Preliminary Report on the 2012 Archaeofauna from E47 Gardar in the Eastern Settlement, Greenland

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Introduction

The excavation at E47 Gardar took place during the 2012 collaborative fieldwork carried out in a cooperation between the Greenland National Museum and Archives, CUNY, U Stirling, National Museum of Denmark, and the Archaeological Institute Iceland coordinated by the North Atlantic Biocultural Organization research cooperative (NABO www.nabohome.org). In response to initial reports on substantial drainage ditch disturbance by Hans Kapel (Kapel 2005) and the ditch profile cleaning and column sampling work done by the UK team (Buckland et al 2008), *Nunatta Katersugaasivia Allagaateqarfialu/the Greenland National Museum & Archives* (NKA) in 2011 requested international support for an emergency rescue excavation aimed at recovering as much of the exposed and degrading cultural deposits exposed by the 2004-05 drainage ditches at Gardar/Igaliku. One major objective of the 2012 season was thus the recovery of animal bones and other organic remains, and this preliminary paper reports on the animal bone collection (archaeofauna) recovered.

The 2012 archaeofauna came from two major excavation units, Area A and Area B, as well as from several test trenches (please see the discussion on field methods in this volume). Excavation area B (trench) has been divided into 6 sections by the excavators (SE, SW, NE, NW, Extension E , Extension W in area B) based on spatial location to identify the most artifact rich areas for future excavations, and the archaeofauna has been recorded in accordance with this division. Since all those locations represent the same time period, and the collection is small, no such distinction has been made in this report. For the purpose of this preliminary report three contexts were chosen for analysis.

Context [505] is the oldest deposit in area B, and is also the thickest and most bone rich layer on site. Since it was very thick, it is most likely a series of layers but the stratigraphy could not be easily distinguished during excavation. The context was divided into six 10 cm deep arbitrary layers. Layer [505-4] (4th spit/arbitrary layer) is the most bone rich deposit, and it contains more bones by volume, than all the other contexts in Area B or A combined. Ca. 95% of the bones have been analyzed, and the results are reported here. Only the smallest, unidentifiable fragments (the remaining 5%) have not been counted yet, due to the time

constrains, but they will be included in the final, full zooarchaeological report to be published later this year.

Context [36] contains the most bones in the undisturbed deposit of Area A, and has been analyzed in the same way as [505-4]. The final 5% of small unidentifiable fragments will be added to the count in the final report. Based on field interpretations this context is grouped with [505-4] (Group 1004) and is from the same time period.

Context [31] in area A is small, but it is the only undisturbed layer with substantial archaeofauna that is stratigraphically younger than the previous two (and has been analyzed in the same way as the previous two). It was chosen for this preliminary analysis to investigate changes over time of the animal husbandry and wild resource use at Gardar.

Photo on the cover page is of Walrus Maxilla bones recovered during the excavation from context [505-4].

Laboratory Methods

Analysis was carried out in 2012-13 at Hunter College Zooarchaeology Laboratory Konrad Smiarowski and Thomas McGovern. Extensive use was made of the major comparative collections of N Atlantic fish and birds housed at the CUNY laboratories and reference was made to the earlier Greenlandic sites such as E172 Tatsipataa, E29N Brattahlid and E74. All fragments were sorted by family (mammal, fish, bird) and all fragments were identified as fully as possible with current methods. Fragments that could not be fully identified to species level have been placed in the next highest taxonomic level, with the most heavily fragmented and least identifiable specimens being placed in the Large Terrestrial Mammal (horse- cattle sized) or Medium Terrestrial Mammal (sheep-pig sized) categories. All measurements follow the metrical standard of Von Den Dreisch (1976) unless otherwise noted, measurements taken with digital calipers (Mitoyoto CD 6BS) to 0.10 mm. Quantification in this report follows NABO Zooarchaeology Working Group recommendations and widespread North Atlantic regional practice by making NISP (number of identified specimens) the basic quantitative measure, as this simple counting technique has proven robust in numerous sampling experiments and is

easily replicable across investigators. Basic data was recorded through the NABO Zooarchaeology working group NABONE system (9th edition, see NABO website www.nabohome for free download). The basic data set (in MS Access 2007 compatibility mode) is available for download through the NABO project management system. Bone specimens are temporarily curated at the CUNY laboratories but will be returned for long term curation at the Zoological Museum in Copenhagen.

Dating and Phasing of the Archaeofauna

Table 1. Presents radiocarbon dating of the three deposits, and it confirms the stratigraphic observations in the field. For further discussion on the stratigraphy and dating of the entire excavation please see the dating section of the main report.

Lab no	context	group	material	BP	d13C	1σ	2σ
SUERC-46219	505-4	5004	cattle	827±29	-21.00%	1188-1199 (10.5%), 1206-1257 (57.7%)	1162-1264 (95.4%)
SUERC-46215	36	5004	cattle	837±29	-21.10%	1170-1225 (68.2%)	1155-1266 (95.4%)
SUERC-46213	31	5004	cattle	681±29	-18.20%	1279-1300 (47.2%), 1369-1381 (21.0%)	1270-1316 (60.9%), 1355-1389 (34.5%)

Contexts [505-4] and [036] are apparently contemporary, and are both within a calibrated two sigma range of 1155-1266 AD, or approximately mid -12th to mid-13th century. The dates of underlying [505-5] and overlying [505-3] suggest these are effectively the same deposit (field observation supports this impression). Based on the SUERC 46213 date, context [031] can be placed within a calibrated two sigma range of 1270-1389 AD, or approximately late 13th to late 14th centuries. This division would appear to place contexts [505-4] and [36] before the onset of summer sea ice ca. 1275-1300 (Miller et al. 2012) and the associated environmental changes on land and sea, and the context [031] after these changes.

For the purpose of this report NISP counts of [505-4] and [036] were thus combined into a single Phase1 (c. 1155-1266 AD), and will be referred to as such throughout this report. Context [031] is referred to as Phase 2 (c. 1270-1389AD).

Taphonomy Discussion

The excavation at E47 was conducted as a rescue project that aimed to recover as much organic artifacts and ecofacts from a semi-waterlogged area that was being drained by local farmers. Unfortunately the drainage and/or freeze and thaw action have partially ravaged the collection. From the lab and field observation (the author co-excavated the collection) it is evident that the bones have signs of mechanical weathering produced by strong freeze-thaw cycling. These diagnostic patterns of exfoliation and cracking on long bone surfaces, is widespread in collections from the arctic that have not been deeply buried enough to insulate them from recurring freeze thaw action (Lyman 1996). It is clear that the preservation is biased towards large and dense bones. Many of them are exfoliated none the less, with significant damage to the cortical bone walls. This pattern is often seen on Greenlandic collections especially in exposed upper layers (Smiarowski 2011). Some bones disintegrated in the field, while wet sieving. The fact that Greenlandic Norse collections, including this one, are usually heavily fragmented due to butchery and trampling may have contributed to the poor preservation of the archaeofauna. Small, trampled fragments are in danger of faster decomposition when exposed to freeze thaw action in wet or moist environment. The shortage of any neonatal bones (which are more porous and fragile than adult ones) of domesticates that were bred on site further demonstrated that this is a partially ravaged collection.

Figure 1. Bones from [505-4].

Overview of species present

Table 2 presents an overview of identified taxa from the three contexts. The total NISP for all contexts combined is 1,541 with 1,356 datable to Phase 1, which is a sufficient sample size to begin a discussion about animal husbandry, hunting and provisioning of the farm during the earlier period. However, context [031] is small (185 NISP), and all the identifiable bones from Phase 2 were analyzed and are presented here. This sample size is below the NABO standard of a minimum of 300 NISP for archaeofauna composed mainly of mammal bones and (despite the comparative graphs below) we should be cautious of over-interpretation of patterns in such a small sample. It should be stressed again that this analysis is only preliminary, and more bones from time period represented by Phase 2 need to be excavated to test the hypotheses set out in this report.

Table 2. Number of Identified Specimens present in each context.

	[36]	[505-4]	[31]	Total
DOMESTICATES				
Bos taurus (cattle)	10	39	14	63
Equus caballus (horse)		1		1
Canis familiaris (dog)	3	6	x	9
Sus scrofa (pig)	1			
Ovis aries (sheep)		12	3	15
Capra hircus (goat)		16	4	20
Ovis/Capra sp.	16	148	37	201
total Ovis/Capra	16	176	44	236
Total Domesticates	**30**	**222**	**58**	**310**
SEALS				
Erignathus barbatus (bearded)	1			1
Pagophilus groenlandicus (harp)	10	16	1	27
Large seal		1	6	7
Phocid sp.	197	730	104	1031
Total Phocid	**208**	**747**	**111**	**1066**
CETACEA				

Great whale				
Small whale/porpoise	1			1
Cetacea sp.	5	2	3	10
Total Cetacea	**6**	**2**	**3**	**11**
OTHER MAMMALS				
Ursus Maritimus (polar bear)			1	1
Odobenus rosmarus (walrus)	2	24		26
Rangifer tarandus (caribou)	14	78	7	99
Total Other Mammals	**16**	**102**	**8**	**126**
BIRDS				
Corvus corax (raven)	3		1	4
Haliaeetus albicilla (white tailed eagle)	1		1	2
Uria aalge (common guillemot)	7	2	2	11
Uria Sp. (murre family)	2		1	3
Birds unid.	3	4		7
Total Birds	**16**	**6**	**5**	**27**
FISH				
Gadid sp. (cod family)	1			1
Total Fish	**1**	**0**	**0**	**1**
TOTAL NISP (Identified fragments) =	**277**	**1079**	**185**	**1541**
Small Terrestrial Mammal	1	2	1	4
Medium Terrestrial Mammal	281	252	61	594
Large Terrestrial Mammal	33	114	5	152
Unident. Mammal Frags		93	236	329
TOTAL TNF (all fragments) =	**592**	**1540**	**488**	**2620**

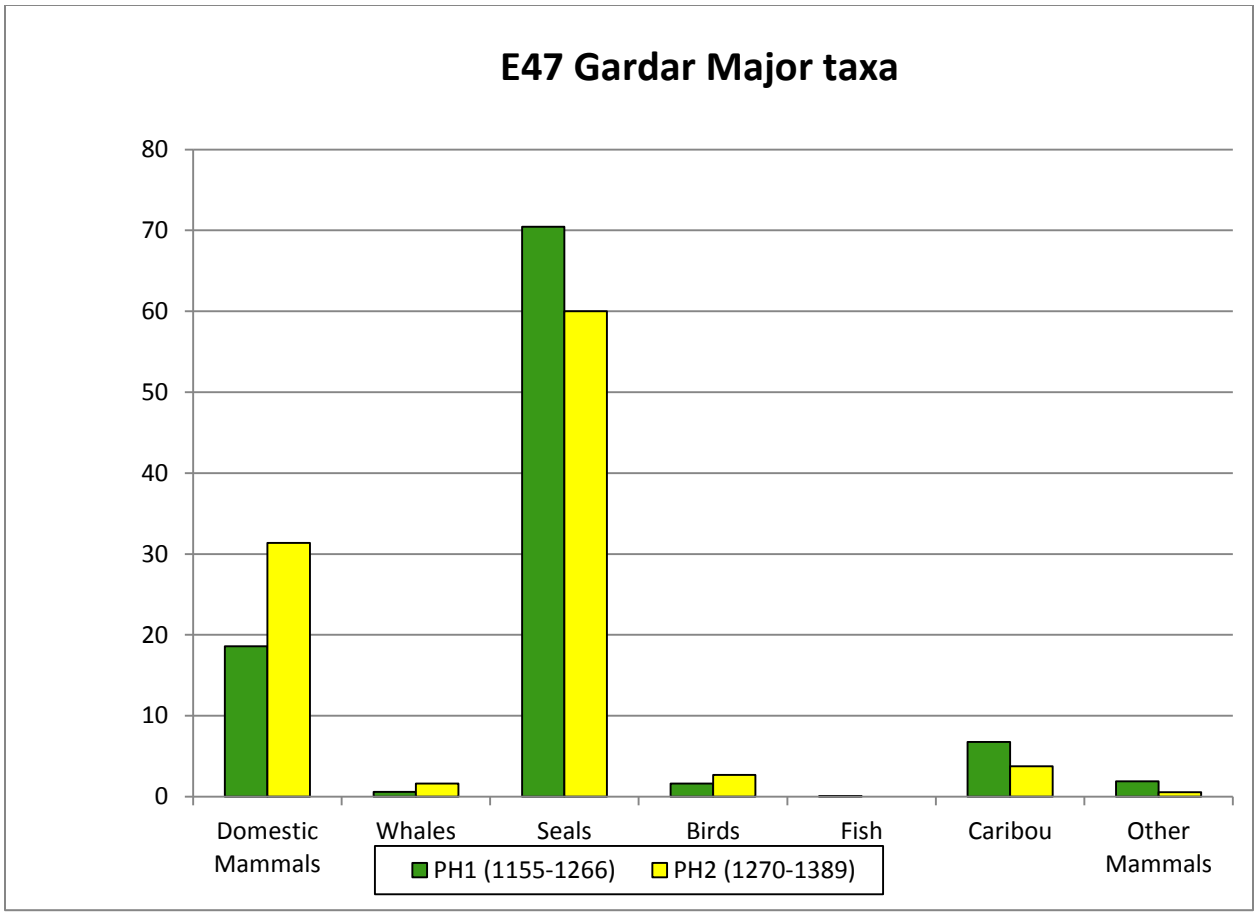

Figure 2. Major taxonomic groups sorted by phase.

Figure 2 presents a comparison of the major taxonomic groups between the two phases in the 2012 Gardar Archaeofauna. Again it should be stressed that the Phase 1 archaeofauna is of fully quantifiable size (despite a somewhat ravaged taphonomic condition) while Phase 2 is significantly smaller as well as similarly ravaged. Thus while patterns across the phases will be discussed in this report, it should be kept in mind that sample size in Phase 2 is not comparable to sample size in Phase 1. Domestic animals, the second most numerous taxon group, comprise ca. 18.58% of all animals in phase 1, and increases to 31.35% in phase 2. Seals, the dominant food source, are apparently declining in numbers with time from around 70% to 60%. The ratio of seals to all domestic mammals changes from 3.79 to 1 to 1.91 to 1 in the current sample. This pattern is not typical to Greenlandic sites, which normally see significant increase in relative proportions of seal bones in the later phases, including the stratified archaeofauna from Brattahlið North Farm (McGovern et al. 2006). One question for further investigation will be

any differences in overall balance of marine and terrestrial sources in provisioning of the Episcopal household during and after the climate changes of the late 13th-early 14th centuries and the apparent ability of this manor farm to maintain its domestic mammal stocks and maintain its lifestyle. Seals clearly still play an important role in provisioning Gardar, but at present we do not see them increasing dramatically in relative abundance after the initial climate impact. Whales and birds play a minor role in this assemblage, as do "other mammals" represented by walrus and polar bear bones. A single thoracic vertebrae bone fragment of gadidae (cod) family fish was recovered from context [36] in phase 1. Caribou also declines through time (see discussion below).

Domestic Mammals

Domestic mammals were key elements in the economy of the Norse settlers in Iceland and Greenland, as well as cultural identity markers and status symbols. In E4 Gardar 2012 collection the domestic stock comprises of all the Nordic imported animal species such as cattle, sheep, goats, pigs, horse and dogs.

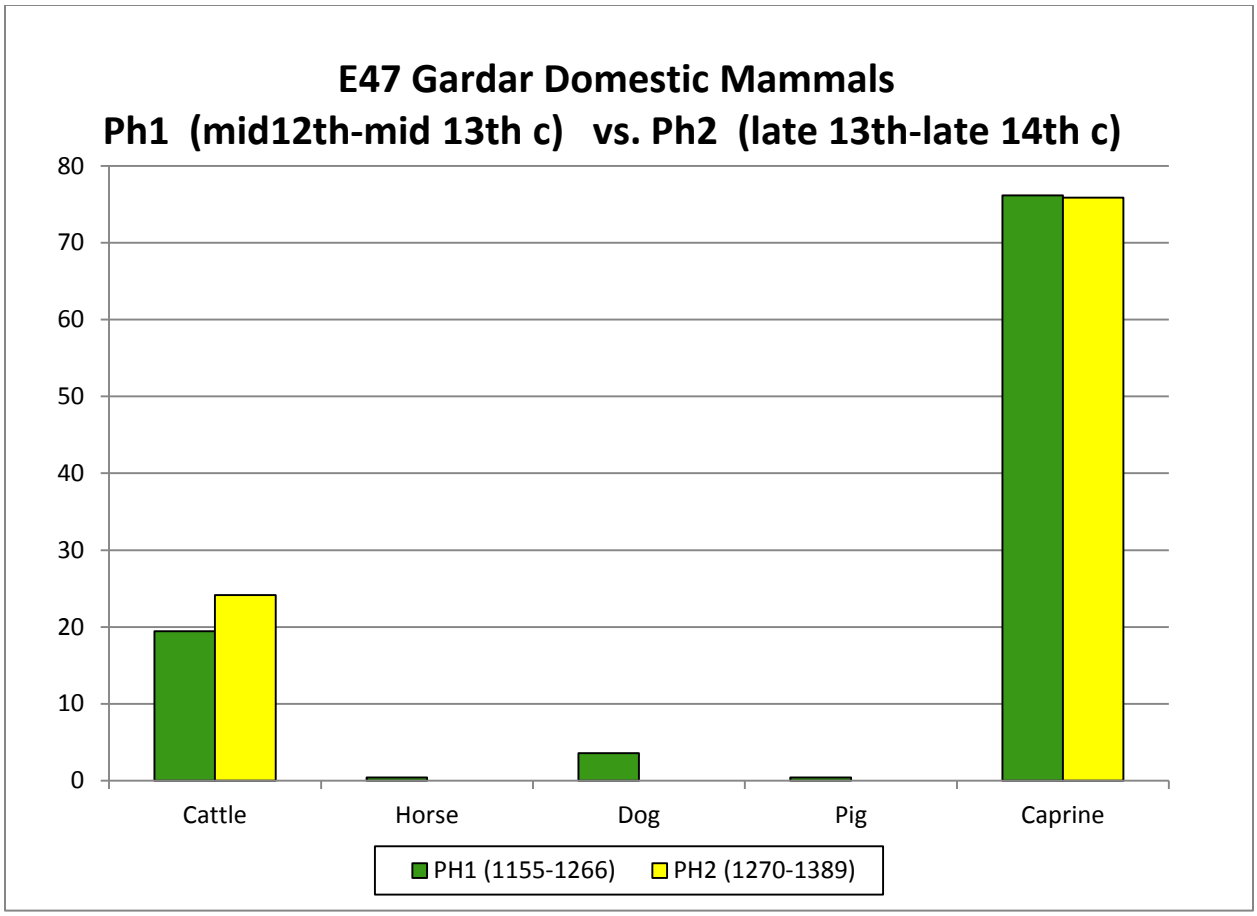

Figure 3. Major distribution of % NISP within the domestic mammal group.

Cattle

Cattle were the most prestigious livestock of a medieval farmer in the Norse North Atlantic, and a farm's worth was traditionally accounted in cattle units. In Greenland, cattle probably carried even greater social significance, as they are the most expensive animals to keep in the harsh environment. In the current E47 Gardar archaeofauna, cattle appear to increase in numbers across phases from 3.62% to 7.57% of all taxa, and from 19.5% to 24.15% within the domestic mammal group (figure 3) probably reflecting the continued high status of the farm. This pattern is in contrast with other Norse farms that tend to reduce cattle, and increase the numbers of caprine herds through time. In phase 1 the ratio of cattle to caprines is 1 to 3.92, while in phase 2 it decreases to 1 to 3.14. Taphonomic bias, with attrition differentially removing the bones of new born animals (neonates), in this case is likely working to disproportionately reduce the

cattle relative numbers in this collection. In most North Atlantic Viking and Medieval archaeofauna, bones of neonatal calves make up 30-50% of all cattle bones recovered, while neonatal sheep and goat bones are generally rare (below 5%). Thus the ravaged condition of the 2012 archaeofauna will tend to skew these numbers against cattle relative to sheep and goats. Despite sample size and taphonomic issues, it does not appear that cattle keeping was reduced at Gardar in the later time period.

Age estimates to determine mortality rates and culling practices could not be completed, as the numbers of long bones suitable for fusion state analysis are too small, and no mandibles suitable for tooth eruption and tooth wear analysis survived. Only two M3 molars were found and scored (Grant 1982), which is not nearly enough for a basic analysis (table 3). Both show high levels of wear and are likely from older adults.

Table 3. Cattle toothwear score for all available specimens.

SU	Species	Bone	REF# teeth	dp4	P4	M1	M2	M3
36	BOS	MO3	16					E
36	BOS	MO3	17					J

Caprines

At Gardar, the caprine herd remains constant in time, relative to other domestic mammals, indicating the stability of the farmstead that seems to be little affected by the changing environmental conditions of the mid-13th century AD. In phase 1 the caprines comprise 76.19% of all domestic mammals, while in phase 2 they are 75.86% of the group (figure 3).

A total of 15 of the 236 caprine bones that could be further identified to species level in collection were sheep, while 20 were goats. As there is no bone density advantage to sheep bone vs. goat bone preservation, it seems likely that this distribution accurately indicates that the herd was almost evenly mixed throughout the two phases, as the ratio of goat to sheep bones is 1 to 0.75 in both phases. A shift towards an all-sheep caprine flock is often associated with an emphasis on wool production, as in most small and medium farms in contemporary Iceland. The lack of such shift in most farms in Greenland, and at Gardar, where the goats are

actually dominant throughout time, indicates a caprine herd aimed at meat and milk supply, rather than surplus wool production. The caprine long bones and mandibles suitable for age at death estimates are not present in the collection. The data below represents the only available toothwear scores on loose teeth, but the quality and quantity of the data is insufficient for drawing even preliminary estimates of the nature of the cull except to note that both juveniles and old adults were present.

Table 4. Caprine toothwear scores for all available specimens.

SU	Species	Bone	REF# teeth	dp4	P4	M1	M2	M3
505-4	Goat	MO3	1					G
505-4	Goat	MO3	2					G
505-4	Goat	MO3	3					G
505-4	Caprine	DP4	4	H				
505-4	Sheep	MO3	5					H
505-4	Caprine	DP4	6	H				
505-4	Caprine	DP4	7	G				
505-4	Goat	MO3	8					D
505-4	Goat	MO3	9					B
505-4	Goat	MO3	10					G
505-4	Goat	MO3	11					G
505-4	Sheep	MO3	12					G
31	Goat	DP4	13	H				
31	Goat	Mo3	14					J
31	Goat	DP4	15	G				
505-4	Sheep	MO3	18					H

Horse

Only a single horse tooth (m3) was recovered from context [505-4] and probably comes from a working, farm animal.

Dogs

Tooth marks on animal bones were present in all contexts, indicating the access of these animals to the midden area, and presence through all phases. Nine dog bones were present in phase 1 in spatially separated excavation areas, indicating that they do not come from a single

individual. The size of the tibia, humerus, and metatarsal bones in both phases, indicates a large sized, long limbed breed of dog, as noted by previous investigators in Greenland (Degerbøl 1934, 1941, McGovern 1985b) perhaps used for reindeer hunting. While known from multiple sites in both the Western and Eastern Settlements in Greenland these large long limbed dogs (which Degerbøl compared to modern Norwegian elk hounds in conformation) have not yet been identified in Iceland.

Pigs

Only one mandible fragment of a pig was found. The animal could have been brought to Greenland on a ship, as a live food store, or raised in Greenland. More pig bones from this site are needed to be able to speculate further about pig husbandry at Gardar.

Wild Animals

Caribou

The caribou was apparently much less exploited and was probably always much less common in the Eastern Settlement area than in the Western Settlement. In the Western Settlement area, cairn drive lines associated with Norse-built dry stone *skemma* structures have been documented in several areas above the 250 m contour (McGovern & Jordan 1982), and caribou hunting appears to have significantly provisioned the chieftain's manor at W51 Sandnes (McGovern et al. 1996). In the Western Settlement sites the relative percentages of this species range from ca. 5% to over 25%, while it is rare to reach 5% mark in Eastern Settlement. In phase 1 at E47 Gardar, the caribou comprised 6.80% of all species present, which is the highest percentage recorded on any site in the Eastern Settlement. This is a terrestrial resource that appears to be associated with status, and the 2012 Gardar archaeofauna probably reflects the manor's special role in the Eastern Settlement. Even when caribou declined to 3.80% in phase 2, it still was one of the highest ratios in the Eastern settlement when compared to all the other sites, even the high status church farms at E29N Brattahlid, E149, and E64 (figure 4). Further investigations at Gardar may expand our understanding of the role of the church and large

manors in the management of the caribou hunt in the Eastern Settlement, and the sustainable harvest of caribou carried out in Norse Greenland.

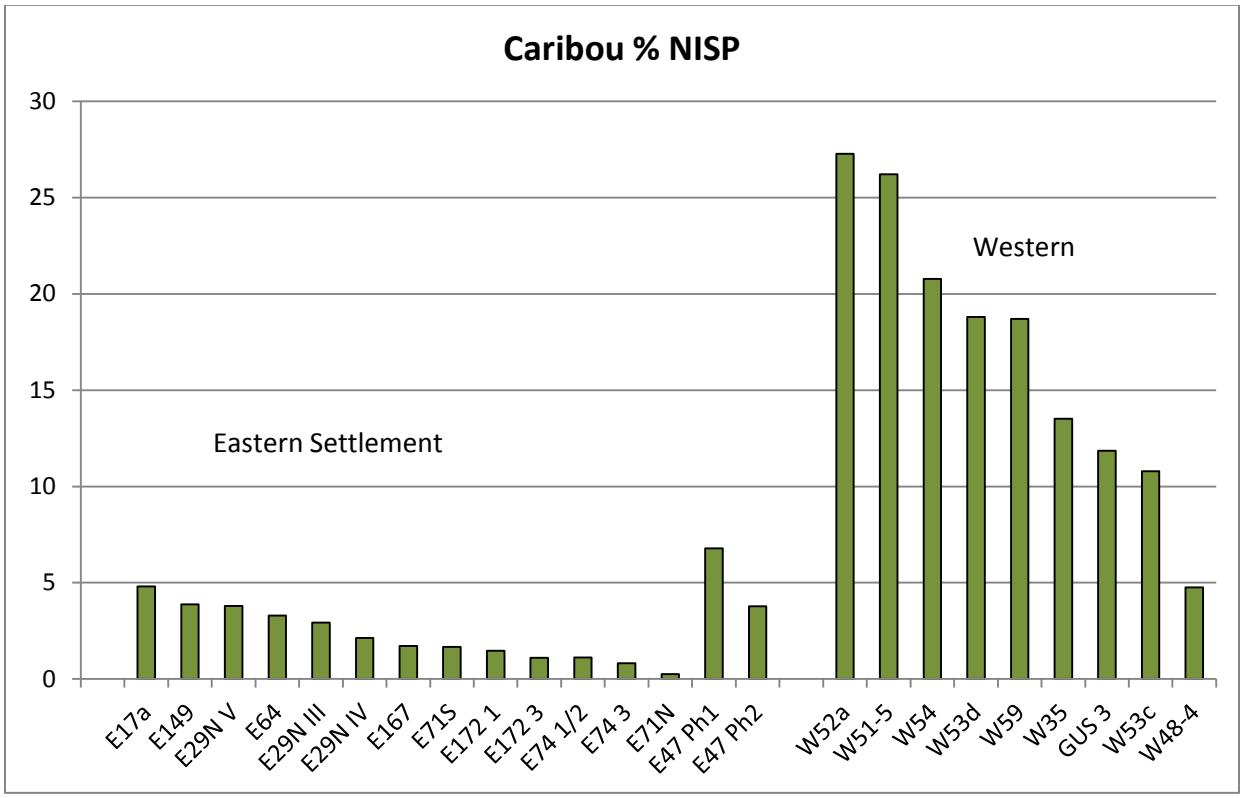

Figure 4 Caribou remains distribution on Eastern and Western Settlement sites.

Seals

Seals are the most important food source at all Norse sites investigated so far, and E47 is not an exception. The seals comprise 70.42% of all taxa, and decrease to 60% in phase 2. Gardar is the only one of 2 sites that we know that the relative percentage of seals decreases. The other one is E74, a specialized caprine herding station located in the inland of Vatnahverfi. Figure 5 (below) demonstrates that even on high status farms such as E29N Brattahlid, the importance of marine (seal) component in the diet increases with time. This is especially noticeable after the 1250-1300AD climatic changes force the Norse to increase their hunt to compensate for lost productivity of the farmstead.

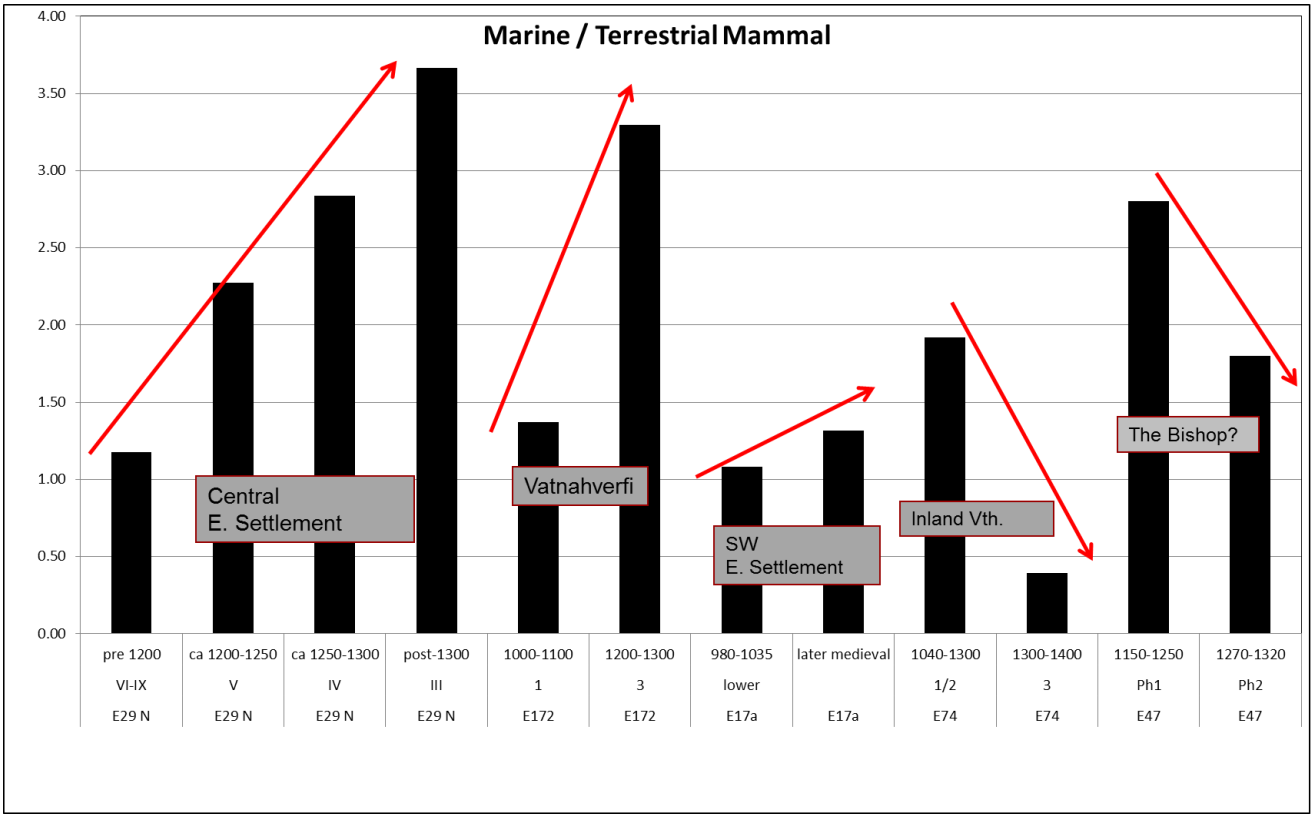

Figure 5. Terrestrial to Marine bone ratios at several Eastern Settlement sites.

This may be yet another indicator of the special status of E47 Gardar. One observation about sealing at Gardar is the absence (thus far) of harbor seals in both phases. While sample size and taphonomy must be considered, other sites with comparable archaeofauna have produced much more varied seal patterns, including non-migratory harbor seals and (in the Eastern Settlement) hooded seals. There are 27 harp seal bones in the 2012 Gardar archaeofauna, and only 1 bone in the collection that is a bearded seal (identifications are mainly based on the auditory bulla, which is equally robust in all seal species). This is unusual as the bearded seal is a very rare species on Norse sites due to hunting methods. The Norse did not tend to hunt solitary bearded and ringed seals, and concentrated on the high yield hunt of migratory seals traveling in pods. We have collectively speculated on the potential differences in ownership/management of the migratory seals (potentially a communally managed resource) vs. the non-migratory harbor seals (privately owned and managed in Iceland). The absence of harbor seals may indicate that the rights to sealing beaches were not owned by E47 inhabitants

and/or that this farm played a key role in the organizing/sponsoring of the annual migratory seal hunt in the outer fjords, and received payment/share of the catch as part of its role in managing the commons. This however does not explain the absence of the hooded seals in the collection, but there are more bones to be analyzed, and the seal hunting pattern will likely become clearer. Figure 6 below demonstrates the uniqueness of the Gardar E47 seal archaeofauna while compared to other sites in both settlements.

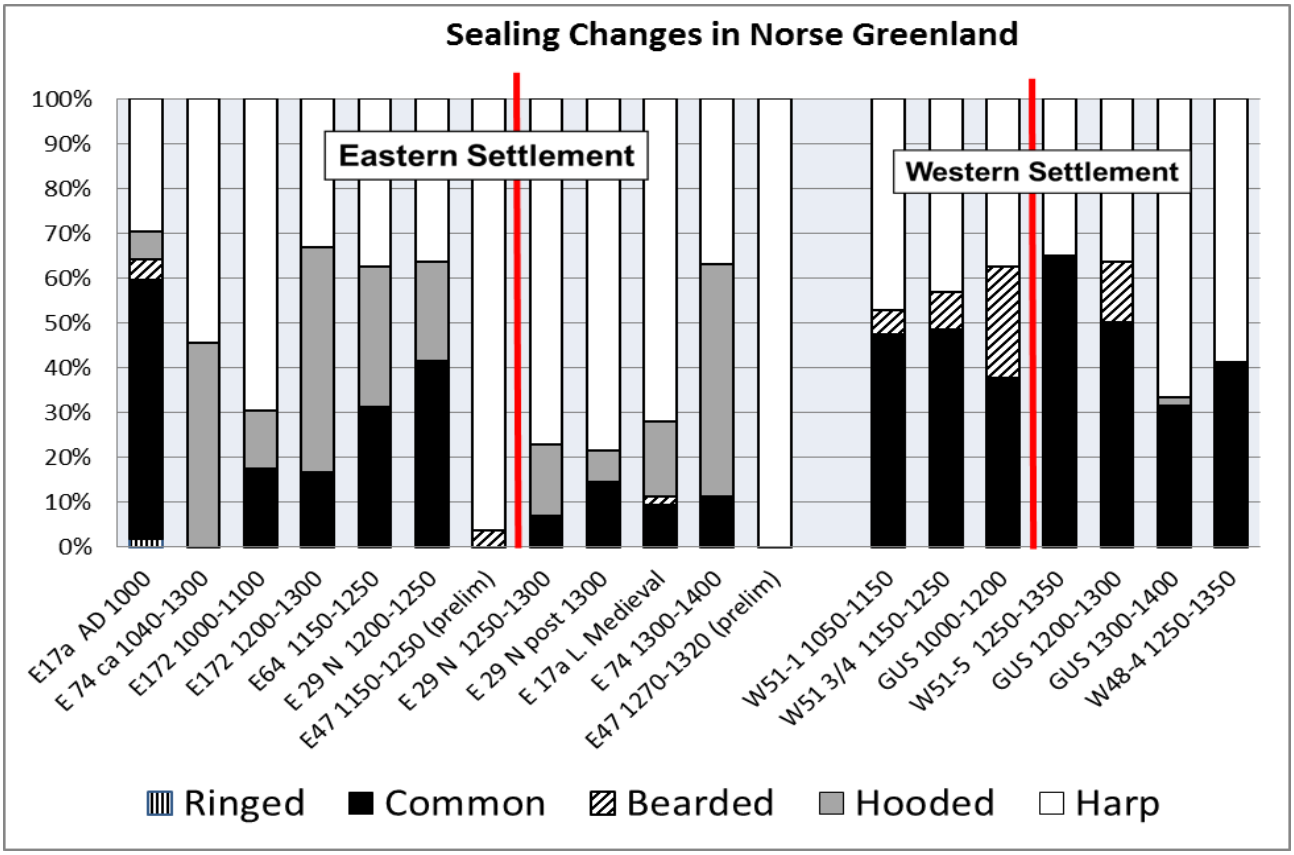

Figure 6. Seal bone distribution on Eastern and Western Settlement Sites.

Walrus

Greatest walrus 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.

Walrus remains at Gardar comprise of the maxillary fragments associated with the tusk extraction. A total of 26 maxillae fragments were recovered from phase1. This site, like other sites in both settlements was part of the acquisition and trade of the walrus ivory, and the byproducts of this industry are represented by this waste material.

Fish

As at most Norse Greenlandic sites fish are virtually absent. Only one cod family (it could not be speciated due to preservation conditions) thoracic vertebrae bone was discovered at Gardar, in context [036]. It is at the moment uncertain if the absence of fish at this site is a taphonomic issue or a part of a wider pattern, but this will be discussed in the final zooarchaeology report, once the whole archaeofauna is analyzed. For now we can only note the presence of at least some marine fish bone.

Figure 7. Fish from [036].

Whales

There are 11 whale bone fragments from the analyzed contexts, eight from phase1 and three from phase 2. These are mostly worked unidentified bone fragments, but one is a fragment of small whale vertebrae, possibly a beluga. It has been chopped, indicating it was brought to the site as food.

Figure 8. Whale bone from [505-4].

Polar Bear

One phalanx no. 3 (the claw) was recovered from [031]. Bears are not regularly present in SW Greenland so the animal most likely travelled to the site within a fur of animal killed somewhere else. Terminal phalanges are regularly left in skins during field processing and (along with some metapodial bones) are usually removed during final finishing and curing, and these are the bear elements most commonly recovered on Norse sites in Greenland (McGovern 1985a).

Birds

Four fragments of raven bones in both phases indicate that ravens were killed at Gardar. This may represent an attempt at pest control, but other explanations are possible. Two white tailed eagle fragments were recovered. A claw (phalanx no. 3) was found in [031] and a fragment of distal humerus in [036]. Eagle bones have been found on other Norse sites in Greenland, and may also represent birds killed for stock protection. The most numerous bird species in the 2012 Gardar archaeofauna is the common guillemot (11 fragments), which is probably the only bird identified in this archaeofauna that was actually consumed by humans at Gardar. Guillemot and auk-family birds are by far the most common in all Norse Greenlandic archaeofauna (Enghoff 2003) and in most Inuit archaeofauna from Greenland (Gotfredsen 1997).

Discussion

While the archaeofauna recovered by the international teams from Gardar in 2012 has limitations due to taphonomic attrition and a larger sample size would always be desirable, these collections represent a significant expansion of our understanding of the economy of the bishop's manor. Already, there are patterns present which appear to distinguish this major center from other known farm archaeofauna in Greenland. Trends in provisioning with wild species (seals and caribou) raise significant questions about communal resource management and response to what we now recognize as major climate change ca. 1275-1300. The presence

of walrus and polar bear remains indicate the connections to the *Norðursetur* hunt and overseas trade. The domestic stock raising strategy at Gardar remains to be fully documented, but the current evidence suggests that the bishop's manor (like other holdings in Greenland) retained the older Viking Age patterns of cattle to caprine ratios and the high proportion of goats to sheep without showing any of the markers of a transition to a sheep-based wool-surplus producing economy as in contemporary Iceland. Prospects for recovering additional stratified archaeofauna from Gardar appear excellent, and there seems to be excellent potential for expanding on (and probably correcting) points raised in this first preliminary report.

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