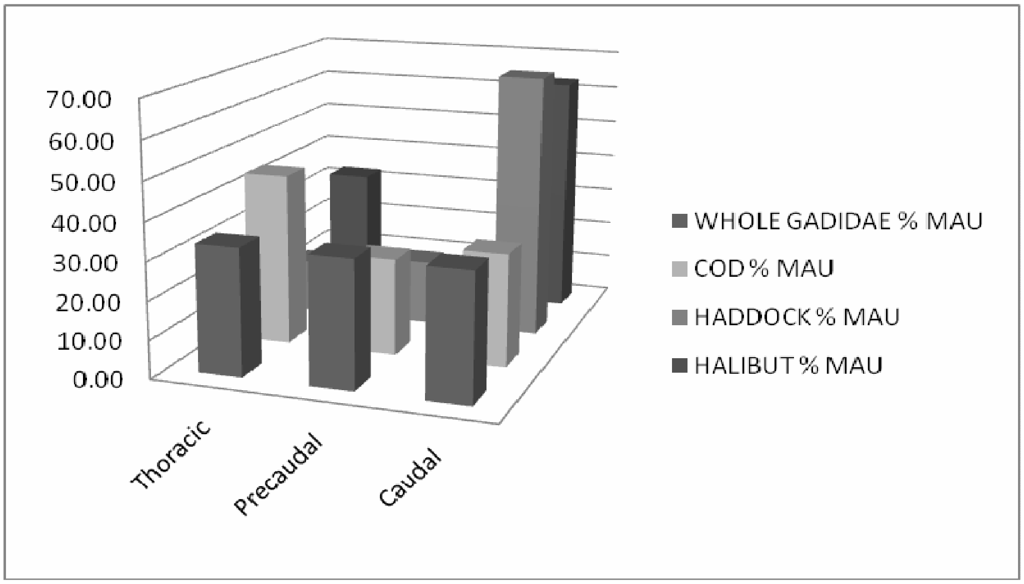


Figure 89 Kongshavn Room 4 Fish Full Elemental Distribution.

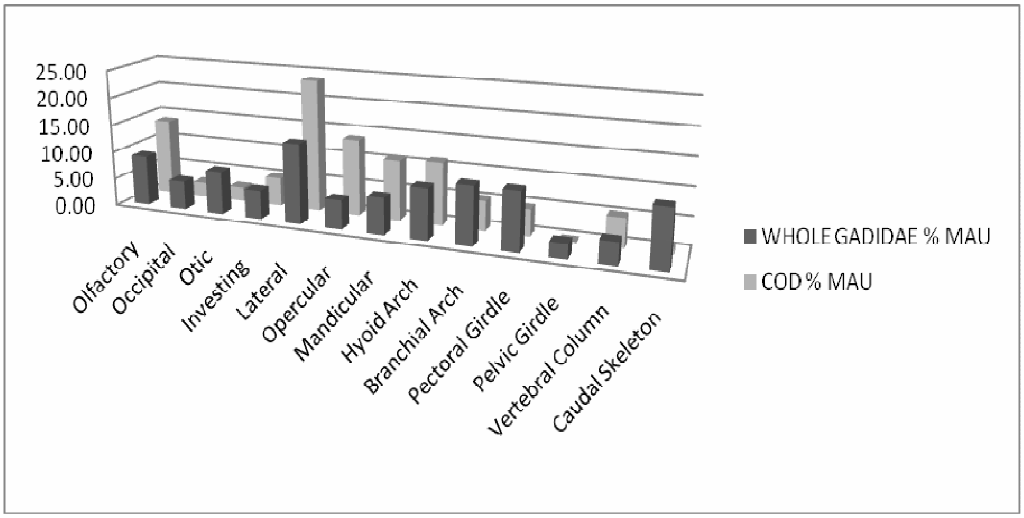


Figure 90 Kongshavn Room 4 Fish Partial Elemental Distribution.

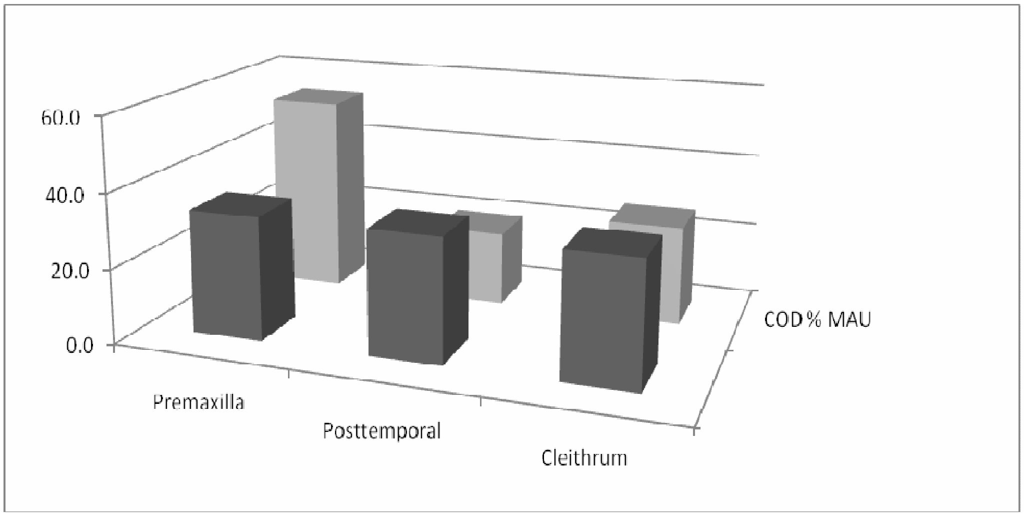
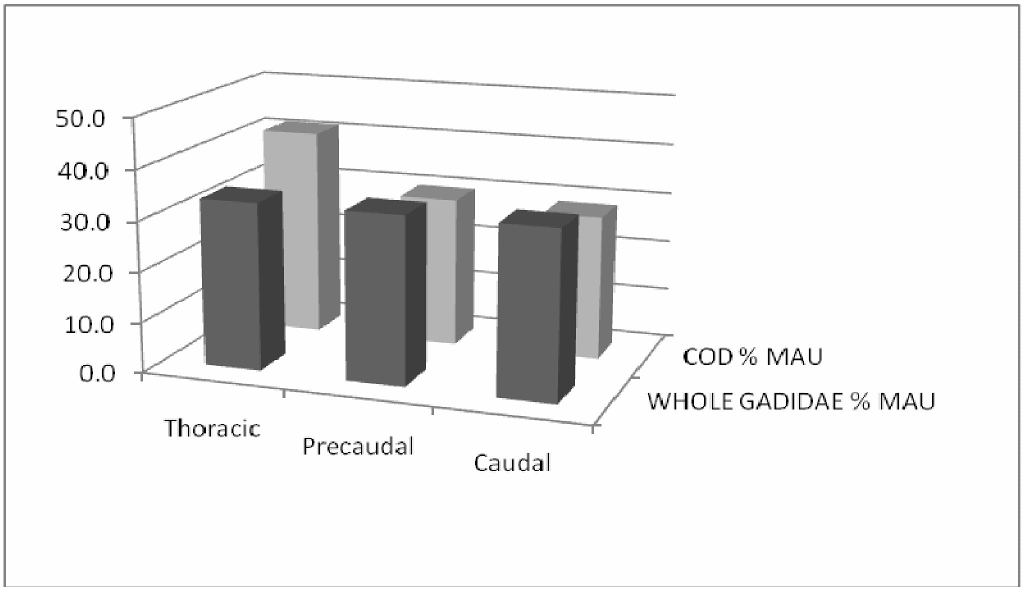


Figure 91 Kongshavn Room 4 Fish Vertebral Series.



BIBLIOGRAPHY

Ahti, T., L. Hämet-Ahti and J. Jalas
1968 Vegetation zones and their sections in northwestern Europe. *Annales Botanici Fennici*, 5, 169–211.

Adderley, P. and I. Simpson
2008 Activities and accumulations: Micromorphology analyses of archaeological sediments from Multi-room houses (Mangeromstuftur) in Finnmark, Norway. In Olsen, B. and P. Urbańzcyk (eds), *Hybrid spaces? Medieval Finnmark and the Archaeology of Multi-Room Houses*. Novus, Oslo (in press).

Albert, O.T.
1994 Ecology of haddock (*Melanogrammus aeglefinus L.)* in the Norwegian Deep. *ICES Journal of Marine Science* 51: 31-44.

Alexandre, P.
1987 *Le climat en Europe au Moyen Age*. Contribution a`l'histoire des variations climatiques de 1000 a` 1425 d'apre`s les sources narratives de l'Europe occidentale. Paris: Ecole des Hautes Etudes en Sciences Sociales.

Ambaum, M.H.P., B. Hoskins, and D.B. Stephenson
2001 Arctic oscillation or North Atlantic oscillation?. *Journal of Climate* 14, 3495–3507.

Amorosi, T.
1991 Icelandic archaeofauna: a prelimanary review. The Norse of the North Atlantic (ed. G.F. Bigelow). Copenhagen: *Acta Archaeologica*, 61: 271-84.

Amorosi, T., J. Woollett, S. Perdikaris and T. McGovern
1996 Regional Zooarchaeology and Global Change. *World Archaeology* Vol. 28, No. 1:126-157.

Amorosi, T., P.C. Buckland, A.J. Dugmore, J.H. Ingimundarson and T.H. McGovern
1997 Raiding the landscape: Human impact in the North Atlantic. (In) Island Archaeology (Eds B. Fitzhugh and T.Hunt), special edition of *Human Ecology*, 25(3), 491-518.

Amundsen, C.P.
2004 Farming and Maritime resources at Miðbaer on Flatey in Breiðfjörd, North-West Iceland. In R.A. Housley and G. Coles (eds) *Atlantic Connections and Adaptations; economies, environments and subsistence in lands bordering the North Atlantic*, AEA/NABO Environmental Archaeology Monographs 21, Oxbow Books.

Amundsen, C.P, J. Henriksen, E. Myrvoll, B. Olsen, and P. Urbanczyk
2003Crossing borders: Multi-room houses and inter-ethnic contacts in Europe's extreme north. *Fennoscandia archaeologica* XX.

Amundsen, C.P., S. Perdikaris, M. Brown, Y. Krivogorskaya, S. Modugno, K. Smiarowski, S.Storm, M. Frik, M. Koczela and T. H. McGovern
2004 *The 15th c Archaeofauna from Akurvík, an early Fishing Station in NW Iceland*, NORSEC Zooarchaeology Laboratory Reports No. 15.

Amundsen, C.P., S. Perdikaris, T.H. McGovern, Y. Krivogorskaya, M. Brown, K. Smiarowski, S. Modugno, M. Frik and M. Koczela
2004 Fishing Booths and Fishing Strategies in Medieval Iceland: an Archaeofauna from Akurvik, North-West Iceland. In R.A. Housley and G. Coles (eds) *Atlantic Connections and Adaptations; economies, environments and subsistence in lands bordering the North Atlantic*, AEA/NABO Environmental Archaeology Monographs 21, Oxbow Books.

Andrews, P. and E.M.N. Evans
1983 Small mammal bone accumulations produced by mammalian carnivores. *Paleobiology* 9: 289-307.

Angerbjörn, A., M. Tannerfeldt and S. Erlinge
1999 Predator-prey relationships: arctic foxes and lemmings. *Journal of Animal Ecology* 68: 34-49.

Appadurai, Arjun
1986 Introduction: commodities and the politics of value. In *The social life of things: commodities in cultural perspective*. Ed. Arjun Appadurai pp.3-63.

Ashley, Bob, J. Hollows, S. Jones and B. Taylor
2004 *Food and Cultural Studies*. Routledge London.

Ådlandsvik, B. and Loeng, H.
1991 A study of the climatic system in the Barents Sea. Polar Research 10, 45-49.

Baker, V. G.
1978 Historical Archaeology at Black Lucy's Garden, Andover, Massechusetts: ceramics from the site of a 19th century Afro-Amrican. *Papers of the Robert S. Peabody Foundation for Archaeology 8,* Andover.

1980 Archaeological visibility of Afro-American culture: an example from Black Lucy's Garden, Andover, Massechusetts. In *Archaeological perspectives on ethnicity in America*, edited by R.L. Schuyter pp. 19-37. Baywood, Farmingdale.

Barlow, L.K., J.P. Sadler, A.E.J. Ogilvie, P.C. Buckland, T. Amorosi, J.H. Ingimundarson, P. Skidmore, A.J. Dugmore, and T.H. McGovern
1997 Interdisciplinary investigations of the end of the Norse Western Settlement in Greenland. *The Holocene* 7(4): 489-500.

Balee, B.
1998 Historical Ecology: premises and postulates, in: W. Balee (ed) *Advances in Historical Ecology*, Columbia Univerisity Press.

Barrett, R. T., T. Anker-Nilssen, G. W. Gabrielsen, and G. Chapdelaine
2002 Food consumption by seabirds in Norwegian waters. *ICES Journal of Marine Science*, 59: 43 - 57.

Barrett, J. H.
1993 Bone weight, meat weight yields estimates and cod (Gadus morhua): a preliminary study of the weight method. *International Journal of Osteoarchaeology*, 3:1-18.

1995 *´Few know an earl in fishing-clothing´. Fish middens and the economy of the Viking Age and Late Norse Earldoms of Orkney and Caithness, Northern Scotland*. Ph.D. thesis. Department of Archaeology, University of Glasgow.

1997 Fish Trade in North Orkney and Caithness: A Zooarchaeological Approach. *Antiquity* 71: 616-638.

Barrett, R. T., G. Chapdelaine, T. Anker-Nilssen, A. Mosbech, W. A. Montevecchi, J. B. Reid, and R. R. Veit
2006 Seabird numbers and prey consumption in the North Atlantic. *ICES Journal of Marine Science*, 63: 1145 – 1158.

Barry, T.N., J.M. Suttie, J.A. Milne and R.N.B. Kay
1991 Control of food intake in domesticated deer. In *Physiological Aspects of Digestion and Metabolism in Ruminants* (Eds T. Tsuda, Y. Sasaki & R. Kawashima), pp. 385–401. San Diego: Academic Press.

Behrensheyer, A.K.
1978 Taphonomic and ecologic information from bone weathering. *Paleobiology*. 4: 150-162.

1993 Discussion: Noncultural processes. In Jean Hudson ed. *From Bones to Behavior: Ethnoarchaeological and Experimental Contributions to the Interpretations of Faunal Remains*, Occasional Paper No. 21, pp. 342-348.

Behrensmeyer A.K., K.D. Gordon, G.T. Yanagi
1986 Trampling as a cause of bone surface damage and pseudo-cutmarks. *Nature* 319: 768–771.

Belcher, W. R.
1992 Fish resources in an early urban context at Harappa. In (R. H. Meadow. Ed) *Harappa Excavations 1986-1990: a multidisciplinary approach to Third Millenium Urbanism*. Monographs in World Archaeology No.3. Madison. WI: Prehistory Press pp. 107-120.

Bentley, G. C.
1987 Ethnicity and Practice. *Comparative Studies in Soceity and History*. Volume 19: 24-55 Cambridge University Press.

Berg, E. and T. Pedersen.
2001 Variability in recruitment, growth and sexual maturity of coastal cod (*Gadus morhua L.*) in a fjord system in northern Norway. *Fisheries Research*, Volume 52, Issue 3: 179-189.

Berg, E. and T.O.Albert
2003 Cod in fjords and coastal waters of North Norway: distribution and variation in length and majurity at age. *ICES Journal of Marine Science*, 60:1-11.

Bergerud, A.T.
2000 Caribou. In: *Ecology and Management of Large Mammals in North America*. Ed. By S. Demarais an P.R. Krausmann, pp. 658-93. Prentice Hall Inc., Upper Saddle River, N.J. USA.

Bergstad, O.A., T. Jørgensen and O. Dragesund
1987 Life history and ecology of the gadoid resources of the Barents Sea. *Fisheries Research*, Volume 5, Issues 2-3: 119-161.

Bergsvik, K.A.
2002 *Arkeologiske Undersøkelser ved Skatestraumen Bind 1.* Arkeologiske Avhandlinger og Rapporter fra Universitetet i Bergen.

Bertelsen, R.
1979 Farm mounds in North Norway, a review of recent research. *Norwegian Archaeological Review* Vol. 12 No. 1. pp. 48-56.

Beverton, R.J.H. and A.J. Lee
1965 The influence of hydrographic and other factors on the distribution of cod on the Spitsbergen shelf. *ICNAF Spec. Publ*. Vol. 6: 225-245.

Beverton, R. J. H., A. Hylen, O.J. Østvedt, J. Alvsvaag and T.C. Iles
2004 Growth, maturation, and longevity of maturation cohorts of Norwegian spring-spawning herring. *ICES Journal of Marine Science* 6: 165–175.

Bigelow, G.F.
1984 *Subsistence in Late Norse Shetland: an investigation into a Northern Island Economy of the Middle Ages*. Unpublished Ph.D. thesis, University of Cambridge.

1985 Sandwick, Unst and the Late Norse Shetland economy. In *Shetland Archaeology New Work in Shetland in the 1970's* (ed. B. Smith). Lerwick:Shetland Times, pp. 95-127.

1991 The Norse of the North Atlantic. Copenhagen: *Acta Archaeologica*, 61: 271-84.

Bjerck, Hein Bjartmann
1989 *Vega: opplev steinalderøya.* Vitenskapsmuseet, Universitetet i Trondheim.

Bjørge, A.
1991 Status of harbour seal *Phoca vitulina L.* in Norway. *Biological Conservation* 58: 229-238.

Blumenschine, R.J.
1986 Carcass consumption sequences and the archaeological distinction of scavenging and hunting. *Journal of Human Evolution* 15: 639–659.

Blumenschine, R. J. and C.W. Marean
1993 A carnivore's view of archaeological bone assemblages. In (J. Hudson, Ed.) *From Bones to Behavior: Ethnoarchaeological and Experimental Contributions to the Interpretation of Faunal Remains*. Occasional Paper 21, Center for Archaeological Investigations. Carbondale: Southern Illinois University, pp. 273–300.

Bogorov, V.G., M.E. Vinogradov, N.M. Voronina, I.P. Kanaeva, and I.A. Suetova
1968 Distribution of zooplankton biomass in the upper layer of the World Ocean. *Doklady* AS USSR 182, 1205–1207 (in Russian).

Bogstad, B. and H. Gjøsæter
2001 Predation by cod (*Gadus morhua*) on capelin (*Mallotus villosus*) in the Barents Sea: implications for capelin stock assessment. *Fisheries Research*, Volume 53, Issue 2: 197-209.

Bond, J.M.
1994 *Change and continuity in an island: the palaeoconomy of Sanday, Orkney.* Ph.D. Thesis. University of Bradford.

Boonstra, R.
2004 Coping with Changing Northern Environments: The Role of the Stress Axis in Birds and Mammals. *Integrative and Comparative Biology*, 44(4): 98-108.

Boonstra, R., C. J. McColl, and T. J. Karels
2001 Reproduction at all costs: The adaptive stress response of male Arctic ground squirrels. *Ecology*, 82:1930-1946.

Bourdieu, P.
1977 *Outline of a Theory of Practice*. Cambridge, UK. Cambridge University Press.

1984 *Distinction. A social critique of the Judgement of Taste*. Cambridege, Mass. Harvard University Press.

1985 The Genesis of the Concepts of Habitus and Field. *Sociocritism*, Vol.2, Nr.2 pp. 11-24.

1990 *The Logic of Practice*. Stanford University Press.

2002 *Habitus*. In Habitus: A Sense of Place. J. Hillier and E. Rooksby (eds.). Ashgate, pp. 27-34.

Bowering, W.R. and K. H. Nedreaas
2000 A comparison of Greenland halibut (Reinhardtius hippoglossoides) fisheries and distribution in the Northwest and Northeast Atlantic. *Sarsia* 85 (1): 61-76.

Boyd, H. and J. Madsen
1997 Impacts of global change on Arctic-breeding bird populations and migration. In W. C. Oechel (ed.), *Global change and Arctic terrestrial ecosystems*, pp. 201–217.

Boytsov, V.D., A.I. Mukhin and N.A. Yaragina
1987 Peculiarities of feeding migrations of the Lofoten-Barents Sea cod n the southern Barents Sea in relation to variability of environmental conditions. In: The Effect of Oceanographic Conditions on Distribution and Population Dynamics of Commercial Fish Stocks in the Barents Sea. Edited by H. Loeng. *Proceedings of the third Soviet-Norwegian Symposium Murmansk*, 26-28 May 1986, pp. 191-198.

Bradley, R.S., K.R. Buffa, T.J. Crowley, M.K. Hughes, P.D. Jones, M.E. Mann
2001 The Scope of Medieval Warming. Science, *New Series* Vol. 292, No. 5524, pp. 2011-2012.

Bradley, R.S. and P.D. Jones
1993 `Little Ice Age' summer temperature variations: their nature and relevance to recent global warming trends. *The Holocene*, 3, 367-376.

Bratrein, H.D.
1981 Settlement and settlement continuity in the parish in the parish of Karlsøy in the Middle Ages. *Norwegian Archaeological Review* Vol. 14, No. 2:106-115.

1990 *Magerøy i middelalderen*. Tromura, kulturhistorie nr. 17. Tromsø Museum, pp. 19 – 25.

1996 Gåtefulle Forsøl: kulturminnene i Kirkegårdsbukt. *Fotefar mot nord*. Hammerfest kommune/Finnmark Fylkeskommune, Vadsø.

Brewington, S., R. Harrison, C. Amundsen, and T. McGovern
2004 *An early 13th c Archaeofauna from Steinbogi, Mývatnssveit, N Iceland*. NORSEC Zooarchaeology Laboratory Reports No. 13.

Briffa, K. L., T.S. Bartholin, D. Eckstein, P.D. Joner, W. Karlén, F.H. Schweingrubler, and P.A. Zetterberg

1990 A 1,400-year tree-ring record of summer temperatures in Fennoscandia. *Nature* 346, 434-439.

Briffa, K.R., P.D. Jones, T.S. Bartholin, D. Eckstein, F.H. Karle´n, P. Zetterberg and M. Eronen

1992 Fennoscandian summers from ad 500: temperature changes on short and long time scales. *Climate Dynamics* 7:111–19.

Briffa, K.R., P.D. Jones, F.H. Schweingruber, S.G. Shiyatov and E.R. Cook

1995 Unusual twentieth-century summer warmth in a 1,000-year temperature record from Sibiria. *Nature* 376, 156-159.

Briffa, K.R., P.D. Jones, R.B. Vogel, F.H. Schweingruber, M.G.L. Baillie, S.G. Shiyatov and E.A. Vaganov

1999 European tree rings and climate in the 16th century. *Climatic Change* 43, 151-168

Briffa, K.R.,T.J.Osborn,F.H.Schweingruber, I.C.Harris, P.D. Jones, S.G. Shiyatov and E.A.Vaganov

2001 Low frequency temperature variations from a northern tree-ring density network, *J.Geophys. Res.*,106: 2929–2941.

Bromage T.G. and A. Boyde

1984 Microscopic criteria for the determination of directionality of cutmarks on bone. *American Journal of Physical Anthropology* 65: 359–366.

Brögger, A.W.

1909 *Den artiske stenalder I Norge*. Kristiania.

Brügge, B.

1995 Near-surface mean circulation and kinetic energy in the central North Atlantic from drifter data. *Journal of Geophysical Research* 100, 20543–20554.

Buckland, P.C., T. Amorosi, L.K. Barlow, A.J. Dugmore, P.A. Mayewski, T.H. McGovern, A.E.J. Ogilvie, J.P. Sadler and P. Skidmore

1996 Bioarchaeological and climatological evidence for the fate of the Norse farmers in medieval Greenland. *Antiquity* 70(267): 88-96.

Buisman, J. and A.F. van Engelen

1995 Duizend Jaar Weer, Wind enWater in de Lage Landen. Onder redactie van Engelen, A.F., *KNMI*. Franeker: Van Wijnen.

Butler, Virginia L.

1987 Distinguishing natural from cultural salmonid deposits in the Pacific Northwest of North America. In (D.T. Nash and M.D. Petraglia, Eds.) *Natural Formation Process and the Archaeological Record*. Oxford: B.A.R. 352: 131-149.

1993 Natural versus Cultural Salmonid Remains: Origin of the Dallas Roadcut Bones, Columbia River, Oregon, U.S.A. *Journal of Archaeological Science* 20: 1-24.

Cannon, A.
2000 Assessing Variability in Northwest Coast Salmon and Herring Fisheries: Bucket-Auger Sampling of Shell Midden Sites on the Central Coast of British Columbia. *Journal of Archaeological Science* 27: 725-737.

Cannon, D.Y.
1987 *Marine Fish Osteology: A Manual for Archaeologists*. Burnaby: Archaeology Press, Simon Fraser University.

Cannon, M.D.
1999 A mathematical model of the effects of screen size on zooarchaeological relative abundance measures. *Journal of Archaeological Science* 26: 205-214.

Canuto, M.A. and J. Yaeger
2000 *Introducing an archaeology of communities*. In M.A. Canuto and J. Yaeger (eds.) The Archaeology of Communities a New World Perspective. Routledge, New York pp. 1-16.

Casteel, R.W.
1972a Some biases in the recovery of archaeological faunal remains. *Proceedings of the Prehistoric Society* 38: 382-388.

1972b Some Archaeological Uses of Fish Remains. *American Antiquity* 37: 404-419.

1976 Comparison of Column and Whole Unit Samples for Recovering Fish Remians. *World Archaeology* 8: 192-196.

1976/1977 A consideration of the behavior of the minium number of individuals index: a problem in faunal characterization. *Ossa* 3/4 :141-151.

1977 Characterization of faunal assemblages and the minium number of individuals determined from paired elements: continuing problems in archaeology. *Journal of Archaeological Science*, 4:125-34.

Casteel, R.W. and D. Grayson
1977 Terminological problems in quantitative faunal analysis. *World Archaeology*, 9(2): 236-42.

CAVM Team
2003 *Circumpolar arctic vegetation map*. Scale 1: 7,500.000. Conservation of arctic flora and fauna (CAFF) map no. 1. US Fish and Wildlife Service, Anchorage, AK.

Chanin, P.R.F.
1985 *The natural history of otters.* Fact On File Publications, New York.

Chapin, F.S. and C. Korner
1994 Arctic and alpine biodiversity: patterns, causes and ecosystem consequences. *Trends Eco Evol* 9: 45-47.

Chaplin, R.E.
1965 Animals in Archaeology. *Antiquity* 39: 204-211.

1971 The Study of Animal Bones from Archaeological Sites: *Studies in Archaeological Sciences No. 1*. Seminar Press London and New York.

Chen, L., A.L. DeVries and C.H.C. Cheng
1997 Evolution of antifreeze glycoprotein gene from a trypsinogen gene in Antarctic notothenioid fish. *Proc. Natl. Acad. Sci.* USA 94: 3811–3816.

Chernov, Y.I.
1995 Diversity of the Arctic Terristrial Fauna. Eds. F. Stuart Chapin III and Christian Körner. Arctic and Alpin Biodiversity: Patterns, Causes and Ecosystem Consequences. *Ecological Studies*, Vol. 113: 81-93.

Christensen, I., T. Haug, N. Øien
1992 Seasonal distribution, exploitation and present abundance of stocks of large baleen whales (*Mysticeti*) and sperm whales (*Physeter macrocephalus*) in Norwegian and adjacent waters. *ICES Journal of Marine Sciences* 49: 341–355.

Chu, Guoqiang, J. Liu, Q. Sun, H. Lu, Z. Gu, W. Wang, and T. Liu
2002 The 'Mediaeval Warm Period' drought recorded in Lake Huguangyan, tropical South China. *The Holocene* 12: 511-516.

Clason, A.T. and W. Prummel
1977 Collecting, Sieving and Archaeozoological Research. *Journal of Archaeological Science*. 4: 171-175.

Cloudsley-Thompson, J.L.
1996 *Biotic interactions in arid lands*. Berlin: Springer-Verlag.

Coard, R.
2007 Ascertaining an agent: using tooth pit data to determine the carnivore/s responsible for predation in cases of suspected big cat kills. *Journal of Archaeological Science* 34(10): 1677-1684.

Cohen, A.
1971 Cultural Stategies in the Organization of Trading Diaspora, in *L'Evolution du Commerce en Afrique de L'Ouest*, Claude Mesailloux, (ed.) Oxford: 261-288.

Colley, S.M.
1984a *The role of fish bones studies in economic archaeology: with special reference to the Orkney Isles*. Ph.D. Thesis. University of Southampton.

1984b *Some methodological problems in the interpratation of fish remains from archaeological sites in Orkney*. In (N.Dease-Berset, Ed.) 2nd Fish Osteoarchaeology meeting. Notes et Monographies Techniques 16. Paris: Centre de Recherches Archaeologiques, pp. 117-131.

1986 Site formation and archaeological fish remains: an ethnohistorical example from the Northern Isles, Scotland. In (D. C. Brinkhuezin and A.T. Clason, Eds) *Fish and Archaeology: studies in osteometry, taphonomy, seasonality and fishing methods*. Oxford: BAR International Series 294, 34-41.

1990 The Analysis and Interpretation of Archaeological Fish Remains. In *Archaeological Method and Theory, Vol. 2*. Michael Schiffer, Tuscon: University of Arizona Press, pp. 2207-2253.

Colloca, F., C. Valerio, S. Cerasi, S.R. Coppola
2004 Structure and Evolution of the artisanal fishery in a southern Italian coastal area. *Fisheries Research* 69: 359-369.

Cook, S.F.
1951 The fossilization of human bone: calcium, phosphate, and carbonate. *University of Califironia publications in American archaeology and ethnology* 40 (6): 263-280.

Cook, S.F. and R.F. Heizer
1965 *Studies on the chemical analysis of archaeological sites*. University of California publications in anthropology Vol. 2, Berkeley, California: University of California Press.

Coy, J.
1978 Comparative Collections for Zooarchaeology. In D.R. Brothwell, K.D. Thomas, and Juliet Clutton-Brock (eds.). Research Problems in Zooarchaeology. Occasional Publication No. 3, pp. 143-145. London: Institute of Archaeology.

Crabtree, P.
1990 Zooarchaeology and complex societies: some uses of faunal analysis for the study of trade, social satus, ethnicity. In Archaeological Method and Theory, Vol. 2 (ed. M.B. Schiffer). Tuscon Arizona: University of Arizona Press, pp. 155-205.

Cruz-Uribe, Kathryn
1988 The Use and Meaning of Species Diversity and Richness in Archaeological Fauna. *Journal of Archaeological Science* 15:179-196.

Currey, J.D.
2002 *Bones: Structures and Mechanics*. Princeton University Press.

Croll, D.A., J.L. Maron, J.A. Estes, E.M. Danner and G.V. Byrd
2005 Introduced predators transform subarctic islands from grassland to tundra. *Science* 307, 1959–1961.

Crowley, T. J. and S.L. Thomas
2000 Northern Hemisphere Temperature Reconstruction. *Ambio* 29: 51-54.

Crumley, C.
1994 Historical ecology:a multidimensional ecological orientation. (In) Historical Ecology: Cultural Knowledge and Changing Landscapes (Ed. Crumley, C.), School of American Research, Santa Fe, pp. 1-16.

Curta, F.
2001 *The Making of the Slavs : History and Archaeology of the Lower Danube Region c. 500-700*. Cambridge University Press.

Curtan, P.
1984 *Cross-cultural Trade in World History*. Cambridge University Press.

Cushing, D.H.
1969 The regularity of the spawning season of some fishes. *Journal Conseil International pour l'Exploration de la Mer*, 185, 201-213.

Dahl E.
1975 Flora and plant sociology in Fennoscandian tundra areas. In: Wielgolaski FE, editor. *Fennoscandian Tundra Ecosystems Part 1. Plants and Microorganisms. Ecological Studies,* Volume 16. Berlin: Springer, pp 63-67.

Dahl, E., R. Elven, A. Moen and A. Skogen
1986 *Vegetasjonsregionkart over Norge 1: 1.500.000*. Nasjonalatlas for Norge. Statens kartverk, Hønefoss, Norway.

Dahle, G. and K.E. Jørstad
1993 Haemoglobin variation in cod-a reliable marker for Atlantic cod (*Gadus morhua L.*). *Fisheries Research* 16: 301-311.

Damm, C.
1999 Kjønnsforskning i arkeologien. *Ottar*, No.3, pp.23-38.

Deetz, J.
1977 *In small things forgotten*. Doubleday, New York.

Denisenko, S.G. and O.V. Tytov
2003 Distribution of zoobenthos and primary plankton production in the Barents Sea. *Oceanology* 43, 78–88 (in Russian).

Deser, C.
2000 On the teleconnectivity of the 'Arctic Oscillation', *Geophysical Resident Letters* 27, 779–782.

Devold, F.
1963 The life history of the Atlanto-Scandian herring. *Conseil Permanent International pour l'Exploration de la Mer: Rapports Proce`s-Verbaux des Re´unions* 154, 98–108.

De Boer, W and D. Lathrap
1979 The making and breaking of Shipibo- Conibo ceramics. In *Ethnoarchaeology: Implications of Ethnography for Archaeology,* Carol Kramer (ed.) . New York: Columbia University Press, pp. 102-138.

Dincauze, D.F.
2000 Environmental Archaeology: principles and practice. Cambridge University Press.

DN – Diplomatarium Norvegicum. Vol. I – XXII. 1874 – 1997. Christiania/Oslo.

Dominguez□Rodrigo M., T.R. Pickering, and L.A. Martinez
2003 Introduction to a new Journal for Taphonomic Research. *Journal of Taphonomy* 1: 1–2.

Douglas, M.
1971 Deciphering a Meal. In *Myth, Symbol, and Culture* edited by Clifford Geertz. W.W. Norton and Company Inc, New York pp. 61-82.

Drinkwater, K.F.
1999 Changes in ocean climate and its general effect on fisheries: examples from the North-west Atlantic. In *The ocean life of Atlantic Salmon-environmental and biological factors influencing survival,* D. Mills (eds.). Fishing News Books, Oxford, UK, 116-136.

Driver, J.C.
1992 Identification, classification and zooarchaeology. *Circaea* 9: 35-47.

Ebert, K.
2002 Landforms and glaciation dynamics on the Varanger Peninsula, Northern Norway. *Examensarbete i Naturgeografi*, Stockholms universitet, Stockholm.

Eda, M., Y. Baba, H. Koike and H. Higuchi
2006 Do temporal size differences influence species identification of archaeological albatross remains when using modern reference samples? *Journal of Arcaheological Science* 33: 349-359.

Edvardsen, A., D. Slagstad, K.S. Tande, and P. Jaccard
2003 Assessing zooplankton advection in the Barents Sea using underway measurements and modelling. *Fisheries Oceanography* 12, 2: 61-71.

Edvardsson, R., S. Perdikaris,. T.H. McGovern, C. Amundsen, N. Zagor, M. Waxman

2003 *Hard times in NW Iceland : an 18th c archaeofauna from Finnbogastaðir.* NORSEC Zooarchaeology Laboratory Reports No. 12.

Edvardsson, R, S. Perdikaris, T.H. McGovern, N. Zagor, and M. Waxman
2004 Coping with hard times in North-west Iceland: Zooarchaeology, History, and Landscape Archaeology at Finnbogastaðir in the 18th century, *Archaeologica Islandica* 3:20-48.

Efremov, I.A.
1940 Taphonomy: A new branch of paleontology. *Pan-American Geologist* 74:81-93.

1950 Taphonomy and the geological record. *Tr. Paleontol. Inst. Acad. Sci. USSR* 24:1-77.
1953 Taphonome et annales géologiques (trans. S. Ketchian and J. Roger). *Ann. du Centre d'Etud. Et de Doc. Paléontol.* No.4: 1-164.

Eggvin, J.
1938 Trekk fra Nord-Norges oseangroafi sett i sammenheng med torskefisket. *FiskDir.Skr. Ser. HavUnders.*, 5: 33-46.

Ellertsen, B., P. Fossum, P. Solemdal and S. Sundby
1989 Relation between temperature and survival of eggs and first-feeding larvae of northeaat Arctic cod (*Gadus morhua L.*). *Rapports et procès-verbaux des réunions, Conseil International pour l'Exploration de la Mer*, 191, 209-19.

Elton,C. S.
1924 Periodic fluctuations in the numbers of animals: their causes and effects. *British Journal of Experimental Biology,* 2119-163.

Elverhøi, A., S.L. Phirman, A. Solheim, B.B. Larssen
1989 Glaciomarine sedimentation in epicontinental seas exemplified by the northern Barents Sea. In: Powell, R.D., Elverhøi, A. (Eds.), Modern Glaciomarine Environments: Glacial and Marine Controls of Modern Lithofacies and Biofacies. *Marine Geology* Vol. 85, 225–250.

Engelstad, E.
1984 Diversity in Arctic maritime adaptations. An example from the Late Stone Age of Arctic Norway. *Acta Borealia* 2: 3-24.

1990 The Meaning of Sedentism and Mobility in an archaeological and historic Context. *Acta Borealia* 2: 23-30.

Enghoff, I.B.
1994 Fishing in Denmark during the Ertebølle period. *International Journal of Osteoarchaeology*, 4: 65-96.

Erlinge, S.
1969 Food habitats of the otter (*Lutra lutra L.)* and the mink (*Mustela vison*) in a trout water in southern Sweden. *Oikos* 20:1-7.

Eronen, M., P. Zetterberg, K. Briffa, M. Lindholm, J. Meriläinen and M. Timonen.
2002 The supra-long Scots pine tree-ring record for Finnish Lapland—Part 1: chronology construction and initial interferences. *The Holocene* 12 (6):673-680.

Esper, J., E.R. Cook, and F.H. Schweingruber.
2002 Low-Frequency Signals in Long Tree-Ring Chronologies for Reconstructing Past Temperature Variability. *Science* 295 (5563): 2250-2253.

Falk-Petersen, S.
1981 Ecological investigations on the zooplankton community of Balsfjorden, Northern Norway: seasonal changes in body weight and the main biochemical composition of Thysanoessa inermis (Krøyer), T. raschii (M. Sars), and Meganyctiphanes norwegica (M. Sars) in relation to environmental factors. *Journal of Experimental Marine Biology and Ecology* 49:103–120.

Ferguson, L.
1980 Looking for the "Afro" in Colono-Indian pottery. In *Archaeological perspectives on ethnicity in America*, edited by R.L. Schuyter. Baywood, Farmingdale, pp. 89-96.

Fevolden, S.E. and G.H. Pogson
1995 Differences in nuclear DNA RFLPs between the Norwegian coastal and the northeast Arctic population of Atlantic cod . In: Skjoldal, H.R., Hopkins, C.C.E., Erikstad, K.E., Leinnas, H.P. (Eds.), *Ecology of Fjords and Coastal Waters*. Elsevier, Amsterdam, pp. 403-415.

Finnmark Novelty Map
n.d. Available at: http://www.finnmark-slekt.com/mappage/000.html.

Fish
2008 Available at: http://sportsmanschoice.com.

Fisher, D.C.
1981 Crocodilian scatology, microvertebrate concentrations and enamel-less teeth. *Paleobiology* 7: 262-275.

Fjærvoll, K.
1961 Korndyrkinga i Hålogaland i gammal tid, 1500-og 1600-åra. Tilleggsbok til Håløygminne. Svorkmo Prenteverk.—— 1964: *Korndyrkinga i Troms fylke i 1700-åra med tilknytting til nyare tid* (Senien og Tromsen Fogderi). Bodø: Nordland Boktrykkeri.

1964 *Korndyrkinga i Troms fylke i 1700-åra med tilknytting til nyare tid* (Senien og Tromsen Fogderi). Bodø: Nordland Boktrykkeri.

Folkow, L.P. and A.S. Blix
1991 Norwegian whale sighting and acoustic surveys in the Atlantic Ocean during the winter of 1989/90. *Rep. Int. Whal. Commn* 41:531-538.

Frafjord, K.
1993 Reproductive effort in the arctic fox Alopex lagopus: a review. *Norwegian Journal of Agricultural Science* 7: 301-309.

1995 Summer food habits of arctic foxes in the alpine region of southern Scandinavia, with a note on sympatric red foxes. *Annales Zoological Fennici*. 32: 111-116.

Frank, A.G.
1966 The Development of Underdevelopment. *Monthly Review* 18:17-31.

Fremstad, E.
1997 Vegetasjonstyper i Norge. Norsk institutt for naturforskning. *Temahefte*, 12, 1–279.

Furevik, T.
2001 Annual and interannual variability of Atlantic Water temperatures in the Norwegian and Barents Seas: 1980–1996. *Deep-Sea Research I* 48, 383–404.

Gabrielsen, G.W. and H. Strøm
2004 Seabird research and monitoring on Jan Mayen Chapter 17. In: Skreslet, S. (Ed.), Jan Mayen Island in Scientific Focus, Nato Science Series, IV, *Earth and Environmental Science*, vol. 45. Kluwer Academic Publications, pp. 181–194.

Galloway, T. W.
1913 Zoology: A Text-Book For Secondary Schools, Normal Schools and Colleges. P. Plakiston's Son & Co. Philadelphia.

Graf, W.
1949 Preserved histological structures in Egyptian mummy tissue and ancient Swedish skeletons. *Acta Anatomy* 8, 236-350.

Grayson, D.K.
1984 *Quantitative zooarchaeology*. Academic, New York.

Greenfield, H. J. and D. Miller
2004 Metal production at Ndondondwane, an Early Iron Age site in KwaZulu/Natal, South Africa. *Journal of Archaeological Science* 31 (11): 1511-1532

Grupe, G.
2007 Taphonomic and Diagenic Processes. (Eds. Winfried Henke and Ian Tattersall). *Handbook of Paleoanthropology*, pp. 241-259.

Geist, V.
1999 *Deer of the world: their evolution, behaviour and ecology*. San-Hill Press, London, United Kingdom.

Giesler, R. M. Högberg and P. Högberg.
1998 Soil chemistry and plants in Fennoscandia boreal forest as exemplified by a local gradient. *Ecology*, Vol. 79, No. 1: 119-137.

Gifford-Gonzalez, D.P.
1989 Ethnographic analogues for interpreting modified bones: some cases from East Africa. In (R. Bonnichsen and M.H. Sorg, eds.) *Bone modification*, Orono: University of Maine Center for the Study of the First Americans, pp.179-246.

1991 Bones are not enough: analogues, knowledge, and interpretative strategies in zooarchaeology. *Journal of Anthropological Archaeology* 10: 215-254.

Gilbert, A.S. and B.H. Singer
1982 Reassessing zooarchaeological quantification. *World Archaeology*, 14:21-40.

Gjertz, I. and Wiig, Ø..
1992 Feeding of walrus Odobenus rosmarus in Svalbard. *Polar Records* 28: 57–59.

Gjertz, I., G. Henriksen, T. Øritsland and Ø. Wiig.
1993 Observations of walruses along the Norwegian coast 1967-1992. *Polar Research* 12: 27-31.

Gjessing, G.
1935 *Fra steinalder til jernalder i Finnmark: etnologiske problemer*.

1939 Noen nord-norske handelsproblemer i jernalder, *Viking*, Vol. 3:37-54.

Gloersen, P., W.J. Campbell, D.J. Cavaliere, J.C. Comaso, C.L. Parkinson, H.J. Zwalley
1992 *Arctic and Antarctic sea ice, 1978–1987.* Satellite passes: microwave observations and analysis. Scientific and Technical Program, NASA, Washington, Washington.

Gobalet, K.W.
2001 A Critique of Faunal Analysis; Inconsistency among Experts in Blind Tests. *Journal of Archaeological Science* 28: 377-386.

Godø, O.R.
1984 Cod (*Gadus morhua L.*) off Møre—composition and migration. In: E. Dahl, D.S. Danielssen, E. Moksness and P. Solemdal, Editors, *The Propagation of Cod* (*Gadus morhua L.).* Flødevigen rapportser pp. 591–608.

1989 The use of tagging studies to determine the optimal time for estimating acoustic abundance of spawning cod. *Fisheries Research* Volume 8, Issue 1, 129–140.

Godø, O.V. and E. Moksness
1987 Growth and Maturation of Norwegian coastal cod and Northeast Arctic cod under different conditions. *Fisheries Research* Volume 5, Issues 2-3: 235-242.

Godø, O.R., I. Huse and K. Michalsen
1997 Bait defence behavior of wolffish and its impact on longline catch rates. *ICES Journal of Marine Science* 54: 273-275.

Gordon, C. C. and J.E. Buikstra
1981 Soil pH, bone preservation, and sampling bias at mortuary sites. *American Antiquity* 46: 566–571.

Gordon, E.A.
1993 Screen size and differential faunal recovery: a Hawaiian example. *Journal of Field Archaeology* 20: 453-460.

Gorshkov, S. and V. Faleev (Eds.)
1980 *Atlas of the Oceans*: *The Arctic Ocean*. USSR Ministry of Defence.

Gosden, C.
1999 *Anthropology and Archaeology: A changing relationship*. Routledge London.

Grandberg, J.
1996 The political and administrative structure of Novgorod. In *Culture Clash or Compromise? The Europeanization of the Baltic Sea Area 1100 – 1400 A.D.*. Paper of the XIth Visby Symposium. Gotland Centre for Baltic Studies, Gotland University College Visby.

Grove, J.M.
1988 *The Little Ice Age*. London: Methuen.

Grove, J.M. and R. Switsur
1994 The glacial geological evidence for the Medieval Warm Period. *Climatic Change* 30: 1–27.

Grudd, H., K.R. Briffa,W. Karlén,T.S. Bartholin,P.D. Jones and B. Kromer
2002 A 7400-year tree-ring chronology in northern Swedish Lapland: natural climatic variability expressed on annual to millennial timescales, *The Holocene*,12: 657–665.

Gunnarson B. and H.W. Linderholm
2002 Low frequency climate variation in Scandinavia since the 10th century inferred from tree rings. *The Holocene* 12: 667-671.

Gurevich, V.S.
1980 Worldwide distribution and migration patterns of the white whale (beluga), Delphinapterus leucas. *Reports International Whaling Commission* 30, 465–480.

Haapasaari, M.
1988 The oligotrophic heath vegetation of northern Fennoscandia and its zonation. *Acta Botanica Fennica*, 135, 1–219.

Haemig, P.D.
2006 *Hawks, owls and falcons that protect nesting birds*. ECOLOGY INFO #3.

Halvorsen, E. and K.S. Tande
1999 Physical and biological factors influencing the seasonal variations in distribution of the zooplankton across the shelf at Nordvestbanken, Northern Norway, 1994. *Sarsia* 84:279–292.

Halstead, P., P. Collins and V. Isaakidou
2002 Sorting the Sheep from the Goats: Morphological Distinctions between the Mandibles and Mandibular Teeth of Adult Ovis and Capra. *Journal of Archaeological Science* 29: 545-553.

Hambleton, E. and P. Rowley-Conwy
1997 The medieval reindeer economy at Gæccevaj'njar'ga 244 B in the Varanger Fjord, North Norway. *Norwegian Archaeological Review* Vol. 30 (1): 55-70.

Hammil, M.O., C. Lydersen, M. Ryg and T.G. Smith
1991 Lactation in the ringed seal (*Phoca hispida*). *Can. J. Fish. Aquat. Sci*. 48: 2471-2476.

Hamre, J.
1994 Biodiversity and exploitation of the main fish stocks in the Norwegian–Barents Sea ecosystem. *Biodivers Conserv* 3:473–492.

Hansen, L.I.
1996 Interaction between Northern European sub-arctic Societies during the Middle Ages. In: Rindal, M. (ed.) *Two Studies on the Middle Ages*, KULTs skriftserie No. 66. p. 31 – 95.

2008 The Overlapping Taxation Areas of the North and the Nature of the Russian-Norwegian Border in Medieval and Early Modern Times. In Olsen, B. and P. Urbańzcyk (eds), *Hybrid spaces? Medieval Finnmark and the Archaeology of Multi-Room Houses.* Novus, Oslo (in press).

Harrison, R. S. Brewington, J. Woollett, T. H. McGovern
2004 *Interim Report of Animal Bones from the 2003 Excavations at Gásir, Eyjafjörður, N Iceland.* NORSEC Zooarchaeology Laboratory Reports No. 16.

Hassel, A., H.R. Skjoldal, H. Gjøsæter, H. Loeng and L. Omli
1991 Impact of grazing from capelin (*Mallotus villosus*) on zooplankton: a case study in the northern Barents Sea in August 1985. *Polar Research* 10: 371–388.

Haug, T., A.B. Krøyer, K.T. Nilssen, K.I. Ugland and P.E. Aspholm
1991 Harp seal (*Phoca groenlandica*) invasions in Norwegian coastal waters: age composition and feeding habits. *ICES Journal of Marine Science* 48: 363-371.

Haug, T., G. Henriksen, A. Kondakov, V. Mishin, K.T. Nilssen, and N. Røv
1994 The status of Grey seals Halichoerus grypus in North Norway and on the Murman coast, Russia. *Biological Conservation* 70:59-67.

Haug, T., H. Gjøsæter, U. Lindstrøm, K.T. Nilssen, I. Røttingen
1995 Spatial and temporal variations in northeast Atlantic minke whale Balaenoptera acutorostrata feeding habits. In A.S. Blix, Walløe, L. and Ulltang, Ø. (eds.), *Whales, Seals, Fish and Man-Proceedings of the International Symposium on the Biology of Marine Mammals in the Northeast Atlantic*, Elsevier, Amsterdam, pp. 225-239.

Helama, S., M. Lindholm, M. Timonen, J. Merilainen, and M. Eronen
2002 The supra-long Scots pine tree-ring record for Finnish Lapland: Part 2, interannual to centennial variability in summer temperatures for 7500 years. *The Holocene* 12: 681-687.

Helskog, E.
1983 *The Iversfjord locality. A study of behavioral patterning during the Late Stone Age of Finnmark, North Norway*. Tromsø Museums Skrifter Vol. XIX.

Helskog, K.
1980 The Chronology of the Younger Stone Age in Varanger, North Norway. *Norwegian Archaeological Review* 13 (1): 97-103.

Henningsson S.S. and T. Alerstam
2006 Implications of migratory connectivity for species' ranges and subspeciation of arctic shorebirds. *Ardea* 94(3): 499–509.

Henry, J.D.
1986 *The red fox, the cat-like canine.* Smithsonian Institute Press, Washington, D.C..

Henriksen, J.E.
1995 *Hellegropene. Fornminner fra en funntom periode*. Hovedoppgaver. Institute i arkeologi, Universitetet i Tromsø.

2002 *Kulturmiljøer fra jernalder og elder historisk tid i kyst-Finnmark: En undersøkelse med utgangspunkt i fenoment mangeromstufter*. Institutt for Arkeologi, Universitetet i Tromsø.

Hesse, B. and P. Wapnish
1985 *Animal Bone Archaeology: From Objects to Analysis*. Washington, D.C.: Taraxacum.

Hilmer, M. And Jung, T.
2000 Evidence for a recent change in the link between the North Atlantic Oscillation and Arctic sea ice export. *Geophysical Research Letters*, 27: 989-92.

Hirotani, A.
1994 Dominance rank, copulatory behaviour and estimated reproductive success in male reindeer. *Animal Behaviour* 48:929–936.

Hjelset, A.M., M. Andersen, I. Gjertz, C. Lydersen and B. Gulliksen
1999 Feeding habits of bearded seals (Erignathus barbatus) from the Svalbard area, Norway. *Polar Biology* 21, 186–193.

Hoffman, B.W., J.M.C. Czederpiltz and M.A. Partlow
2000 Heads or tails: The zooarchaeology of Aleut Salmon storage of Unimak island, Alaska. *Journal of Archaeological Science* 27: 699-708.

Holm-Olsen, M. I.
1981 The Helgøy project. Economy and settlement pattern 1350 – 1600 A.D.. *Norwegian Archaeological Review* Vol. 14:86-100.

1985 Farm mounds and land registers in Helgøy, North Norway: an investigation of trends in site location by Correspondence Analysis. *American Archaeology*, Vol. 5, No 1:27-34.

1988 The archaeological survey of North Norway. In Multivariate archaeology. Numerical approaches in Scandinavian archaeology. *Jutland Archaeological Society Publications*, Vol. 21: 61-69.

Holzhauser, H. and H.J. Zumbühl
1988 Alpengletscher in der Kleinen Eiszeit. *Die Alpen* 64(3).

Hopkins, T.S.
1991 The GIN Sea—a synthesis of its physical oceanography and literature review 1972–1985. *Earth-Science Reviews* 30 (3–4), 175–318.

Hurrell, J. W.
1995 Decadal trends in the North Atlantic Oscillation: Regional temperatures and precipitation. *Science* 269: 676-679.

Hurrell JW, Y. Kushnir, G. Ottersen and M. Visbeck
2003 An overview of the North Atlantic Oscillation. In: Hurrell JW, Kushnir Y, Ottersen G, Visbeck M (eds) The North Atlantic Oscillation: climatic significance and environmental impact. *Geophysi Monograph* 134: 1–35.

Hughes, M.K. and H.F. Diaz
1994 Was there a 'Medieval Warm Period',and, if so, where and when? *Climatic Change* 26: 109–42.

Huse, I. and A.V. Soldal
2000 An attempt to improve size selection in pelagic longline fisheries for haddock. *Fisheries Research* Vol. 48, Issue 1: 43-54.

Hylen, A., Midttun, L. and Sætersdal, G.
1961 Torskeundersokelsene i Lofoten og i Barentshavet 1960. *Fisk. Gang*, 47:101-114.

Høines, Å.S. and K. Korsbrekke
2003 Population structure of Greenland halibut (*Reinhardtius hippoglossoides*) in the Northeast Arctic, 1992-2000. *Journal of Northwest Atlantic Fishery Science* 31: 85-97.

Hämet-Ahti, L.
1963 Zonation of the mountain birch forest in northernmost Fennoscandia. *Annales Botanici Fennici Vanamo*, 34, 1–127.

Ims, R.A. and H. Steen.
1990 Geographical synchrony in microtine population cycle: a theoretical evaluation of the role of nomadic avian predators. *Oikos* 57: 381-387.

Ingold, T.
2000 *The Perception of the Environment: Essays in livelihood, dwelling and skill.* Routledge: London

Ingram, M.J., G. Farmer and T.M.L. Wigley
1981 Past climates and their impact on man. In Wigley, T.M.L., Ingram, M.J. and Farmer, G., editors, *Climate and history: studies in past climates and their impact on man*. Cambridge: Cambridge University Press, 3–50.

Jakobsen, T.
1987 Coastal cod in Northern Norway. *Fisheries Research*, Volume 5, Issues 2-3: 223-234.

James, S. R.
1997 Methodological Issues Concerning Screen Size Recovery Rates and Their Effects on Archaeofauanal Interpretations. *Journal of Archaeological Science* 24: 385-397.

Jennings, A.E. and N.J. Weiner
1996 Environmental change in eastern Greenland during the last 1, 300 years: Evidence from foraminifera and lithofaces in Nansen Fjord, 68 Degrees N. *The Holocene* 6 (2): 179-191.

Jensen, C.
2008 Vegetation history and anthropogenic impact on vegetation at localities with multi-room houses in Finnmark, Norway. In Olsen, B. and P. Urbańzcyk (eds), *Hybrid spaces? Medieval Finnmark and the Archaeology of Multi-Room Houses*. Novus, Oslo (in press).

Johannesen, J. M.
2004 Operational Ethnicity-Serial Practice and Materiality. In *Material Culture and Other Things Post-disciplinary Studies in the 21st Century Gotarc*, Series C, No 61 edited by Fredrik Fahlander and Terje Oestigaard. Department of Archaeology University of Gothenburg pp. 161-184.

Johannessen, O.M., L. Bengtsson, M.W. Miles, S.I. Kuzmina, V.A. Semenov, G.V. Alekseev, A.P. Nagurny, V.F. Zakharov, L.P. Bobylev, L.H. Pettersson, K. Hasselmann, H.P. Cattle
2002 Arctic climate change – observed and modelled temperature and sea ice. *Tellus A* 56, 328–341.

Johnansen, S.
1947 On the distributions of precipitation in northern Norway in various weather situations. *Meteorologiske Annaler* 2:11, 343-386.

Jones, S.
1997 *The Archaeology of Ethnicity: Constructing identities in the past and present.* Routledge. London and New York.

Jones, P.D., K.R. Briffa, T.P., Barnett and S.F.B. Tett
1998 High-resolution palaeoclimatic records for the last millennium: interpretation,integration and comparison with General Circulation Model control run temperatures. *The Holocene*, 8, 455-471.

Jørgensen, R.
1987 Eldre metalder i Nordland og Troms. *Acta Borelia* Vol. 3, No.2: 61-87.

Jørgensen, R., N. O. Handegard, H. Gjøsæter and A. Slotte
2004 Possible vessel avoidance behaviour of capelin in a feeding area and on a spawning ground. *Fisheries Research*, Volume 69, Issue 2: 251-261.

Karlsen, S. R., A. Elvebakk and B. Johansen
2005 A vegetation-based method to map climatic variation in the arctic–boreal transition area of Finnmark, north-easternmost Norway. *Journal of Biogeography* 32, 1161–1186.

Kauhala, K.
1996 Distributional history of the American mink (*Mustela vison*) in Finland with special reference to the trends in otter (*Lutra lutra*) population. *Annales of Zoologici Fennic* 33: 283-291.

Kay, R.N.B.
1979 Seasonal changes of appetite in deer and sheep. *Agricultural Research Council.* Research Review 5, 13–15.

Kirchhefer, A.J.
2005 A discontinuous tree-ring record AD 320-1994 from Dividalen, Norway: inferences on climate and tree-line history. In: Broll, G & Keplin, B (eds) *Mountain Ecosystems - Studies in Treeline Ecology*. Springer, Berlin, p. 219-235.

Klein, R.G. and K. Cruz-Uribe
1984 *The Analysis of Animal Bones from Archaeological Sites*. Chicago: University of Chicago Press.

Klein, D. R.
1999 The roles of climate and insularity in establishment and persistence of Rangifer tarandus populations in the high Arctic. *Ecological Bulliten* 47: 96-014.

Klepinger, L.L.
1984 Nutritional Assessment From Bone. *Annual Review of Anthropology* 13: 75-96.

Kleppe, E.J.
1974 *Samiske jernalderstudier ved Varangerfjorden*. Magister thesis, University of Bergen.

1977 Archaeological material and ethnic identification. A study of Lappish material from Varanger, Norway. *Norwegian Archaeological Review* Vol. 12:1-2.

Konstantinov, K.G.
1967 Forecasting of the distribution of fish concentrations in the Barents Sea according to the temperature factor. *Fish. Res. Board Can.,* Transl. Set. No. 1132: 1-28.

Konstantinov, K.G.
1969 Effect of natural factors and fishing on the abundance of groundfish in Northern Seas. *Fish. Res. Board Can. Transl*. Ser. No. 1559: 1-12.

Kopytoff, I.
1986 The cultural biography of things: commoditization as process. In *The social life of things: commodities in cultural perspective.* Ed. Arjun Appadurai pp. 64-94.

Korhola, A., K. Vaski, H.T.T. Toivonen, and H. Olander
2002 Holocene temperature changes in northern Fennoscandia reconstructed from chrinomids using Bayesian modelling. *Quaternary Science Reviews* 21, 1841-1860.

Korhola, A., J. Weckström, L. Holmström, and P. Erästö
2000 A quantitative Holocene Climatic Record from diatoms in Northern Fennoscandia. *Quaternary Research* 54, 284-294.

Korpimäki, E.
1985 Rapid tracking of microtine populations by their avian predators: possible evidence for stabilizing predation. *Oikos* 45: 281-284.

Kovalev, Roman Konstaninovich

2003 *The Infrastructure of the Novgorodian Fur Trade in the Pre-Mongol Era (CA. 900-CA. 1240).* Unpublished Ph.D. thesis.

Krauss, W.

1986 The North Atlantic current. *Journal of Geophysical Research* 91, 5061–5074.

Krebs, C. J., and J. H. Myers

1974 Population cycles in small mammals. *Advances in Ecological Research*, 8:267-399.

Krebs, C.J.

1996 Population Cycles Revisited. *Journal of Mammology*, Vol.77, No. 1: 8-24.

Krivogorskaya, Y., S. Perdikaris and T.H. McGovern

2005 Fish bones and fishermen: the potential of zooarchaeology in the Westfjords. *Archaeologia Islandica* 4: 31-50.

Kruuk, H.

1996 *Wild otters. Predation and populations*. Oxford University Press, Oxford.

2006 *Otters: ecology, behavior and conservation*. Oxford University Press, Oxford.

Kulturhistorisk leksikon for nordisk middelalder, 1-21, 1956 – 1978.

Kvamme, C., L. Nøttestad, A. Fernö , O.A. Misund, A. Dommasnes, B.E. Axelsen, P. Dalpadado and & W. Melle.

2003 Migration patterns in Norwegian springspawning herring: why do young fish swim away from the wintering area in late summer. *Marine Ecology Progress Series* 247: 197–210.

Lamb, H. H.

1977 *Climate — Present, Past and Future*. Volume 2. Climatic history and future. Methuen, London.

Lamb, P. J. and R. A. Peppler

1987 North Atlantic oscillation: Concept and an application. *Bull. Amer. Meteor. Soc*. 68: 1218-1225.

Larivière, S. and M. Pasitschniak-Arts

1996 Vulpes vulpes. *Mammalian Species*, No. 537: 1-11.

Larsen, G., W. Hemmingsen, K. MacKenzie and D. A. Lysne

1997 A population study of cod, Gadus morhua L., in northern Norway using otolith structure and parasite tags. *Fisheries Research*, Volume 32, Issue 1: 13-20.

Lauritzen, S.-E., and J. Lundberg

1999 Calibration of the speleothem delta function: an absolute temperature record for the Holocene in northern Norway. *The Holocene* 9, 659-669.

Leach, F.
1997 *A Guide to the Identification of Fish Remains from New Zealand Archaeological Sites*. New Zealand Journal of Archaeology Special Publication. Kilbirnie: New Zealand Journal of Archaeology.

Lee, A.J.
1952 The influence of hydrography on the Bear Island cod fishery. Rapp. P.-v. Réun. *Cons. Explor. Mer*. 131: 74-102.

Leetmaa, A., J.P. McCreary Jr., D.W. Moore
1981 Equatorial currents: observations and theory. In: Warren, B.A., Wunsch, C. (Eds.), *Evolution of Physical Oceanography*. MIT Press, Cambridge, pp. 184–196.

Lie, R.
1980 Minimum number of individuals from archaeological samples. *Norwegian Archaeological Review*, 13(1): 24-31.

Linderholm, H.M.
2001 Climatic influence on Scots pine growth on dry and wet soils in the central Scandinavian mountains, interpreted from tree-ring width. *Silva Fennica* 35(4): 415–424.

Lindholm, H.M. and M. Eronen
2000 A reconstruction of mid-summer temperatures from ring-widths of scots pine since AD 50 in Northern Fennoscandia. *Geografiska Annaler* 82 A, 527-535.

Lindström, E.
1980 The red fox in a small game community of the south taiga region in Sweden. *Biogeographica* 18: 177-184.

Linse, A. R.
1992 Is bone safe in a shell midden? In (J. K. Stein,Ed.) *Deciphering a Shell Midden*. San Diego: Academic Press, pp. 327–345.

Linse, A. R. & Burton, J. H.
1990 *Bone solubility and preservation in alkaline depositional conditions*. Paper presented at the 55th Annual Meeting of the Society for American Archaeology, Las Vegas.

Loeng, H.
1991 Features of the physical oceanographic conditions in the central parts of the Barents Sea. *Polar Research* 10, 5–18.

Loeng, H.
1992 Fysisk Oseanografi. In: Sakshaug, E. (Ed.) *Økosystem Barentshavet*, NAVF, NFFR, MD, Oslo, pp. 23–42 (in Norwegian).

Loudon, A.S.I., J.A. Milne, J.D. Curlewis and A.S. McNeilly
1989 A comparison of the seasonal hormone changes and patterns of growth, voluntary food intake and reproduction in juvenile and adult red deer (Cervus elaphus) and Pere David's deer (Elaphurus davidianus) hinds. *Journal of Endocrinology* 122, 733–745.

Lund, H.
1962 The red fox in Norway II. The feeding habits of the red fox in Norway. *Medd. Stat. Viltund.*. 12: 1-19.

Lund, H.E.
1957 Gårdgshaugene-Gammelgårde-Gården og Vaeret I jernalder, mellomalder og ny tid (Hålogaland). *Håløygminne*, Vol. 10: 18-21.

Lund, D.C., J. Lynch-Stieglitz and W.B. Curry
2006 Gulf Stream density structure and transport during the past millennium. Nature, Vol. 444, No. 7119: 601-605.

Lyman, L.R. and G.L. Fox
1989 A critical evaluation of bone weather as an indication of bone assemblage formation. *Journal of Archaeological Science*, 16:3:293-317.

Lyman, Lee R.
1994 *Vertebrae Taphonomy*. Cambridge University Press.

Løken, S. And Pedersen, T.
1996 Effect of parent type and temperature on vertebrae number in juvenile cod (*Gadus morhua L.*) in northern Norway. *Sarsia* 80, 293-298.

Løken, S., Pedersen, T. and Berg, E.
1994 Vertebrae numbers as an indicator for the recruitment mechanism of coastal cod of northern Norway. *ICES Marine Science Symposium* 198: 510-519.

Løset, S..
1993 Thermal energy conservation in icebergs and tracking by temperature. Journal of Geophysics Research 98 C6., 10001–10012.

Mann,M.E., R.S. Bradley and M.K. Hughes
1998 Global-scale temperature patterns and climate forcing over the past six centuries. *Nature*, 392: 779-787.

Map at the Oceans
n.d. Available at: library.thinkquest.org/TQ0311165/atocean.htm.

Marshall, J., Y. Kushnir, D. Battisti, P. Chang, A. Czaja,
R. Dickson, J. Hurrell, M. McCartney, R. Saravanan and M. Visbeck
2001 Nort Atlantic climate variability: phenomena, impacts and mechanisms. *International Journal of Climatology*, 21, 1863-1898.

Mason, C.F. and S.M. Macdonald
1986 *Otters: ecology and conservation*. Cambridge University Press, Cambridge.

Matsui, A.
1996 Archaeological Investigations of Anadromous Salmonid Fishing in Japan. *World Arcaheology* 27: 444-460.

Mayewski, P.A., L.D. Meeker, S. Whitlow, M.S. Twickler, M.C. Morrison, P. Bloomfield, G.C. Bond, R.B. Alley, A.J. Gow, P.M. Grootes, D.A. Meese, M. Ram, K.C. Taylor, and W. Wumkes
1994 Changes in atmospheric circulation and ocean ice cover over the North Atlantic during the last 41, 000 years. *Science* 263: 1747-1750.

Maykut, G.A.,
1985 The ice environment. In: Horner, R.A. (Ed.), *Sea Ice Biota*. CRC Press, Boca Raton, USA, pp. 21–82.

McGovern, T.H.
1979 *The paleoeconomy of Norse Greenland: Adaptation and extinction in a tightly bounded ecosystem*. Ph.D. unpublished dissertation, University of Michigan.

1981 The economics of extinction in Norse Greenland. In *Climate and history, studies in past climates and their impact on man*, edited by T.M.L. Wigley, M.J. Ingram, and G. Farmer, 404-434. Cambridge: Cambridge Univeristy Press.

1985 Contributions to the paleoeconomy of Norse Greenland. *ACTA Archaeologica*, 54: 73-122.

1991 Climate, correlation, and causation in Norse Greenland. *Arctic Archaeology* 28 (2): 77-100.

2000 The Demise of Norse Greenland. In *Vikings: The North Atlantic Saga*. William W. Fitzhugh and Elisabeth I. Ward (Eds.). Smithsonian Institution Press, pp. 327-339.

McGovern, T.H, S. Perdikaris, Á. Einarsson, and J. Sidell
2002 *Inland Sites and Coastal Connections - Patterns of Wild Animal Exploitation in Settlement Age Mývatn District, Northern Iceland*. NORSEC Zooarchaeology Laboratory Reports No.4.

McGovern, T.H. and Sophia Perdikaris
2002 *Preliminary report of animal bones from Hrísheimar N Iceland.* NORSEC Zooarchaeology Laboratory Reports No.6.

McGovern, T.H and Sophia Perdikaris
2003 *Report of Animal Bones from Selhagi, Mývatn District, Northern Iceland.* NORSEC Zooarchaeology Laboratory Reports No. 7.

McGovern, T.H., C. Amundsen, S. Perdikaris, R. Harrison, Y. Krivogorskaya
2004 *An Interim report of a Viking-Age & Medieval Archaeofauna from Undir Junkarinsfløtti, Sandoy, Faroe Islands*. NORSEC Zooarchaeology Laboratory Reports No. 17.

McGovern, T.H., O. Vésteinsson, S. Perdikaris, C. Amundsen
2004 *Zooarchaeology of Landnám: 9th-11th c Midden Deposits at Sveigakot, N Iceland.* NORSEC Zooarchaeology Laboratory Reports No. 18.

McGovern, Thomas H., Sophia Perdikaris, Arni Einarsson, and Jane Sidell
2005 Inland Cod and Sustainable Waterfowl; wild species use in Viking age Mývatnssveit, N Iceland, *Environmental Archaeology* in press.

McGuire, Randall H.
1982 The Study of Ethnicity in Historical Archaeology. *Journal of Anthropological Archaeology* Vol 1, Number 2 pp. 159-178.

Mehlum, F.
1989 Summer distribution of seabirds in northern Greenland and Barents Sea. *Norsk Polarinstitute Skrifter* 191: 1-56.

1997 Seabird species associations and affinities to areas covered with sea ice in the northern Greenland and Barents Sea. *Polar Biology* 18: 116-127.

Mehlum, F., and G.W. Gabrielsen
1995 Energy expenditure and food consumption by seabird populations in the Barents Sea region. In:Skjoldal, H.R., Hopkins, C., Erikstad, K.E., Leinaas, H.P. (Eds.), *Ecology of Fjords and Coastal Waters*. Elsevier Science, Amsterdam, pp. 457–470.

Meinen, C.S.
2001 Structure of the North Atlantic current in stream-coordinates and the circulation in the Newfoundland basin. *Deep-Sea Research I* 48, 1553–1580.

Meldgaard, M.
1983 *Resource fluctuations and human subsistence. An archaeozoological and ethnographical investigation of a West Greenland caribou hunting camp*. BAR, International.

Melle, W. and H.R. Skjoldal
1998 Reproduction and development of *Calanus finmarchicus*, *C. glacialis* and *C. hyperboreus* in the Barents Sea. *Marine Ecolological Progressive Series* 169:211–228.

Michalsen, K.
1999 *Distribution of gadoids in the Barents Sea: impact on survey results*. D.Sc. Thesis, University of Bergen, pp. 143-167.

Mitchell, D.
1988 Changing Patterns of Resources Use in the Prehistory of Queen Charlotte Strait, British Columbia. *Research Economic Anthropology*, Supplement 3:345-290.

Miller, D.
1997 *An Ethnographic Approach*. Berg: Oxford.

Miller, F.L.
1974 *Biology of the Kaminuriak Population of barren-ground caribou Part 2*. Canadian Wildlife Service Report Series Number 31 Ottawa.

1976 *Biology of the Kaminuriak Population of barren-ground caribou Part 3*. Canadian Wildlife Service Report Series Number 36 Ottawa.

Moen, A.
1987 The regional vegetation of Norway; that of central Norway in particular. *Norsk Geografic Tidskrifter* 41: 179-226.

1999 *National Atlas of Norway: Vegetation*. Hsnefoss: Norwegian Mapping Authority.

Moen, J. and Danell, O.
2003 Reindeer in the Swedish mountains: an assessment of grazing impacts. *Ambio* 32: 397-402.

Mukhin, A.I.
1979 Distribution of the demersal fishes in the Southern Barents Sea depending on the heat content of water masses. *Counc. Meet. Int. Counc. Explor Sea*, 1979 (G 18): 1-8.

Murray, J. L.
1998 *Ecological characteristics of the Arctic*. In AMAP (ed.), AMAP assessment report: Arctic pollution issues: Arctic monitoring and assessment programme (AMAP), pp. 117–140. Oslo, Norway.

Myklestad, Å.
1993 The Distribution of Salix Species in Fennoscandia: A Numerical Analysis. *Ecography*, Vol. 16, No. 4: 329-344.

Møller, D.
1968 Genetic diversity in spawning cod along the Norwegian coast. *Hereditas* 60: 1-32.

Nagaoka, L.
2005 Differential recovery of Pacific Island fish remains. *Journal of Archaeological Science* 32: 941-955.

Nakken, O. and A. Raknes
1987 The Distribution and Growth of North-east Arctic cod in Relation to Bottom Temperatures in the Barents Sea, 1978-1984. *Fisheries Researchers*, 5: 243-252.

Nance, J.D. and B.F. Ball
1986 No Surprises? The Reliability and Validity of Test Pit Sampling. *American Antiquity*, 51 (3): 457-483.

Newman, M.E., J.S. Parboosingh, P.J. Bridge, H. Ceri
2002 Identification of archaeological animal bone by PCR/DNA analysis. *Journal of Archaeological Science* 29: 77-84.

NgL, 2. rekke - Norges gamle Love, Annen rekke 1388 - 1604, Vol. I – IV, 1914 –1995. Christiania/Oslo.

Nicolaissen, O.
1921 En boplads fra den arktiske stenalder. *Ts. M. Aarsh*. 44 nr. 4.

Nicholson, R.A.
1998 Fishing in the Northern Isles: a case study based on fish bone assemblages from two multi-period sites on Sanday, Orkney. *Environmental Archaeology: The Journal of Human Palaeocology* 2: 15-58.

Nicolaissen, O.
1904 *Katalog over Oldsager i Tromsø Musuem*. Universitetet i Tromsø.

Nielsen-Marsh, C.M. and R.E.M. Hedges
2000 Patterns of Diagensis in Bone I: The Effects of Site Environment. *Journal of Archaeological Science* 27:1139-1150.

Niemi, E..
1994 Østsamene – ressursutnyttelse og rettigheter. *NOU*, No. 21:299-350.

Nilsen, K.
1945 *Spørmålet om den lappiske torvgammens opprinnelse*. Studia Septentrionalia 1.

Nilsen, E. B., T. Pettersen, H. Gundersen, J.M. Milner,
A. Mysterud, E. J. Solberg, H. P. Andreassen and N. C. Stenseth
2005 Moose harvesting strategies in the presence of wolves. *Journal of Applied Ecology* 42: 389-399.

Nordeide, J.T. and Pettersen, I.H..
1998 Haemoglobin frequencies and vertebral numbers of cod (*Gadus morhua L.*) off northern Norway-at test of a population structure hypothesis. *ICES Journal of Marine Science* 55: 134-146.

Noe□Nygaard, N.
1989 Man□made trace fossils in bone. *Human Evololution* 4: 461–491.

Norten, C.J., B. Kim and K. Bae
1999 Differential Processing of Fish During the Korean Neolithic: Konam-Ri. *Arctic Anthropology* 36, No. 1-2:151-165.

North Atlantic Oscillation
2004 Available at: http://www.giub.unibe.ch/klimet/wanner/nao.html.

Odner, K.
1964 *Erverv og bosetning I Komsakulturen*. Viking XXVIII, pp. 117-128.

1992 *The Varanger Saami. Habitation and Economy AD 1200-1900*. The Institute of Comparative Research in Human Culture. Scandinavian Press.

2001 Trade, tribute and household responses. The archaeological excavation at Geahčevájnjárga 244B in Varanger fjord, Northern Norway. *Acta Borealia*, Vol. 18 (1): 25- 50.

Ogilvie, A.E.J.
1991 Climatic changes in Iceland, ad 865 to 1598. In Bigelow, G.F., editor, The Norse of the North Atlantic. *Arctic Archeology*, 61: 233–251.

Ogilvie, A.E.J. and G. Farmer
1997 Documenting the medieval climate. In Hulme, M. and Barrow, E., *Climates of the British Isles. Present, past and future*. London: Routledge, pp. 112–33.

Ogilvie, A.E.J. and T.H. McGovern

2000 Sagas and science: climate and human impacts in the North Atlantic. In: Fitzhugh, W.W. and Ward, E.I. (eds.), *Vikings: the North Atlantic saga*. Washington, Smithsonian Institution Press, pp. 385-393.

Oksanen, L. and T. Oksanen

1981 "Lemmings (*Lemmus lemmus*) and grey-sided voles (*Clethrionomys rufocanus*) in interaction with their resources and predators on Finnmarksvidda, northern Norway". Reports of Kevo Subarctic Research Station, 17: 7-31.

1992 Longterm microtine dynamics in north Fennoscandia tundra: the vole cycle and lemming chaos. *Ecography* 15: 226-236.

Oksanen, T., M. Schneider, U. Rammul, P. Hamback and M. Aunapuu

1999 Population fluctuations of voles in North Fennoscandian tundra: contrasting dynamics in adjacent areas with different habitat composition. *Oikos* 86: 463-478.

Oksanen, L., J. Moen and T. Helle

1995 Timberline patterns in northernmost Fennoscandia. *Acta Botanica Fennica*, 153: 93–105.

Oksanen, L. and R. Virtanen

1995 Topographic, altitudinal and regional patterns in continental and suboceanic heath vegetation of northern Fennoscandia. *Acta Botanica Fennica*, 153: 1–80.

Olbers, D., M. Wenzel, and J. Willebrand

1985 The inference of North Atlantic circulation patterns from climatological hydrographic data, *Rev. of Geophys*., 23(4): 313-356.

Olsen, B.

1984 *Stabilitet og endring. Produksjon og samfunn i Varanger 800 f.Kr. - 1700 e.Kr.* Magisterthesis, Universitetet i Tromsø.

1985 *Arkeologi og etnisitet*. Arkeologisk Museum I Stravanger – Varia, Vol. 15: 25-31.

1986 Norwegian archaeology and the people without (pre-)history, or: how to create a myth of a uniform past. *Archaeological Review from Cambridge* Vol. 5(1).

2000 *Kulturmiljø fra jernalder og eldre historisk tid i kyst Finnmark en undersokelse med utgangspunkt i fenomenet mangeromstufter*. A report submitted to the Norwegian Science Council.

Olsen, B. and P. Urbańzcyk (eds).

2008 *Hybrid spaces? Medieval Finnmark and the Archaeology of Multi-Room Houses. Novus, Oslo* (in press).

Olsen, H.
1967 *Varangerfunnene IV. Osteologisk materiale: Innledning – fisk-fugl*. Tromsø Museums Skrifter VII:4.

Olsen, S.J.
1971 *Zooarchaeology: Animal Bones in Archaeology and their Identification.* Reading: Addison-Wesley Publishing Company, Inc.

Orchard, T.J.
2003 *An Application of the Linear Regression Technique for Determing Length and Weight of Six Fish Taxa: The role of selected fish species in Aleut paleodiet*. BAR International Series 1:172.

Ottersen, G., and N.C. Stenseth
2001 Atlantic Climate Governs Oceanographic and Ecological Variability in the Barents Sea. *Limnology and Oceanography* 46:1774-1780.

Ottersen, G., J. Alheit, K. Drinwater, K. Freidland, E. Hagen and N.C. Stenseth
2004 The response of fish populations to ocean climate fluctuations. In *Marine Ecosystems and Climate Variation : the North Atlantic: A Comparative Perspective*, edited by N. C. Stenseth and G. Ottersen, in collaboration with J. W. Hurrell and A. Belgrano, pp. 73-94, Oxford University Press.

Ottersen, G, N. C. Stenseth, and J. W. Hurrell
2004 Climatic Fluctuations and Marine Systems: A General introduction to the Ecological Effects. In *Marine Ecosystems and Climate Variation : the North Atlantic: A Comparative Perspective*, edited by N. C. Stenseth and G. Ottersen, in collaboration with J. W. Hurrell and A. Belgrano, pp. 3-14, Oxford University Press.

Outram, A.
2001 A New Approach to Identifying Bone Marrow and Grease Exploitation: Why the "Indeterminate" Fragments should not be Ignored. *Journal of Archaeological Science*, Volume 28, Issue 4: 401-410.

O'Brien, S., P.A. Mayewski, L.D. Meeker, D.A. Meese, M.S. Twickler and S.I. Whitlow
1995 Complexity of Holocene climate as reconstructed from a Greenland ice core. *Science*, 270, 1962-1964.

O'Connor, T.
2005 *Introduction*. In Biosphere to Lithosphere: New studies in vertebrate taphonomy. Ed. Teryy O'Connor. Proceedings of the 9th Conference of the International Council of Archaeozoology, Durham, August 2002.

O'Corry-Crowe, G.M.

2002 Beluga whale Delphinapterus leucas. In: Perrin, W.F., Wu¨ rsig, B., Thewissen, J.G.M. (Eds.), *Encyclopedia of Marine Mammals*. Academic Press, San Diego, pp. 94–99.

O'Reilly, K. M., and J. C. Wingfield
1995 Spring and Autumn migration in Acrtic shorebirds: Same distance, different strategies. *American Zoological*, 35:222-233.

Otto, J.S.
1977 Artifacts and status differences: a comparison of ceramics from planter, to overseer, and slave sites on an anterbellum plantation. In *Research strategies in historical archaeology,* edited by S. South, pp. 91 – 118. Academic Press, New York.

1980 Race and class on antebellum plantations. In *Archaeological perspectives on ethnicity in America*, edited by R.L. Schuyter pp. 3-13. Baywood, Farmingdale.

Pape, C.
2004 Rethinking the Medieval Russian-Norwegian Border. *Jahrbücher für Geschichte Osteuropas*, vol. 52, p. 161 – 187.

Parker, G.R.
1972 *Biology of the Kaminuriak Population of barren-ground caribou Part 1*. Canadian Wildlife Service Report Series Number 20. Ottawa.

Partlow, Megan A.
2006 Sampling Fish Bones: A Consideration of the Importance of Screen Size and Disposal Context in the North Pacific. *Arctic Anthropology*, Vol. 43, No. 1: 67-79.

Pauketet, T.
2001 Practice and History in Archaeology: An Emerging Paradigm. *Anthropological Theory* 1:73-98.

2004 The Economy of the Moment: Cultural Practices and Mississippian Chiefdoms. In *Foundations of Archaeological Inquiry* editor James M. Skibo pp. 25-39.

Payne, S.
1972 Partial Recovery and Sample Bias: The Results of Some Sieving Experiments. In *Papers in Economic Prehistory*. Ed. E.S. Higgs, pp. 49-64. Cambridge University Press. London.

Pedersen, T. and J. G. Pope
2003 Sampling and a mortality model of a Norwegian fjord cod (Gadus morhua L.) population. *Fisheries Research*, Volume 63, Issue 1: 1-20.

Pedersen, B.
1990 Distributional patternsof vascular plants in Fennoscandia: a numerical approach. *Nord. J. Bot.*. 10: 163-189.

Perdikaris, S.
1996 Scaly heads and tales: detecting commercialization in early fisheries. *Archeaofauna*, 5: 21-33.

1998a *From Chiefly Provisioning to State Capital Ventures: The Transition from Natural to Market Economy and the Commercialization of Cod Fisheries in Medieval Arctic Norway*. Unpublished doctoral thesis.

1998b The transition to a commercial economy: Lofoten fishing in the Middle Ages, a preliminary report. *Anthropozoologica* No. 25–26:505–10.

1999 From Chiefly Provisioning to Commercial Fishery: Long-term Economic Change in Arctic Norway. *World Archaeology*, Vol. 30, No. 3: 388-402.

Perdikaris, S., C. Amundsen and T.H. McGovern
2001 *Report of Animal Bones from Tjarnargata 3C, Reykjavík, Iceland*. NORSEC Zooarchaeology Laboratory Reports, No 1.

Perkins, D. and P. Daly
1968 A hunters' village in neolithic Turkey. *Sceintific American*, 219(5): 97-105.

Pfister, C., J. Luterbacher, G. Schwarz-Zanetti and M. Wegmann
1998 Winter air temperature variations in Central Europe during the Early and High Middle Ages (A.D. 750-1300). *Holocene*, 8: 547-564.

Pielou, E.C.
1994 *A Naturalist's Guide to the Arctic*. The University of Chicago Press. Chicago.

Piersma, T., Å. Lindström, R. H. Drent, I. Tulp, J. Jukema, R. I. G. Morrison, J. Reneerkens, H. Schekkerman and G. H. Visser
2003 High daily energy expenditure of incubating shorebirds on High Arctic tundra: a circumpolar study. *Functional Ecology*, 17: 356-362.

Prestrud, P.
1992 Food habits and observations of the hunting behaviour of arctic foxes, *Alopex lagopus*, in Svalbard. *Candian Field-Naturalist* 106: 225-236.

Pyszczyk, H.
1989 Consumption and ethnicity: An example of the fur trade western Canada. *Journal of Archaeological Science* Vol. 8 Issue 3: 213-249.

Påhlsson, L.
1998 (ed.) *Vegetationtyper i Norden*. Nordisk Ministerråd, TemaNord, 510, 1–706.

Redfield, R., R. Linton and M.J.Herskovits
1936 A Memorandum on Acculturation. *American Anthropologist* 38: 149-152.

Reimers, E., D.R. Klein and R. Sørumgård
1983 Calving time, Growth rate and body size of Norwegian reindeer on different ranges. *Arctic and Alpine Research*, Vol. 15, No. 1:107-118.

Reimers, E. S. Eftestøl, J.E. Colman
2003 Behavior Responses of Wild Reindeer to Direct Provocation by a Snowmobile or Skier. *The Journal of Wildlife Management*, Vol. 67, No. 4: 747-754.

Reimers, E.
1972 Growth in domestic and wild reindeer in Norway. *Journal of Wildlife Management* 36:612–619.

1983 Reproduction in wild reindeer in Norway. *Canadian Journal of Zoology* 61:211–217.

Reitz, E.J. and E. S. Wing
1999 *Zooarchaeology*. Cambridge: Cambridge University Press.

Remmert, H.
1980 *Arctic Animal Ecology*. Springer-Verlag, New York.

Renouf, M.A.P.
1981 *Prehistoric Coastal Economy in Varangerfjord, North Norway*. Unpubl. Ph.D., University of Cambridge.

1989 *Prehistoric Hunter-Fishers of Varangerfjord, Northeastern Norway*. BAR Internatioanl Series 487, Oxford.

Reymert, P. K.
1980 *Arkeologi og etnisitet: en studie i etnisitet og gravskikk i Nord-Troms og Finnmark i tiden 800-1200*. Magisterthesis, Universitetet i Tromsø.

Reverdin, G., P.P. Niiler and H. Valdimarsson
2003 North Atlantic Ocean surface currents. *Journal of Geophysical Research* 108, 3002.

Rhind, S.M., S.R. McMillen, E. Duff, D. Hirst and S. Wright
1998 Seasonality of meal patterns and normal correlates in red deer. *Physiology and Behavior* 65, 295–302.

Rick, Torben C., Jon M. Erlandson, Michael A. Glassow and Madonna L. Moss
2002 Evaluating the Economic Significance of Sharks, Skates, and Rays (Elasmobranchs) in Prehistoric Economies. *Journal of Archaeological Science* 29: 111-122.

Riseth, J.Å.
2006 Sámi reindeer herd managers: why do they stay in a low-profit business? *British Food Journal* Vol. 108, No. 7: 541-559.

Roff, D. A.
1988 The evolution of migration and some life history parameters in marine fishes. *Environmental Biology of Fishes*, 22: 133–146.

Rogers, J.C.
1997 North Atlantic storm track variability and its association to the North Atlantic Oscillation and climate variability of Northern Europe. *Journal of Climate* 10(7): 1635-1647.

Rojo, A.
1986 Live Length and weight of cod (Gadus morhua) estimated from various skeletal elements. *North American Archaeologist*, Vol. 7(4): 329-351.

1991 *Disctionary of Evolutionary Fish Osteology*. Boca Baton: CRC Press, Inc.

Rollefsen, G.
1933 *The otoliths of the cod*. Fisk Dir. Skr. Ser. Hav. Undrs. 4: 1-14.

Rootenberg, S.
1964 Archaeological field sampling. *American Antiquity* 30: 181-188.

Ross, A. and R. Duffy
2000 Fine mesh screening of midden material and the recovery of fish bone: the development of flotation and deflocculation techniques for an efficient and effective procedure. *Geoarchaeology* 15: 21-31.

Rossby, T.
1996 The North Atlantic Current and surrounding waters: At the crossroads. *Reviews of Geophysics*, 34, 463-481.

Rudels, B., H.J. Friedrich, and D. Quadfasel.
1999 The arctic circumpolar boundary current. *Deep-Sea Research Part II*, 46: 1023-1062.

Røed, K.H., Ø. Holand, M. E. Smith, H. Gjøstein, J. Kumpula and M. Nieminen.
2002 Reproductive success in reindeer males in a herd with varying sex ratio. *Molecular Ecology* 11:1239–1243.

Røed, K.H., Ø. Holand, H. Gjøstein, and H. Hansen.
2005 Variation in Male reproductive success in a wild population of reindeer. *Journal of Wild Life Management* 69(3): 1163-1170.

Sackett, James R.
1986 Isochrestisim and Style: A Clarification. *Journal of Anthropological Archaeology* Vol. 5, Number 3: 266-277.

Sakshaug, E.
1997 *Biomass and productivity distributions and their variability in the Barents Sea*. ICES Journal of Marine Science 54, 341–350.

Sakshaug, E.
2004 Primary and secondary production in the Arctic Seas. In: R. Stein and R.W. Macdonald, Editors, *The Organic Carbon Cycle in the Arctic Ocean*, Springer-Verlag, Berlin. pp. 57–81.

Sakshaug, E. and Skjoldal, H.R.
1989 Life at the ice edge. *Ambio* 18, 60–67.

Salvanes, A.G.V., J. Giske and J.T. Nordeide.
1994 Life-history approach to habitat shifts for coastal cod, Gadus morhua L. *Aquaculture and Fisheries Management* 25, Supplement 1: 215-228.

Santesson, R., Moberg, R., Nordin, A., Tønsberg, T. and Vitikainen,O.
2004 *Lichen-forming and lichenicolous fungi of Fennoscandia*. Museum of Evolution, Uppsala University, Sweden.

Schanche, A.
1986 *Nordnorsk jernalderarkeologi. Et sosialgeografisk perspektiv*. Magisterthesis, Universitetet i Tromsø.

1995 Det symbolske landskapet- lanskap og identitet i samisk kultur. *Ottar*, No. 4: 38-48.

2000 *Graver i ur og berg. Samisk gravskikk og religion fra forhistorisk til nyere tid.* Davvi Girji OS. Karasjok.

Schmitz, W.S., and M.S. McCartney.
1993 On the North Atlantic circulation. *Rev. Geophys.*, 31: 29-49.

Schmitt, D.N. and K.E. Juell.
1994 Toward the Identification of Coyote Scatological Faunal Accumulations in Archaeological Contexts. *Journal of Archaeological Science* 21: 249-262.

Schweingruber, F.H.
1988 Tree rings. *Basics and applications of dendrochronology*. Dordrecht: Kluwer.

Scott, P. A.
1993 Relationship between the onset of winter and collared lemming abundance at Churchill, Manitoba, Canada: 1932–90. *Arctic*, 46:293-296.

Seeman, M.
1986 Fish remains from Smeerenburg, a 17th ~tury Dutch Whaling Station on the west rout of Spitsbergen. In (D. C. Brinkhuizn and A.T. Cason, Eds) *Fish and Archaeology*. Oxford: BAR International Series 294, 129-139.

Selvaggio, M.M., and J. Wilder.
2001 Identifying the involvement of multiple carnivore taxa with archaeological bone assemblages. *Journal of Archaeological Sciences* 28, 465-470.

Sendstad, E.
1977 *Notes on the biology of the Arctic bird rock*. Norsk Polarinstitutt Årbok 1977/78: 265–270.

Seppä, H., and Birks, H. J. B.
2001 July mean temperature and annual precipitation trends during the Holocene in the Fennoscandian tree-line area: pollen-based climate reconstructions. *The Holocene* 11, 527-539.

Serning, I.
1956 Lapska offerplatsfynd från järnålder och medeltid. *Acta Lapponica* 11.

Shaffer, B.S.
1992 Quarter-inch screening: understanding biases in recovery of vertebrate faunal remains. *American Antiquity* 57: 129-136.

Shaffer, B.S. and J.L. J. Sanchez.
1994 Comparison of 1/8″- and 1/4″- mesh recovery of controlled samples of small-to-medium-sized mammals. *American Antiquity* 59: 525-530.

Shemesh, A., Rosquist, G., Rietti-Shati, M., Rubensdotter, L., Bigler, C., Yam, R., and W. Karlén.
2001 Holocene climatic change in Swedish Lapland inferred from an oxygen-isotope record of lacustrine biogenic silicia. *The Holocene* 11, 447-454.

Shipman, P.
1981 *Life history of a fossil: An introduction to taphonomy and paleoecology*. Harvard University Press, Cambridge/Mass.

Shiskin, G.S. and Ustyuzhaninova, N.V.
1997 Morphological Peculiarities of Respitory Compartments of Arctic Animal Lungs. *The Anatomical Record*, 247:496-500.

Sigmond, E.M.D.
1992 Bedrock map of Norway and adjacent ocean areas. Scale 1:3 million. *Geological Survey of Norway*.

Simonsen, P.

1954 Middelalderens og renessansens kulturminner i Nordland. In H.M. Fiskå, H. F. Myckland (eds.) *Norges bebyggelse*. Fylkesbindet for Sør-Trøndelag, Nord Trøndelag og Nordland fylker, Oslo: 477-511.

1961 *Varangerfunnene II*. Tromsø Museum skrifter, VII:2.

1963 *Varangerfunnene III*. Tromsø Museum skrifter, VII:3.

1973 Jæger og nomade i Finnmark. I.G. Stamsø Munch og P. Simonsen (red.): *Bonde-veidemann – bofast – ikke bofast i Nordens forhistorie*. Tromsø Museums Skrifter XIV.

1980a *Fiskerbonden i Nord Troms 1300-1700*. Publikasjoner fra Helgøyprosjektet Nr. 1.

1980b Comments on The Chronology of the Younger Stone Age in Varanger, North Norway. Norwegian Archaeological Review 13 (1): 55-57.

1981 *Arkeologiske undersøkelser i det gamle Vadsø*. Varanger årbok 1981.

Simonsen, K., Haugan, P.M.
1996 Heat budgets of the Arctic Mediterranean and sea surface heat flux parameterizations for the Nordic Seas. *Journal of Geophysical Research* 101(C3), 6553–6576.

Simpson, I.A., S. Perdikaris, G. Cook, J.L. Campbell and W.J. Teesdale.
2000 Cultural sediment analyses and transitions in early fishing activity at Langenesvaeret, Vesteralen, northern Norway. *Geoarchaeology* 15, 743-763.

Sirenko, B.S.
2001 List of species of free living invertebrates of Eurasian Arctic Seas and adjacent deep waters. In: *Explorations of the Fauna of the Seas* 51 (59). Russian Academy of Sciences, St. Petersburg, Russia.

Sjøvold, T.
1974 *The Iron Age Settlement of Arctic Norway: A study in the expansion of European Iron Age Culture within the Arctic Circle*. Vol. II. Norwegian Universities Press. Oslo.

Sjöåsen, T.
1996 Survivorship of captive-bred and wild-caught reintroduced European otters (Lutra lutra) in Sweden. *Biological Conservation* 76: 161-165.

Skardhamar J and Svendsen H.
2005 Circulation and shelf-ocean interaction off North-Norway. *Continental Shelf Research* 25: 1541-1560.

Skjenneberg, S. And Slagsvold, L.
1979 *Reindeer Husbandry and Its Ecological Principles*. Universitetsforlaget, Oslo.

Skogland, T.
1989 Comparative social organization of wild reindeer in relation to food, mates and predator avoidance. *Advances in Ethology* 29(Supplement):1–74.

Slagstad, D. and S. Stokke.
1984 Simulations of currents, hydrography, and ice distribution and primary production in the northern sector of the Barents Sea. *Fish and Sea* (Institute of Marine Research) 9, 1–47 (in Norwegian).

Slotte, A.
1999 Differential utilization of energy during wintering and spawning migration in Norwegian spring-spawning herring. *Journal of Fish Biology* 54: 338–355.

Smedbol, R.K. and J. S. Wroblewski.
2002 Metapopulation theory and northern cod population structure: interdependency of subpopulations in recovery of a groundfish population. *Fisheries Research*, Volume 55, Issues 1-3: 161-174.

Smestad, O.M. and J.C. Holm.
1996 Validation of back-calculation formulae for cod otoliths. *Journal of Fish Biology*. 49, 973-985.

Solberg, O.
1909 *Eisenzeitfunde aus Ostfinnmarken*. Christiana Videnskabsselskabers skrifiter nr.7.

1911 Ein neuer eisenzeitlicher Fund aus Ostfinnmarken. *Praehist. Zeitschr*. III (3-4): 347-355.

Sollid, J. L., Andersen, S., Hamre, N., Kjeldsen, O., Salvigsen, O., Stuerød, S., Tveità, T. and Wilhelmsen, A.
1973 Deglaciation of Finnmark. North Norway. *Norsk Geografisk Tidsskrift* 27: 233-325.

Sonerud, G.A..
1986 Effects of snow cover on the seasonal changes in the diet, habitat and regional distribution of raptors that prey upon small mammals in the boreal zone of Fennoscandia. *Holarctic Ecology* 9: 33-47.

Southwood, T. R. E.
1988 Tactics, strategies and templets. *Oikos* 52:3-18.

Speth, J.D.
1983 *Bison Kills and Bone Counts: Decision Making by Ancient Hunters*. Chicago. University of Chicago Press.

Spicer, E. H.
1971 Persistent cultural systems. *Sceince* 174:795-800.

Staaland, H. and Hove, K.
2000 Seasonal changes in sodium metabolism in reindeer (Rangifer tarandus tarandus) in an inland area of Norway. *Arctic Antarctic and Alpine Research* 32, 286–294.

Stabeno, P.J. and J.E. Overland
2001 Bering Sea shifts toward an earlier spring transition. *EOS* 82, 317–321.

Stamsø-Munch, G.
1966 Gardshauger I Nord-Norge. *Viking* Vol.XXX pp. 25-59.

Stenseth, N.C. and Ims, R.A. (eds.)
1993 *The Biology of Lemmings*. Academic Press, London.

Stewart, K.M.
1991 Modern fish bone assemblages at Lake Turkana, Kenya: A methodology to aid in recognition of Hominid fish utilization. *Journal of Archaeological Science* 18: 579-603.

Stiner, M.C.
1991 The Faunal Remains from Grotta Guattari: A Taphonomic Perspective. *Current Anthropology* Vol 32, No. 2:103-117.

Stiner, M.C., S. L. Kuhn, S. Weiner and O. Bar-Yosef.
1995 Differential Burning, Recrystallization, and Fragmentation of Archaeological Bone. *Journal of Archaeological Science*, Vol. 22, Issue 2:223-237.

Stockfish
2006 Available at: http://www.alibaba.com/catalog/11382159/Stockfish.html.

Stoddart, D.M.
1970 Individual Range, Dispersion and Dispersal in a population of Water Voles (Arivicola terrestris L.). *The Journal of Animal Ecology* Vol. 39, No. 2: 403-425.

Storeheier, P. V., S.D. Mathiesen, N.J.C. Tyler and M.A. Olsen
2002a Nutritive value of terricolous lichens for reindeer in winter. *The Lichenologist* 34, 247–257.

Storeheier, P. V., S.D. Mathiesen, N.J.C. Tyler, I. Schjelderup and M.A. Olsen
2002b Utilization of nitrogen- and mineral-rich vascular forage plants by reindeer in winter. *Journal of Agricultural Science*, Cambridge 139, 151–160.

Storeheier, P.V., Van Oort, B.E.H., M.A., Sundset and S.P. Mathiesen
2003 Food intake of reindeer in winter. *Journal of Agriculture Science* 141:93-101.

Storli, I.
1994 *Stallo-boplassene. Spor etter de første fjellsamer?* The Institute of Comparative Research in Human Culture. Novus Forlag, Oslo.

Strann, K.B., N.G. Yoccoz and R.A. Ims
2002 Is the heart of Fennoscandian rodent cycle still beating? A 14-year study of small mammals and Tengmalm's owls in northern Norway. *Ecography* 25(1):81-87.

Sturluson, S.
1979 *Norges konge sagaer*.Gyldendal Norsk Forlag A/S.

Sundby, S.
1994 *The influence of bio-physical processes on fish recruitment in an arctic-boreal ecosystem*. Ph.D. Thesis, University of Bergen, Bergen.

Sutton, David E.
2001 *Remembrance of Repasts: An Anthropology of Food and Memory*. Berg: Oxford.

Svoboda, J.
1982 An Arctic Ecosystem. *Ecology*, Vol. 63, Issue 4: 1194-1195.

Syroechkovskiy Y.V., Litvin K.Y., Ebbinge B.S.
1991 Breeding success of geese and swans on Vaygach Island (USSR) during 1986-1988; interplay of weather and arctic fox predation. *Ardea* 79: 373-382.

Sørbel, L.
2003 *Viekimorener i Finnmark, Nord-Norge*. Norsk Geografisk Tidsskrift, Vol. 57: 125-127.

Tallgren, A.M.
1937 The arctic Bronze Age in Europe. *Eurasia Septentrionalis Antiqua*, Vol. 11:1-46.

Talve, Ilmar 1997 Finnish Folk Culture. Studi Fennica Ethnologica 4

Tanner, V.
1928 *Om Petsamo kustlapparnas sägner om forntida underjordiska boningar,* s.k. jennam'vuölas'kuatt. Finsk Museum vol. XXXV.

Tantsiura, A.I.
1959 *On the currents of the Barents Sea*. Transactions of the Polar Scientific Research Institute of Marine Fisheries and Oceanography (PINRO) 11, 35–53 (in Russian).

Thomas, D.H.
1969 Great Basin hunting patterns: a quantitative method of treating faunal remains. *American Antiquity* 34: 392-401.

The Travelling Naturalist
2006 *Islands of the North Atlantic,* Available at: www.naturalist.co.uk/cruises2006/islands.php.

Timoshenko, Y.K. and Popov, L.A.
1990 On the predatory habits of the Atlantic walrus. In: Fay, F.H., Kelly, B.P., Fay, B.A. (Eds.), *The ecology and management of walrus populations*. Report of an International Workshop, Marine Mammal Commission Report FB91-100479, pp. 177–178.

Torsethaugen, K.
1989 *Wind and Waves in the Barents Sea*. Naturdatakonferanse, Harstad, September 26–28, 1989. SINTEF Report STF60 A89094, p. 33.

Townsend, C.
1987 The inner shelf of North Cape, Norway and its implications for the Barents Shelf-Finnmark Caledonide boundary. *Norwegian Journal of Geology* 67, 151-153.

Trivers, R.L. and D.E. Willard
1973 Natural selection of parental ability to vary the sex ratio of offspring. *Science* 179:90–92.

Tveito, O. E. et al.
1997 *Nordic precipitation maps*. Norwegian Meteorological Institute:22.

Tveito, O. E. et al.
2000 *Nordic temperature maps.* Norwegian Meteorological Institute:52.

Tveraa, T. et al.
2003 An examination of a compensatory relationship between food limitation and predation in semi-domestic reindeer. *Oecologia* 127: 370-376.

Tveraa, T., P. Fauchald, N. G. Yoccoz, R. Ims, R. Aanes, and K.A. Høgda
2007 What regulate and limit reindeer populations in Norway? *Oikos* 116: 706-715.

Uerpmann, Hans-Peter
1973 Animal Bone Finds and Economic Archaeology: a Critical Study of Osteoarchaeological Method. *World Archaeology* 4(3): 307-322.

Uppenbrink, J.
1999 The North Atlantic Oscillation. Science, *New Science*, Vol. 283, No. 5404: 948-949.

Urbańczyk, P.
1992 *Medieval Arctic Norway*. Semper. Warsaw

1996 Samowie i Norwegowie – 2000 lat sąsiedztwa [The Saami and the Norse – 2000 years of neighbourhood]. In Konflikty etniczne. Źródła – typy – sposoby rozstrzygania, I. Kabzińska-Stawarz, S Szynkiewicz (eds).Warszawa: 283-287.

Vale, D. and R.H. Gargett
2002 Size matters: 3-mm sieves do not increase richness in a fishbone assemblage from Arrawarra I, an Aboriginal Australian Shell midden on the Mid-north coast of New South Wales, Australia. *Journal of Archaeological Science* 29: 57-63.

Van Neer, W. and Anton Ervynck
1993 *L'archéologie et le poisson*. Institut du Patrimoine. Archéologique de la Région Flamande.

Vetrov, A.A., Romankevich, E.A.
2004 *Carbon cycle in the Russian Arctic*. Springer, Berlin–Heidelberg.

Vibe, C.
1967 Arctic animals in relation to climatic fluctuations. *Meddr Grønland* 170 (15):1-227.

Vinje, T. and Kvambek, A.S.
1991 Barents Sea drift ice characteristics. *Polar Research* 10, 59–68.

Vorren, T.O., Rønnevik, H.C., Reiersen, J.E.
1980 Kontinentalsokkelen utafor Norge i nord. *Ottar*, University of Tromsø 118 39pp.

Vorren, T. O., HaId, M. and Thomsen, E
1984 Quaternary sediments and environments on the continental shelf off northern Norway. *Marine Geology* 57, 229-257.

Vorren, Ø.
1958 Samisk villreinsfangst i eldre tid. *Ottar* No. 17.

1998 *Villreinfangst in Varanger fram til 1600-1700 årene*. Tromsø Museums skrifter XXVIII. Nordkalottforlaget.

Vorren, Ø. and Eriksen, H.K.
1993 *Samiske offerplaser i Varanger*. Tromsø Museums skrifter XXIV. Nordkalottforlaget.

Wabakken, P, 0.J. Sørensen, D. T. Kvam
1983 Wolves (*Canis lupus*) in southeastern Norway. *Acta. Zool. Fenn.* 174:277.

Wallace, J.M.
2000 North Atlantic Oscillation/annular mode: Two paradigms – one phenomenon, *Quarterly Journal of the Royal Meteorological Society* 126, 791–805.

Wanner, H., Stefan Brönnimann, C. Casty, D. Gyalistras, J. Luterbacher, C. Schmutz, D.B.Stephenson and E. Xoplaki
2001 North Atlantic Oscillation-Concepts and Studies. *Surveys in Geophysics* 22: 321-382.

Wassmann P, Reigstad M, Haug T, Rudels B, Carroll ML, Hop H, Gabrielsen GW, Falk-Petersen S, Denisenko SG, Arashkevich E, Slagstad D & Pavlova O.
2006 Food webs and carbon flux in the Barents Sea. *Progress in Oceanography* 71(2-4): 232-287.

Watanabe, N
1950 The preservation of bony substances in the soil of prehistoric sites. *Zinriugaku Zassi* (Journal of the Anthropological Society of Japan) 61 (2): 1-8.

Waterman, T.H..
1999 The Evolutionary Challenges of Extreme Environments (Part 1). *Journal of Experimental Zoology*, 285: 326-359.

Weckstrom, J., Korhola, A., Erasto, P., and Holmstrom, L.
2006 Temperature patterns over the past eight centuries in Northern Fennoscandia inferred from sedimentary diatoms. *Quaternary Research* 66, 78-86.

Westgaard, J.I. And S.E. Fevolden.
2007 Atlantic cod (Gadus morhua L.) in inner and outer coastal zones of northern Norway display divergent genetic signature at non-neutral loci. *Fisheries Research*, Volume 85, Issue 3: 320-329.

Wheeler, A
1978 Problems of Identification and Interpretation of Archaeological Fish Remains. In D.R. Brothwell, K.D. Thomas and Juliet Clutton-Brock (eds.). *Research Problems in Zooarchaeology* , pp. 69-75. London: Institute of Archaeology.

Wheeler, Alwyne and Andrew K.G. Jones
1989 *Fishes*. Cambridge: Cambrdge University Press.

White, E. M. & Hannus, L. A.
1983 Chemical weathering of bone in archaeological sites. *American Antiquity* 48: 316–322.

Whittaker, M. E., and V. G. Thomas
1983 Seasonal levels of fat and protein reserves of snowshoe hares in Ontario. *Canadian Journal of Zoology*, 61:1339-1345.

Wikipedia
2008a *Republic of Karelia*, Available at: http://en.wikipedia.org/wiki/Republic_of_Karelia.

2008b *Barents Region*, Available at: http://en.wikipedia.org/wiki/Barents_Sea.

Woodhead, P.M.J. and Woodhead, A.D.
1965 Seasonal changes in the physiology of the Barents Sea cod Gadus morhua L., in relation to its environment. *ICNAF Spec. Publ.*, Vol. 6: 717-734.

Wolf, E.R.
1982 *Europe and the People Without History*.Berkeley University California Press.

Woolf, D.K., A.G.P. Shaw and M.N. Tsimplis
2003 The influence of the North Atlantic Oscillation on sea-level variability in the North Atlantic region. *The Global Atmosphere and Ocean System*, Vol. 9, No. 4: 145-167.

Wöhrmann, A.P.A..
1995 Antifreeze glycopeptides of the high-Antarctic silverfish Pleuragramma antarcticum (Notothenioidei). *Comp. Biochem. Physiol.*, 111:121–129.

Ydenberg, R
1987 Nomadic predators and geographical synchrony in microtine populations cycles. *Oikos* 50: 270-272.

Zauke, G.P., B. Clason, V.M. Savinov and T. Savinova
2003 Heavy metals of inshore Benthic invertebrates from the Barents Sea. *The Science of the Total Environment* Vol. 306, Issues 1-3: 99-110.

Zenkevich, L.A.
1963 *Biology of the Seas of the USSR*. George Allen and Unwin Ltd, London.

Zhigunov, P.S. (editor)
1968 *Reindeer Husbandry*. Translated from Russian by Israel Program for Scientific Translations, Jerusalem.

Zohar, Irit and Miriam Belmaker
2005 Size Does Matter: Methodological Comments on Sieve Size and Species Richness in Fishbone Assemblages. *Journal of Archaeological Science* 32: 635-641.

Zöckler, C
1998 Patterns in Biodiversity in Arctic Birds. WCMC Bulletin No. 3., *World Conservation Monitoring Centre*, Cambridge:15.