Preliminary Report of a Medieval Norse Archaeofauna from Brattahlið North Farm (KNK 2629), Qassiarsuk, Greenland

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Introduction : This is a preliminary report of the animal bone collected in 2005-06 by international teams led by Ragnar Edvardsson for the Greenland National Museum and Archives (NKA) and NABO. The bone collections come from stratified contexts in the midden area south of the *Brattahlið North Farm (*E29N under the old Bruun system: now KNK 2629) whose structures were excavated in 1932. Degerbøl (1934) has provided a pioneering and still valuable zooarchaeological report of the early excavations, which like many of the period were not carried out stratigraphically. The current cooperative project was aimed at providing a modern stratigraphically controlled collection of bones and artifacts and to assess conditions of preservation at this major site. While both the 1932 work and subsequent digging caused significant disturbance of the midden deposits, the NKA/NABO team was able to recover a substantial archaeofauna from intact stratigraphy. A final report will include the unstratified collections deriving from the post-1932 spoil and will include a fuller discussion of taphonomy, deposition, and comparative questions. This report will be incorporated within a larger interim report by Ragnar Edvardsson to the Greenland National Museum and Archives.

Excavation, Recovery, Preservation

The 2005-06 Qassiarsuk project employed current standard NABO methods of stratigraphic excavation and 100% sieving through 4 mm mesh dry sieves, with an approximate 3% whole soil sample reserved for flotation. Backdirt was regularly checked for missed bone and every attempt was made to recover small fragments of bone, wood, and charcoal. The 2005-06 Brattahlið N Farm collections are thus directly comparable in method of recovery to other modern excavations in the N Atlantic region and can be reasonably compared to contemporary collections from Iceland and the Faroes. Conditions of preservation ranged from fair to excellent, although (unlike the summer 1932 season) no frozen deposits were encountered. Some bone showed the exfoliation typical of repeated extreme freeze-thaw cycles, and some unrecoverable “bone mush” was encountered during excavation, but most bone survived in good condition. More extensive discussion of taphonomic indicators will follow in later reports, but overall the collection seems to be broadly comparable in condition to most Icelandic archaeofauna, though the superb conditions of organic preservation typical of seasonally frozen Greenlandic sites is no longer present at the Qassiarsuk / Brattahlið middens.

Laboratory Methods

Analysis of the collection was carried out at the Hunter College Zooarchaeology Laboratory and made use of extensive comparative skeletal collections of the lab and the holdings of the American Museum of Natural History. All fragments were identified as far as taxonomically possible (selected element approach not employed) but most land mammal ribs, long bone shaft fragments, and vertebral fragments were assigned to “Large Terrestrial Mammal” (cattle-horse sized), “Medium terrestrial mammal” (sheep-goat-pig-large dog sized), and “small terrestrial mammal” (small dog-fox sized) categories. Only elements positively identifiable as *Ovis aries* were assigned to the "sheep" category, with all other sheep/goat elements being assigned to a general "*caprine*" category potentially including both sheep and goats. Seal bones are likewise identifiable to species level only on a restricted range of elements (following NABO draft sea mammal guide, currently distributed as part of the FISHBONE 2.1 package). This creates a substantial "phocid species" category comparable to the "caprine" category (which incorporates ribs, small cranial fragments, unidentifiable long bone elements and vertebrae). On some elements it is possible to distinguish "large seals" (either hooded *Cystophora cristata* or bearded *Erignathus barbatus*) from the three smaller species (common/harbor seals *Phoca vitulina*, harp seals *Phoca groenlandica*, and ringed seals *Phoca hispida*). Most cetacean (whale) bone is highly fragmented and probably often represents craft debris, but it has been occasionally possible to distinguish bones of great (usually baleen) whales ("large cetacean") from the bones of smaller whales (probably narwhal or beluga) or porpoise ("small cetacean"). Murre and Guillemot are not distinguishable on most bones and are presented together as *Uria species.* The data presentation thus attempts to reasonably reflect the different levels accuracy possible in osteological identification, but creates some pooled categories at different taxonomic levels, which require some care in comparisons. Following NABO Zooarchaeology Working Group recommendations and the established traditions of N Atlantic zooarchaeology we have made a simple fragment count (NISP) the basis for most quantitative presentation. Measurements (Mitoyo digimatic digital caliper, to nearest mm) follow Von Den Dreisch (1976), mammal tooth eruption and wear recording follows Grant (1982) and general presentation follows Enghoff (2003). Digital records of all data collected were made following the 8th edition NABONE recording package (Microsoft Access database supplemented with specialized Excel spreadsheets, see discussion and downloadable version at www.geo.ed.ac.uk/nabo) and all digital records (including archival element by element bone records) and the bone samples will be permanently curated at the Greenland National Museum and Archives with full copies at the Zoological Museum of the University of Copenhagen. CD R versions of this report and all archived data are also available on request from nabo@voicenet.com.

Phasing of Bone-bearing contexts

As discussed in the main report, the stratified deposits could be divided into nine phases based on superposition and a suite of 12 radiocarbon dates (Figure 1).

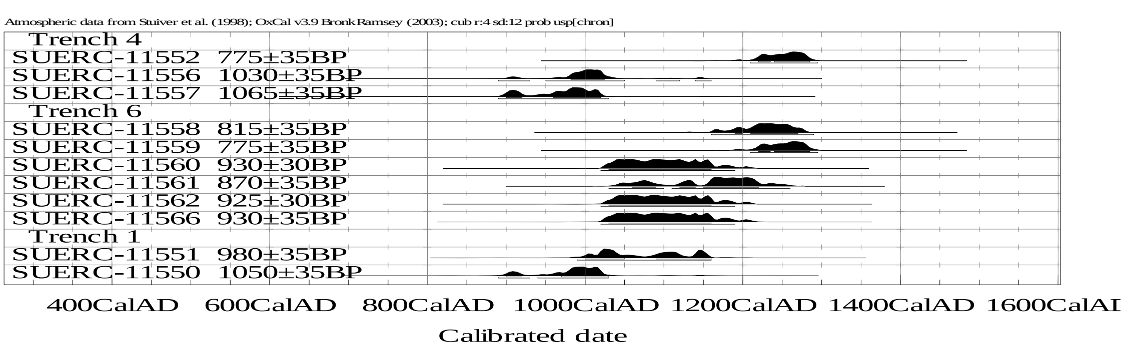

Figure 1 calibrated AMS radiocarbon dates (all on fully terrestrial domestic mammal bone), data courtesy of Dr. Gordon Cook, Scottish Universities Reactor Centre, E. Kilbride, calibration OxCal v3.9.

Phases I –II relate to prior archaeological excavations carried out 1932-1990 and contain no *in situ* bone (the unstratified bone material from the spoil will be reported later). Phases III to IX appear to span most of the period of Norse occupation from the late 10th to 15th centuries. Bone bearing midden deposits concentrate in phases V, IV, and III, all of which have produced quantifiable archaeofauna (over ca. 300 NISP for an archaeofauna composed mainly of mammals). The lower phases produced bone collections which are too small to individually quantify, though sharing many of the main patterns observed in the larger collections. The large archaeofauna thus come from Phase V (the first half of the 13th century or ca. 1200-50), Phase IV (second half of the 13th century, ca. 1250-1300) and the upper Phase III (securely post -1300 by C14). We thus do not have a continuously quantifiable record of economy at Brattahlið N farm from first settlement to final abandonment, but rather a substantial, well documented archaeofauna dating from the middle- to -later years of the Norse settlement in Greenland. By good luck, this slice of time seems to have caught some zooarchaeological transitions with both economic and environmental significance.

Species present

Table 1 presents the taxa identified from the smaller earlier phases VIII-IX.

Table 1 ***Taxon***		***IX*** ***early 11th c***	***VI*** ***late 11th-12th c***	***VII*** ***late 11th-12th c***	***VIII*** ***late 11th-12th c***
Scientific	***English***				
Domestic Mammals					
Bos taurus	Cattle	7	25	4	9
Equus caballus	Horse	0	1	0	0
Canis familiaris	Dog (X= tooth marks)	**x**	**x**	**x**	**x**
Sus scrofa	Pig	0	0	0	1
Capra hircus	Goat	1	2	0	0
Ovis aries	Sheep	1	6	0	0
Ovis or Capra	Caprine	6	28	0	10
Wild Mammals					
Rangifer tarandus	Caribou	12	4	0	5
Alopex lagopus	Arctic fox	0	2	0	0
Phoca groenlandica	Harp seal	1	8	0	1
Phoca vitulina	Harbor seal	0	0	0	0
Cystophora cristata	Hooded seal	0	1	0	0
E. barbatus or *C. cristata*	Large Seal	0	3	0	0
Phocidae sp.	Seal sp.	24	90	0	7
Odobenus rosmarus	Walrus	0	8	0	1
Small cetacean	Porpoise/Beluga size	0	1	0	0
Cetacea sp	Whale sp	1	0	0	0
Birds					

Larus marinus	Black backed gull	0	0	0	1
Uria sp.	Guillemot or Murre	0	4	0	0
Aves sp	Bird sp.	1	0	0	0
	total NISP	54	139	4	35
Large Terrestrial Mammal		5	38	0	1
Medium Terrestrial Mammal		28	73	3	11
Unidentified Mammal		36	181	0	65
	total TNF	123	431	7	112

Canine (probably domestic dog) tooth marks were present in all phases.

Table 2 presents the larger archaeofauna of Phases III-V, which provide NISP large enough for fuller quantification and form the basis for further discussion.

Table 2		***V***	***IV***	***III***
Taxon		***early 13th c***	***later 13th c***	***14th-15th c***
Scientific	***English***			
Domestic Mammals				
Bos taurus	Cattle	64	94	25
Equus caballus	Horse	1	1	0
Canis familiaris	Dog (X= tooth marks)	1	**x**	1
Sus scrofa	Pig	2	5	0
Capra hircus	Goat	6	5	4
Ovis aries	Sheep	20	19	9
Ovis or Capra	Caprine	74	115	53
Wild Mammals				
Rangifer tarandus	Caribou	25	22	15
Phoca groenlandica	Harp seal	15	34	11
Phoca vitulina	Harbor seal	17	3	2
Cystophora cristata	Hooded seal	9	7	1
E. barbatus or *C. cristata*	Large Seal	9	8	0
Phocidae sp.	Seal sp.	360	640	360
Odobenus rosmarus	Walrus	14	19	7
Small cetacean	Porpoise/Beluga size	0	3	5
Cetacea sp	Whale sp	14	24	6
Cetacea sp	L Whale sp.	1	3	1
Birds				
Lagopus mutus	Ptarmigan	0	1	0
Anser sp.	Duck species	0	1	0
Cygnus sp.	Swan species	1	0	0
Haliaeetus albicilla	Sea eagle	1	0	0
Uria sp.	Guillemot or Murre	8	15	7
Cepphus grylle	Black guillemot	0	0	1
Fratercula arctica	Puffin	0	1	0
Aves sp	Bird sp.	18	16	4
	total NISP	660	1036	512
Large Terrestrial Mammal		100	184	14
Medium Terrestrial Mammal		161	289	137
Unidentified Mammal		3446	4451	3338
	total TNF	4367	5960	4001

Domestic Mammals

Relative Proportions

Domestic mammal bones recovered from Phases III, IV, and V include Cattle, both sheep and goat, dog, horse and a few pig bones. Sheep, goat, and cattle dominate the domestic mammal assemblage in all periods, as is normal for Greenlandic Norse collections. While pigs were probably most common in the earlier phases of settlement in Greenland, some pigs definitely survived into the 13th-14th centuries. Bone elements recovered at Brattahlið in both 20th and 21st century excavations and also on the Vatnahverfi farm E167 suggest local pig keeping rather than the import of occasional cured ham (Degerbøl 1934, McGovern in Vebaek 1992, McGovern et al 1996). Dog and horse bones are very rare in all layers, though as noted dog tooth marks are very widespread.

As figure 2 illustrates, the overall proportions of the domestic stock at Brattahlið N Farm appear virtually identical in the two 13th century collections (Phases IV and V), but there is an apparent shift after 1300 AD, with fewer cattle and no pig bones being deposited. Caprines increase relative to cattle after 1300 though cattle remain a major element in the farming pattern throughout.

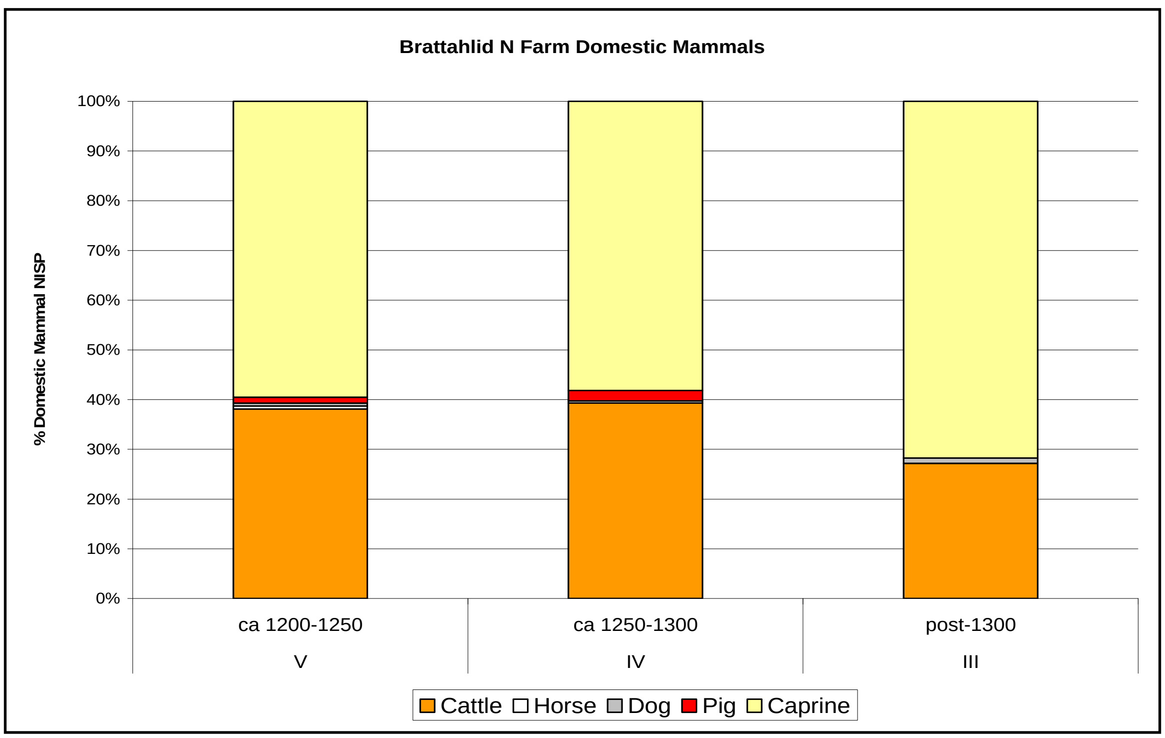

Figure 2 Relative proportions (NISP) of domestic stock (all sheep and goat combined as Caprine)

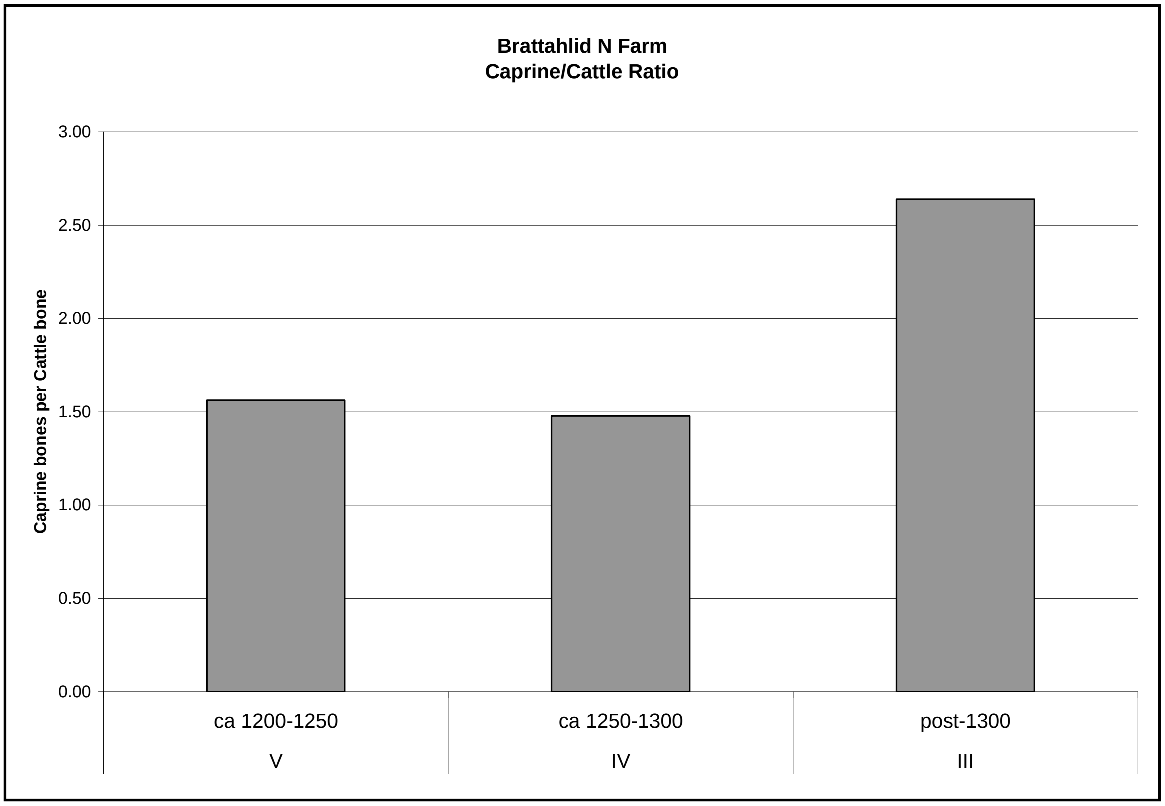

Figure 3 Ratio of Caprine bones per cattle bone in the three major phases (tall bar = more caprine).

The changing proportions of cattle to caprine bones at Brattahlið N Farm is illustrated clearly by figure 3, which presents a direct ratio of the two taxa. Note that even in Phase III, the proportion of cattle to caprines remains high, and there is no sign of the sort of transition from a ratio of around two to five caprine bones per cattle bone to around twenty caprine per cattle bone that is seen in the Mývatn Icelandic archaeofauna in the period ca 900-1200 AD (McGovern et al 2007). This major early 13th c Icelandic shift towards caprines is probably linked to intensified wool production, as mixed flocks of sheep and goats become nearly all sheep at the same time.

As a major new overview and re-analysis of existing Norse archaeofauna demonstrates, there is no evidence for a similar shift in sheep and goat husbandry in Greenland (Mainland and Halstead 2005). Mainland and Halstead's finding is further confirmed by the results of the new archaeofauna from Brattahlið; goat proportions remain high throughout the deposit (table 3). As Mainland and Halstead argue, this suggests that the Norse Greenlanders were unlikely to have produced more wool than required for their own household needs, and wool or woolen cloth is unlikely to have been produced for export as in Iceland.

Table 3 Sheep to Goat bones	*V*	*IV*	*III*
	ca 1200-1250	***ca 1250-1300***	***post-1300***
Sheep/Goat Ratio	3.33	3.80	2.25

A fuller discussion of animal size, age at death, and reconstructed management strategy will be included in the final report, but the presence of young (neonatal) calf bones would suggest the widespread Norse pattern of dairying noted on other Greenlandic and N Atlantic sites (McGovern 1992, McGovern et al 2001, Mulville & Thoms 2005). While sample size will constrain some analyses, it appears overall that the domestic mammal economy was aimed at production of food (milk and meat) rather than other secondary products.

Wild Species

Caribou bones are present in low but consistent frequency throughout the phases, with the relative percentage for the three later phases well within the prior Eastern Settlement range of around 2-5% (table 4). In addition to caribou bone, several pieces of worked antler craft debris have been identified, providing additional evidence for widespread Norse antler working in Greenland.

Table 4 Caribou	*V*	*IV*	*III*
	ca 1200-1250	***ca 1250-1300***	***post-1300***
Caribou %	3.79	*2.12*	*2.93*

This differs from the known Western settlement range of between 5 and 27 % of NISP total, which almost certainly reflects biogeography as much as economy. Greenlandic caribou have tended to fragment along the long coastline into localized breeding populations subject to different crash-boom cycles that in historic times are driven mainly by climatic variation but whose intensity can be enhanced or reduced by changing amounts of hunting pressure by humans or wolves (Meldgaard 1986). The caribou of the two Norse settlement areas thus represent two different population pockets, which had different dynamics and different vulnerabilities. The caribou of the Western Settlement area enjoy more closely inter-connected grazing areas and were probably less subject to deadly range-icing in winter than were caribou in the Eastern Settlement area (Vibe 1967). Western Settlement caribou have also proven more resilient in the face of sustained human hunting. Caribou were driven to complete extinction in the entire Eastern Settlement region by Inuit hunters in the early 19th century (following the widespread introduction of firearms) but they survive in substantial numbers today in the former Western Settlement area. The medieval Norse settlers certainly had the capacity to place heavy pressure on the relatively fragile Eastern Settlement caribou herds, maintaining large hunting dogs and probably employing drive systems (Degerbøl 1934, 1941; McGovern & Jordan 1982, McGovern 1985b)The zooarchaeological evidence from Brattahlið N Farm in combination with the older unstratified collections thus suggests that the Norse were willing and able to manage their hunting of the smaller and probably more climatically vulnerable Eastern Settlement caribou herds to allow a long term sustainable yield.

Arctic Fox: Fox bones are present in small numbers on many Norse sites in Greenland and Iceland, and the Brattahlið N Farm archaeofauna contains two elements (femora and atlas vertebra) found in the same context. Fox were probably taken in snares for both their fur and for stock protection.

Sea Mammals

Whales: As table 5 indicates, whale bone fragments are present in low frequency throughout the Brattahlið N Farm archaeofauna. As observed by Enghoff (2003), it is difficult to know if whalebone in such context represents tons of meat or simply the remains of whalebone artifact production from curated fleshless bone. In this case, nearly all the fragments are small chips, many of which show cut marks and polish suggesting they are better seen as craft waste than a major item of diet.

Table 5 Cetacea	***V***	***IV***	***III***
	ca 1200-1250	***ca 1250-1300***	***post-1300***
total cetacean	15	30	11
cetacean %	2.27	2.90	2.15

Walrus: While walrus occasionally appear all around the coast of Greenland, the greatest concentrations historically have been far from the Eastern Settlement area around modern Disko Bay (Arneborg 2000, Vibe 1967). This was the area known to the Norse as the *Norðursetur* and multiple lines of evidence suggest a large scale summer hunt drew participants from both Eastern and Western Settlements hundreds of kilometers north from their farms in the inner fjords (McGovern 1985a, Dugmore et al 2007). The deeply rooted tusk was not usually extracted at the kill site, but instead the front of the maxilla was cut away and brought back to the home farms for final finishing for export (Roesdahl 2005). Fragments of the dense maxillary bone have been found on nearly every Norse farm excavated, in both settlement areas and on inland as well as coastal farms. Complete walrus bacula (penis bones) and the burial of complete skulls inside the churchyard wall at both Brattahlið and Gardar may underline the importance of the hunt to the Norse Greenlanders, and perhaps point to its ritual as well as purely economic aspects. The walrus bone found at Brattahlið N Farm in 2005-06 are mainly small chips of ivory and maxillary fragments, but the peg like post-

Table 6	**Walrus Elements**	**count**
Ivory chips		13
Maxillary fragments		40
Post Canine		2
Baculum		1
Rib		1

canines (often used in Greenland for craft work) and a single baculum fragment were also recovered (Table 6). Walrus ribs are also often used in craft work, and the single find thus may not necessarily represent a meal.

Figure 4 illustrates a portion of the very end of the tusk root, cut off with a backed medieval saw, apparently as part of final finishing of a tusk for export. Similar fragments are reported by Degerbøl (1934).

It is always difficult to reasonably quantify walrus tusk extraction debris, as a single skull can generate a very large number of potentially identifiable fragments (see discussion in McGovern et al 1996). Despite such fundamental counting issues, it is probably still safe to assume that larger quantities of tusk extraction debris accumulating through time is connected to the nature and intensity of the hunting and ivory processing effort. Figure 5 presents such a rough comparative quantification by site and settlement area.

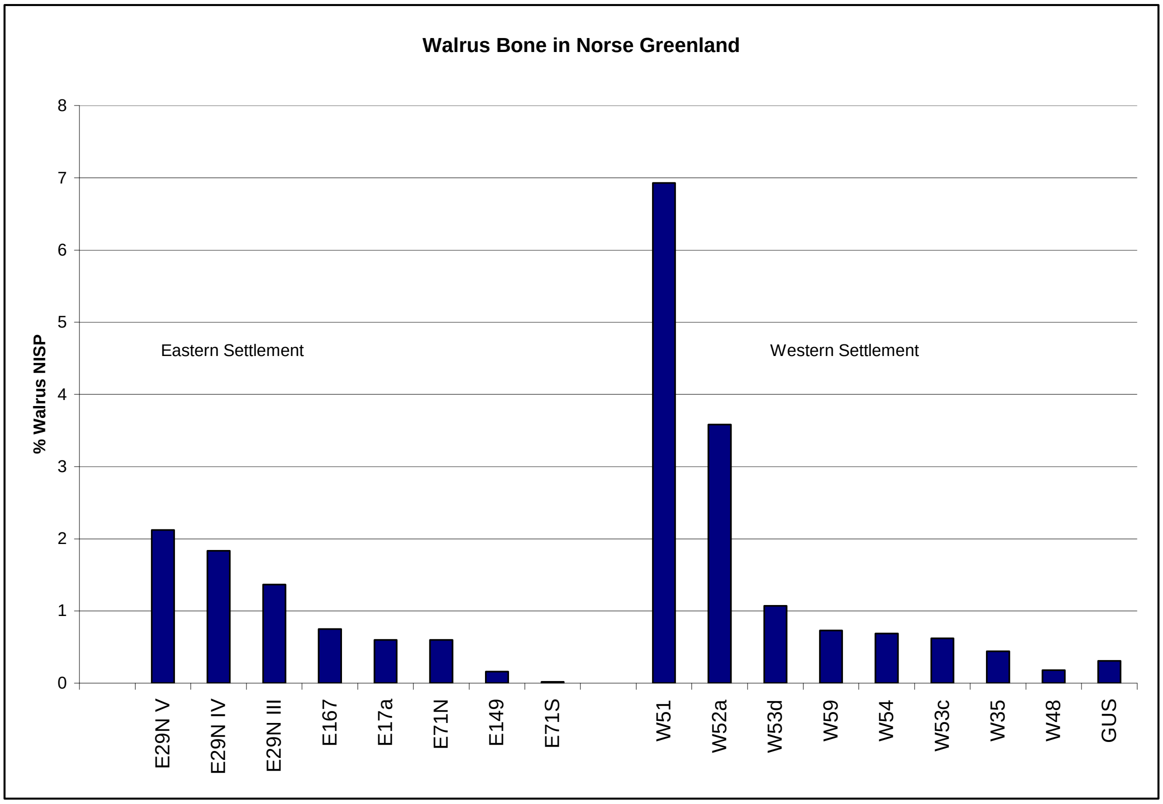

Figure 5 Comparison of the NISP % of walrus tusk processing debris in archaeofauna from the Eastern and Western Settlements.

Most of the Western Settlement walrus processing debris is concentrated on the two nearby farms of W51 (Sandnes) and W52a. Sandnes is a known chieftain's farm with church and extensive buildings, and seems to have been heavily involved in the northern hunt and tusk processing for export, and W52a may have been a closely connected client farm (Roussell 1941, McGovern et al 1996). While the Western Settlement seems to have been particularly active, it is clear that the Eastern Settlement also played a role in the long range hunt. The E29N (Brattahlið N Farm) Phase III, IV, and V walrus processing debris counts take first place among currently known Eastern Settlement archaeofauna, and compare favorably to most of the Western Settlement archaeofauna. Did the chieftain's farm at Brattahlið play a central role in the Eastern Settlement comparable to Sandnes in the Western Settlement in organizing the Norðursetur hunt and the processing of walrus products?

Seals

Seal bones make up a large portion of all Greenlandic Norse archaeofauna, and they are abundant in the Brattahlið N Farm deposits. Five species of seals are present in Greenlandic waters, two (harp and hooded seal) are carried by the circulating drift ice from Labrador, and the other three are non-migratory residents (common/harbor seals, ringed seals, and bearded seals). Harp seals and the larger but rarer Hooded seals (*P. groenlandica* and *C. cristata*) appear in spring in the Eastern Settlement area and follow the drift ice northwards along the coast. Harp seals are one of the most abundant seal species on earth, and have been hunted by all human cultures to settle the eastern arctic. The harp seal formed a key element in Norse subsistence in Greenland, and its bones are common in archaeofauna from both Eastern and Western Settlements. The common seal (*Phoca vitulina*) is a widespread North Atlantic species near the northern edge of its range in the low arctic. Common seal pups do not thrive in ice filled waters, and the presence of persistent summer sea ice is thus tends to reduce common seal populations (for discussion see Woollett et al. 2000). Adults are able to survive winter ice and low temperatures, so where open water is present in summer, common seal populations can thrive in southern Greenland. Inuit hunters have also successfully taken the arctic adapted ringed seal (*P. hispida*) and the rarer large bearded seal (*E. barbatus*), which make breathing holes through winter ice and are the characteristic seals of the high arctic. Comprehensive catch records (Figure 6) provide a useful picture of recent hunting patterns by modern (Inuit-descended) Greenlanders in the two former Norse settlement areas (Vibe 1967, McGovern 1991).

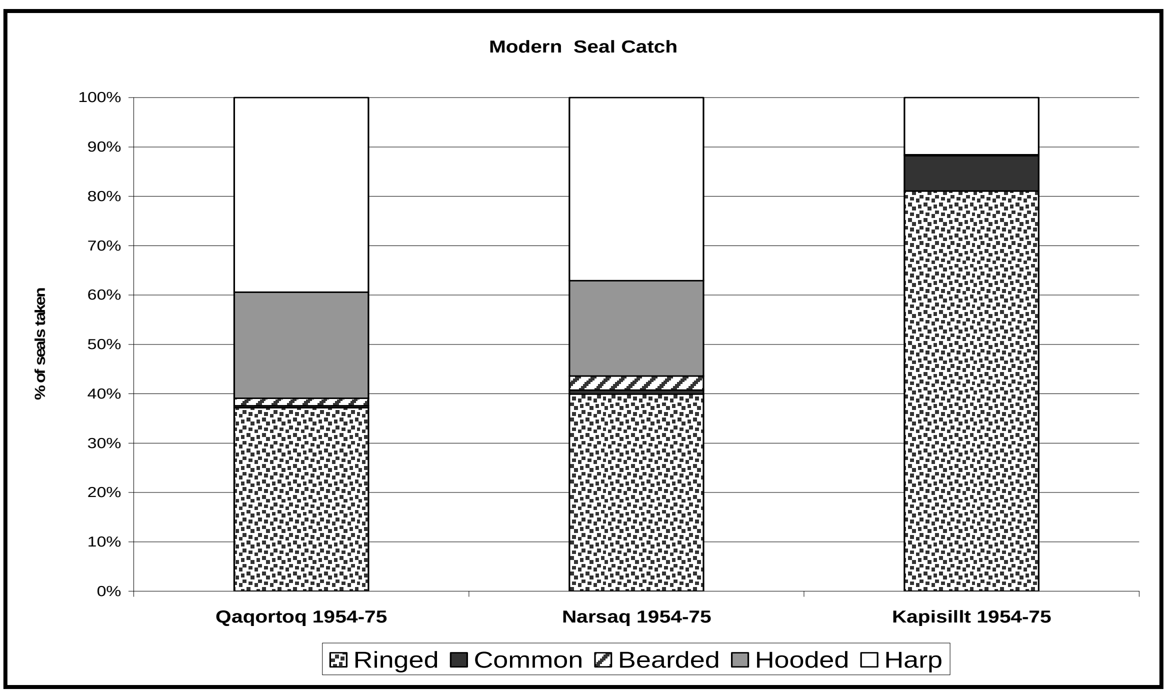

Figure 6 Modern Catch records for Qaqortoq and Narsaq districts (covering the former Norse Eastern Settlement) and the village of Kapisillit (part of Nuuk District)in the middle of the former Western Settlement.

Today, Qaqortoq and Narsaq districts are heavily affected by summer drift ice carried around Cape Farewell from East Greenland and Danmark Strait, and as a result common seals are very rarely seen or hunted in these districts. Migratory hooded and harp seals along with the ringed seal (taken especially in winter) provide the bulk of the subsistence sealing in the former Eastern Settlement area. Further north in the inner fjords of Nuuk district around modern Kapisillit are not affected by summer drift ice, and common seals are regularly taken (hooded seal migration diverges from the harp seals' and hooded seals are rare in the former Western Settlement area).

Figure 7 presents the identified seal bones recovered from the quantifiable Phases III-V from the 2005-06 excavations at Brattahlið. Note that ringed seal bone is rare or absent (a few specimens were reported from the 1932 excavation: Degerbøl 1934:153). This is a pattern typical of all other Norse archaeofauna from Greenland, Norse sealers do not seem to have regularly taken this species (McGovern 1985b, 1992). Common seal bones are far more abundant in the lower layers than the modern catch data would predict, and early 13th c Norse hunters seem to have taken them in some numbers. Common seals seem to have then declined sharply in abundance between the early and late 13th century. Are these differences from the modern catch records due to differences in culture, technology, or climate?

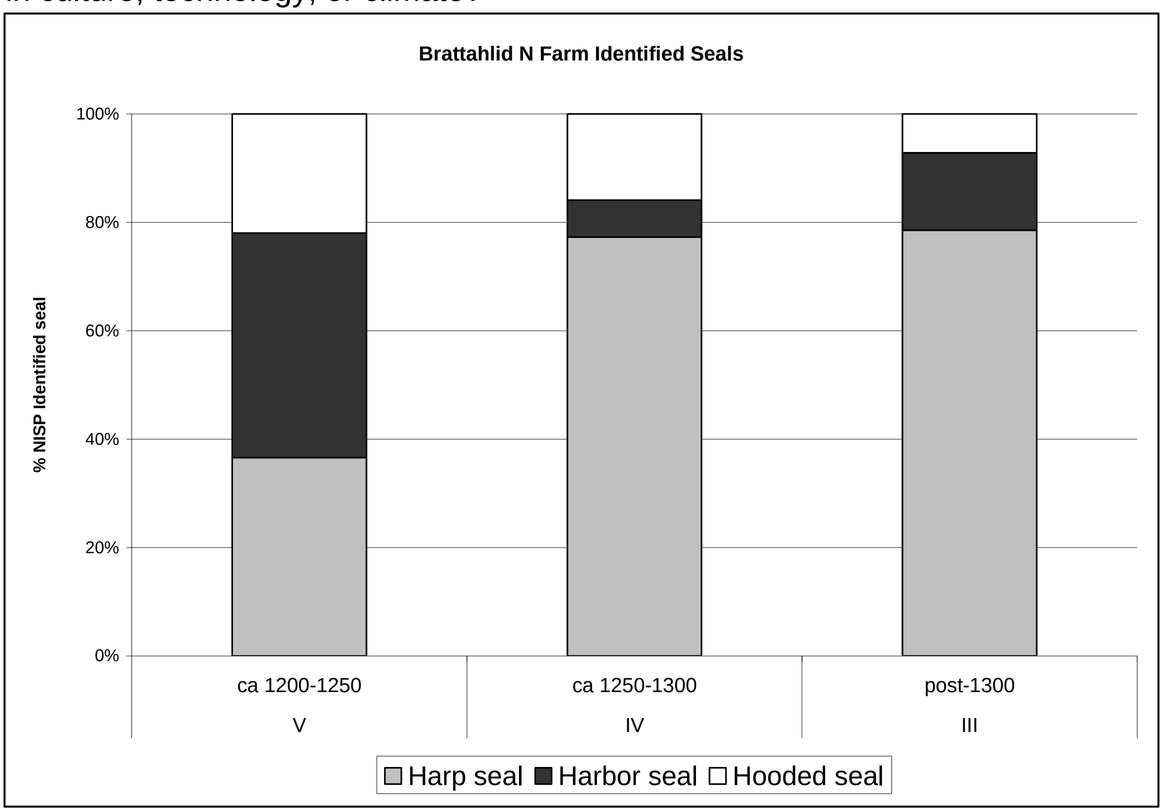

Figure 7 Relative proportions of identified seal bones. Phase V n= 41, Phase IV n = 44, Phase III n= 14.

Climate Change or Over-hunting?

The scarcity of ringed seal bones in these Norse deposits is almost certainly the product of a very different seal hunting technology and social organization from that of modern Inuit Greenlanders. Norse sealing apparently did not make significant use of harpoons or Inuit ice hunting techniques, but concentrated instead upon mass netting and clubbing of seals on land or drift ice by coordinated groups of hunters. While much remains to be learned about Norse sealing in Greenland, the presence of large amounts of seal bone in inland farms may suggest the special communal nature of Norse sealing. Analysis of available seal dental annuli suggests a hunt concentrated in spring/summer (McGovern et al 1996).

The presence of substantial numbers of common seals in earlier phases and their reduction in later phases is not readily explained by technological or social differences in the seal hunters. The observed change occurs completely within the Norse cultural context during a period of apparent stability. Two hypotheses can be advanced to explain this marked transition in the Brattahlið archaeofauna:

1) depletion of common seal stocks in the area due to over hunting by Norse sealers, or;
2) climatic change from earlier warmer conditions with little or no summer drift ice to a climate regime similar to modern conditions during the later 13th century.

Common seal populations tend to be localized and it is certainly possible that particular pods could have been wiped out or forced to relocate to less accessible hauling out locations by over-exploitation. However, one expect would such impacts to occur earlier in the settlement process- by around 1250 AD the Norse had been hunting in this part of Greenland for about nine human generations. Our understanding of Norse natural resource management capabilities has been expanded by work in Iceland and the Faroes, where there is growing evidence for successful community-level management of seabirds, waterfowl, freshwater fishing, and common grazing (Church et al 2005, McGovern et al 2006, Simpson et al 2002, 2003, 2004). As we have learned more about Viking-Medieval Norse economy in the N Atlantic, older ideas of widespread heedless depletion of all forms of natural capital (eg. McGovern et al 1988) are being replaced by notions of more sophisticated and successful resource management. If the Norse Greenlanders in the Eastern Settlement area were successfully conserving their fragile caribou stocks, why were common seals over hunted? Common seal populations are still sustainably hunted in several parts of Iceland today on a small scale.

However, Icelandic sealing has clearly been very different in scope from the far larger Greenlandic effort, and unanticipated consequences or just bad luck can certainly overtake management strategies on the local scale. A broadening of the data set to include more sites in both settlement areas may be helpful in assessing the two hypotheses (Figure 8).

Figure 8 compares available stratified seal bone collections in both settlement areas. These collections can be roughly sorted temporally by radiocarbon and stratigraphy to before vs. after the late 13th / early 14th century. In the Eastern Settlement area, both the older archaeofauna from E17a at Narsaq and the

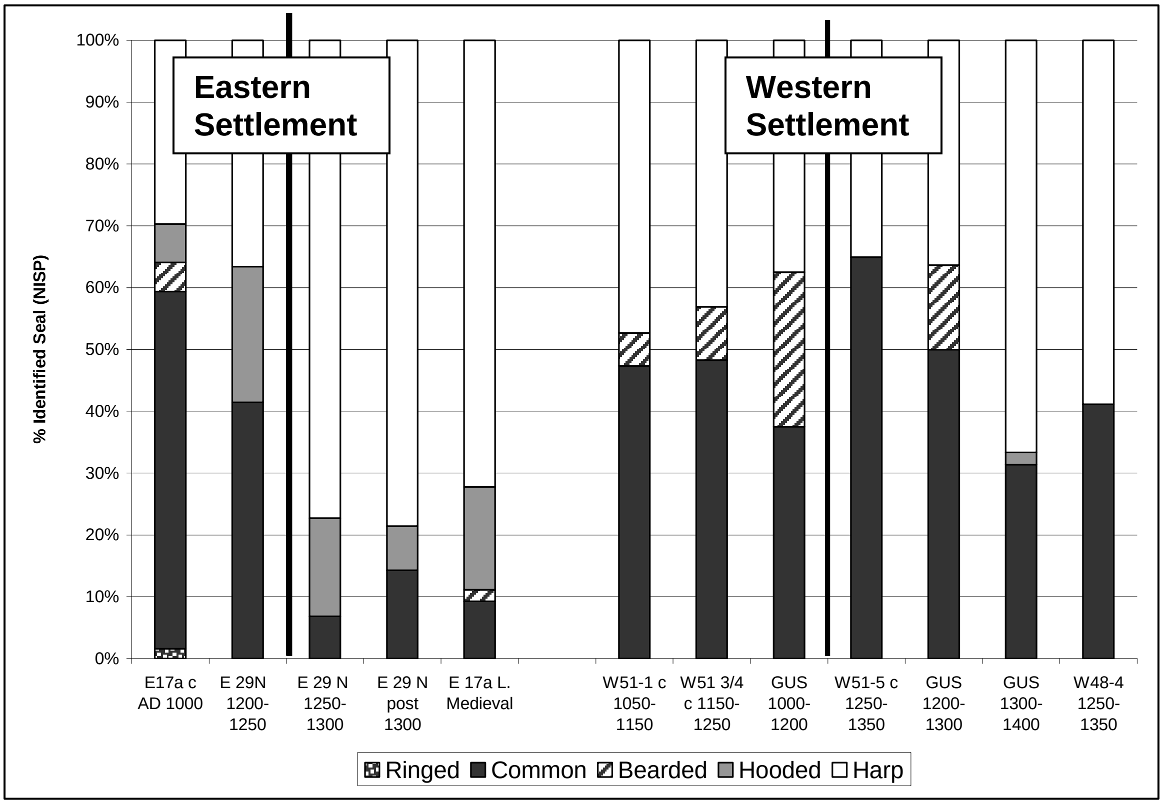

Figure 8. Identified seal species from stratified sites in both the Eastern and Western Settlements. Broad vertical lines roughly divide archaeofauna from before and after the later 13th century in both settlement areas. Data: Enghoff (2003), McGovern et.al. (1996), McGovern et al. (1993)

2005-06 Brattahlið North Farm (E29N) phased collections show similar patterns of abundant common seal bones in the earlier layers, and a sharp reduction in the later layers. The two sites are far enough apart that it is unlikely that both would have hunted the same local common seal pods, suggesting a wide impact rather than a local depletion. In the Western Settlement, collections from *Garden under Sandet* (GUS), W 51 Sandnes, and the small site W48 all continue to contain varied but always substantial amounts of common seal bones both before and after the late 13th century. The W 51 Sandnes site is close to what was the largest common seal hauling out and pupping ground in this portion of Nuuk district, and the continued availability of common seals throughout the Norse occupation at Sandnes may be another argument in favor of successful management of common seal resources.

It would appear that something happened to change Norse hunters' access to common seals in the latter half of the 13th century in several parts of the Eastern Settlement but not in the Western Settlement area, and at present the most likely hypothesis seems to be climate change and a transition to modern conditions of increased summer drift ice. Some geophysical and oceanographic data may support a mid-to-late 13th century transition point from a largely open water summer marine environment in Danmark Strait. High resolution sea cores from Nansen Fjord in East Greenland seem to flag such a threshold (Jennings & Weiner 1996, Jennings et al. 2001). Jennings and Weiner (1996) report evidence from foraminifera and ice transported debris for an on set of heavier summer drift ice in the last half of the 13th century. Further consultation with climatologists will be important to attempt to better tie down this apparent temporal correlation and we welcome collaborative efforts.

Birds

Bird bones make up a small but significant portion of most Norse archaeofauna from Greenland (usually ten percent of total or less), and the Brattahlið North Farm archaeofauna follows this pattern. Like most other Norse, Inuit, and Palaeoeskimo archaeofauna in Greenland, the E29N bird collection is mainly made up of guillemot or murre, whose nesting colonies are widespread along the west coast (Gotfredsen 1997). A few raptor bones (gyrfalcon and sea eagle) reported from both the 20th and 21st century excavations (Degerbøl 1934: 154) may possibly relate to the historically known Greenlandic falconry trade.

Fish

No fish remains were recovered from the 2005-06 excavations at Qassiarsuk/ Brattahlið, despite complete sieving and excavation by a highly motivated team which included zooarchaeological specialists alerted to watch for any fish remains. This negative result only duplicates the outcome of intensive sieving efforts (largely aimed at recovering missing fish bones) carried out by several teams in the Western Settlement. While taphonomic forces may well have destroyed fish bone at Brattahlið, contemporary Icelandic sites with comparable (or worse) conditions of organic preservation are typically filled with fish bones. The Greenlanders simply do not seem to have made fish or fishing a major portion of their economy, and their unique seal-dominated subsistence strategy appears to extend from the latest to the earliest layers excavated. While other parts of the Scandinavian North Atlantic intensified fishing for both local provisioning and trade, the Norse Greenlanders did not follow the path of their near relatives and seem to have concentrated upon sea mammals to provide both trade goods and subsistence. While the causes for this unusual pattern remain to be satisfactorily explained, the 2005-06 excavations at Brattahlið North farm can only add confirmation of its reality.

Intensified Use of Marine Resources?

While fishing may have played a minor role in Norse economy in Greenland, the use of sea mammals seems to have increased steadily through time at Brattahlið North Farm. By combining all bone that can be identified as terrestrial mammal, and comparing this total to all bone that can be identified as marine mammal (mainly seals), a broad overview of the balance between these two major categories is possible. Since this scale of analysis allows inclusion of the smaller earlier Phases VI-IX, a longer time perspective can be achieved (figure 9). As Figure 9 illustrates, there is a very strong overall trend towards more marine mammal bone from earlier to later contexts. Even at what must have been an elite household, subsistence relied more and more upon the use of marine species, a finding supported by the large scale isotopic study carried out on human bone from Norse Greenland by Jette Arneborg and her colleagues (Arneborg et al. 1999, 2007). Seals increasingly seem to have filled any provisioning gaps left by the domestic farming economy, and the importance of sealing and marine resources seems to have progressively increased with time, even in the heart of the Eastern Settlement.

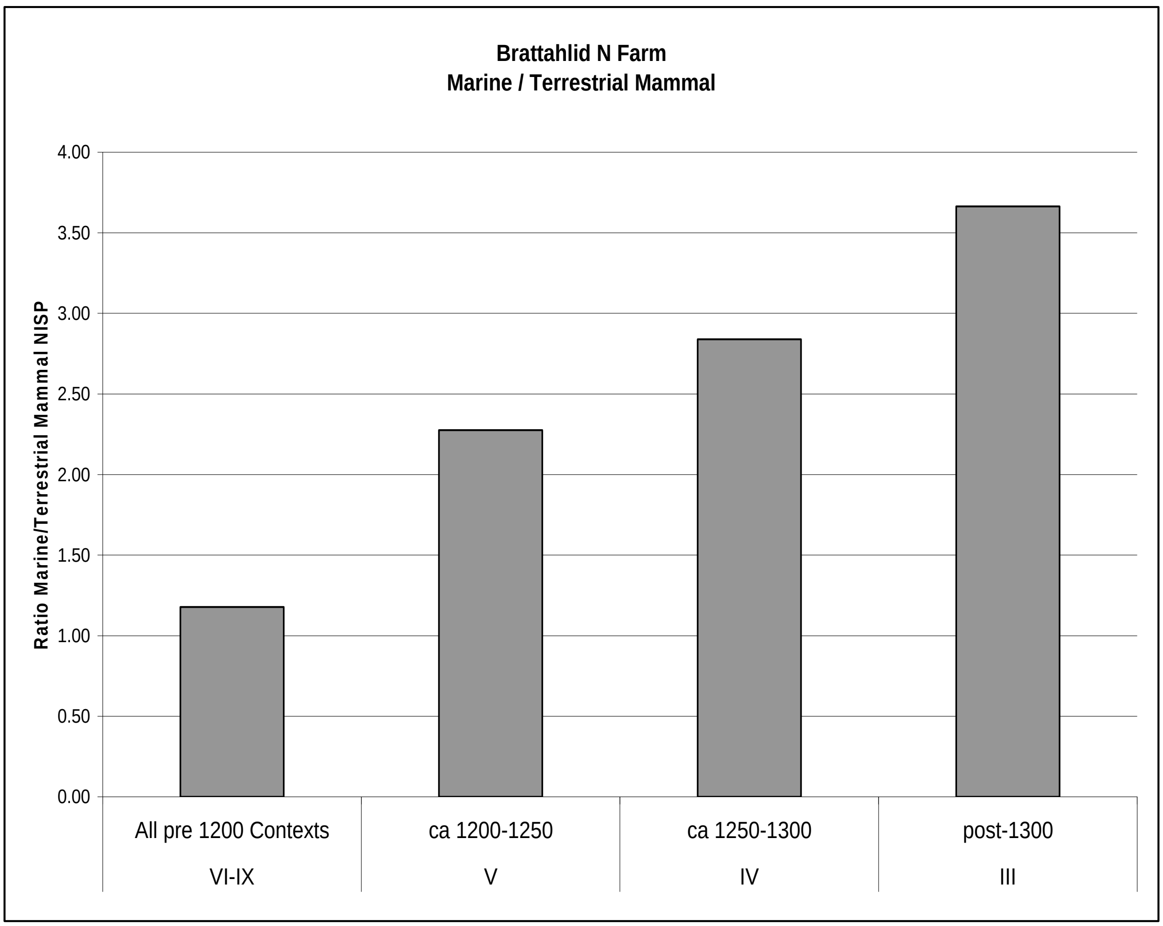

Figure 9 All bone fragments identifiable as terrestrial mammal compared to all marine mammal bones in direct ratio (taller bar = more marine).

Directions for Further investigations

This short preliminary report hopes to provide a timely perspective of the main features of the 2005-06 Brattahlið North Farm archaeofauna, and will be superseded by a final report with more complete analysis.

As new fieldwork is being planned in the Eastern Settlement area, it may be helpful to suggest some potentially productive directions for further research from a zooarchaeological standpoint.

- **More stratified archaeofauna**: at present only three archaeofauna (E29N, E34, E17a) from the Eastern Settlement come from stratified contexts, and the E17a excavation was unsieved. If we are to better understand the changing dynamics of Norse economy we need to expand this sample with directly comparable excavations at other sites.
- **Herding patterns and Farming Strategy** : Work by Mainland and Halstead (2005) have pointed the way towards a more effective and systematic approach to reconstructing Norse farming strategies. Larger stratified archaeofauna containing sufficient numbers of useable tooth rows will be key to successfully applying their approach.
- **Better understanding of Norse sealing**: seal hunting seems to have been of central (and perhaps growing) importance to the Norse Greenlanders, and it appears that it differed in important ways from known Inuit patterns. We need a better understanding of the organization and scheduling of the hunt and the distribution of its products. More excavation of inland sites may aid understanding of labor coordination and seal meat distribution, and larger archaeofauna with more seal teeth suitable for incremental analysis and seasonal reconstruction will be needed to better document this key element in the Norse economy.
- **Seals and Climate Change**: Interdisciplinary work by Jim Woollett and colleagues in Canada (Woollett 1999, 2007, Woollett et al 2000, Grumet et al 2001) has demonstrated the potential for the application of archaeological seal bone assemblages in the interdisciplinary study of climate change. The advent of summer drift ice in SW Greenland must have been a threshold crossing event with wide impacts in marine and terrestrial ecosystems. Close cooperation between zooarchaeologists and climatologists appears to have considerable potential for improving our understanding of such climatic discontinuities in SW Greenland.

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