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Skútustaðir: An Interim Zooarchaeological Report following the 2009 Field Season

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Introduction

The discovery of an intact midden at Skútustaðir's historic farmstead in 2007 was a key finding for the planned investigation of the medieval and early modern periods in the lake Mývatn area of northern Iceland. The 2009 field season followed a soil coring survey and surface collection in 2007 and the excavation of four test trenches in 2008. Work was carried out by international team of archaeologists (hailing from the City University of New York (CUNY), North Atlantic Biocultural Organization (NABO) Fornleifastofnun Islands(FSÍ) and the University of Bradford) as part of an ongoing National Science Foundation, International Polar Year (NSF, IPY) project focusing on long term subsistence practices and human and environmental interactions. Zooarchaeological evidence from Skútustaðir excavation seasons in 2008 and 2009 is reviewed in this report, and laboratory analysis of animal bones is ongoing at the CUNY Hunter College and CUNY Brooklyn College Zooarchaeology Laboratories. The ongoing analysis has shown that the most important domesticates were sheep and cattle- used for meat, wool. and dairy throughout all periods. Skútustaðir may have had some advantages in their ability to keep cattle over other farms in the area. Goats, pigs, and horses are also present in the archaeofauna in low numbers. The presence of birds, bird egg shell, seals, cetaceae (whales and porpoises), marine fish and freshwater fish points toward a breadth of local and non local resources being consumed at the site. Ongoing analysis aims to uncover the diets and economies of the site's residents as well as the related social and ecological interactions through time.

The Field Team 2009

Thomas McGovern (CUNY) and Ágústa Edwald (FSÍ) led our team which included students from the Ph.D. program at CUNY : Francis Feeley, George Hambrect, Megan Hicks, and Aaron Kendall. Joining our team from the University of Bradford Ph.D. Program in Archaeology, was Marianne Robson. Jasmine Patel, Reaksha Persaud, and Jessica Vobornik represented the Research Experience for Undergraduates (REU) program out of Brooklyn College Zooarchaeology Laboratory. As part of a large interdisciplinary project, we worked alongside archaeological teams pursuing related projects nearby from the University of Sterling (U.K.), Durham (U.K.), and Fornleifastofnun Islands (FSÍ, Iceland).

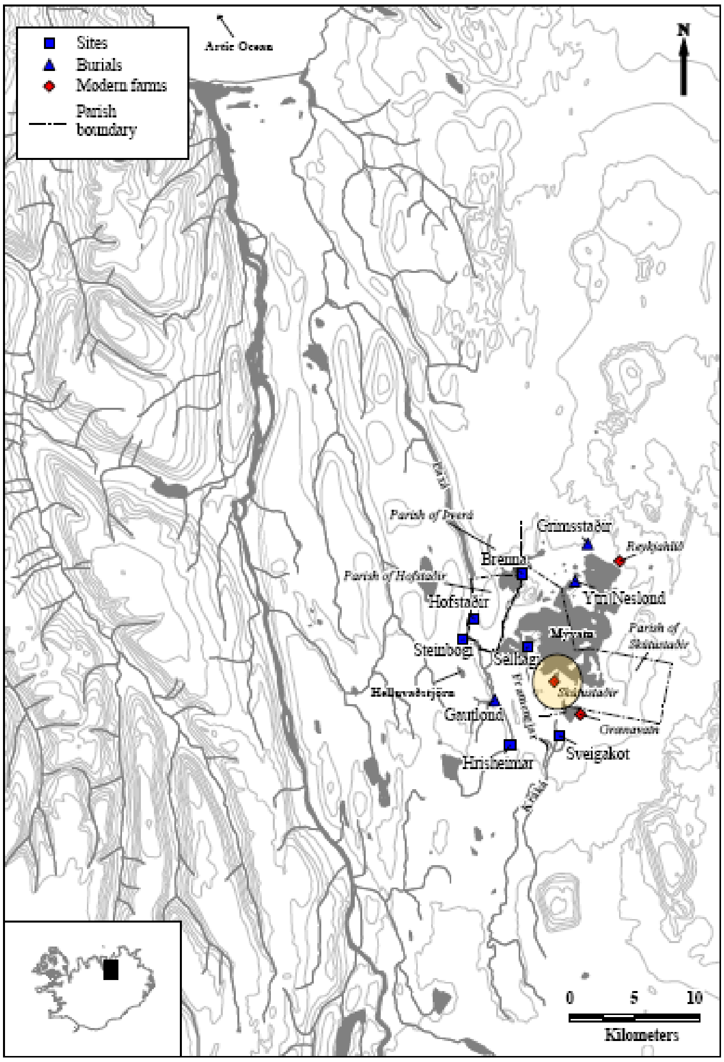
Many thanks to

Dr. Arni Einarsson, who first noticed archaeological midden at Skútustaðir and has been an important source of support since the inception of the project. Kind thanks are also due Gerdir Benediktsdóttir and the other residents of Skútustaðir for welcoming out team. We are grateful to Kid's Archaeological Project Iceland (KAPI, formerly *Fornleifaskóli barnana* (Kid's Archeological School)) who's company we enjoyed for some valuable and fun learning experiences. Thanks to Unnsteinn Ingasson for hosting our team so warmly at Narfastaðir.

Gratitude is due to Norman Kennard (Hunter College, CUNY) for his assistance in laboratory analysis and Ramona Harrison and George Hambrecht of the Ph.D. program at CUNY for their valuable comments. Funding support from the U.S. National Science Foundation Office of Polar Programs Arctic Social Science Program through International Polar Year grant 0732327 is gratefully acknowledged. This report is a product of the International Polar Year program and of the NABO research cooperative.

Beginnings: 2007

Skútustaðir was investigated in 2007 as part of an extensive survey of farms in the Lake Mývatn Region of Northern Iceland. Orri Vésteinsson and Adolf Friðriksson of the *Archaeological Institute of Iceland* (FSÍ) Orri Vessteinsson lead the 2007 excavation and coring regime with the purpose of establishing the archaeological potentials of additional farms in an area that had been intensively investigated since 1991 as part of the *Landscapes of Settlement Project* and the *Human and Social Dynamics in Mývantssveit Project* (Vésteinsson ed 2008). Until 2008, the large scale excavations in the area (Hofstaðir, Sveigakot and Hrísheimar) had illuminated the nature of settlement, economy and ecology of the settlement period (ca 870- 1000 AD) and a portion of the medieval period (ca 1000 through the 13th century AD) (for more information on the above excavations see McGovern et al 2007). Through the coring survey, a team of CUNY archaeologists lead by Orri Vésteinsson hoped to find archaeological sites that would contribute to our understanding of long term, post- Viking settlement in the Mývatn area- i.e. sites that included archaeological remains dating to the medieval and early modern periods (ca 1000 AD through the 18th century AD).



1 Archaeological sites of lake Mývatn (courtesy of O. Aldred. from (McGovern et al 2007), highlight is author's own.)

The extensive coring survey of Skútustaðir focused on three promising areas: Area A was cluster of possible structural remains on the high point of the site; Area B, a steep slope southeast of area A, and downslope and pond-side Area C called “Oskutangi” or ash peninsula- possibly indicating a historic rubbish disposal area (McGovern in Vésteinsson 2008). Area B proved to yield the best results for the presence of deep midden deposits- prefaced by a surface collection carried out by Arni Einarsson of the Mývatn science station- the coring survey found there to be extensive midden material with very good preservation . The following year, test trenches would be excavated to explore the extent, preservation and temporality of the midden and to obtain a collection of animal bone and artifacts for analysis.

2008

Four test pits (Areas D, E1, E2, and F) and extensive soil coring were the focus of the excavation in 2008. The test pit areas E1 and E2 indicated archaeological deposits on the *landnam* (settlement era) surface, a bare and craggy lava bedrock with traces of the 871 volcanic tephra. The results of the coring survey by Frank Feeley and George Hambrecht showed the midden to occupy a massive area and pointed to the impressive archaeological potential of the site. The zooarchaeological report of the following summarized analysis (post-2008) is available online at www.nabohome.org (Hicks and Harrison 2009).

Following the field season, radiocarbon dating of bone recovered from Skútustaðir was done by Drs. Gordon Cook and Philippa Ascough at the Scottish Universities Environmental Research Centre (SUERC) and the results are presented in the table below.

Lab Code	Radiocarbon age	delta C13 %	Delta N15 %	C/N ratio	C14 BP	1 sigma range	2 sigma range
SUERC 20218	1215 +/- 30 BP	-22.1	5.7	3.6	1215+/- 30	770-870 AD	690-890 AD
SUERC 20219	1040 +/- 30 BP	-21.4	2.6	3.4	1040+/- 30	985-1025 AD	890-1040 AD
SUERC 20220	785 +/- 30 BP	-20.8	1.6	3.3	785+/- 30	1220-1265 AD	1205-1285 AD
SUERC 20225	625 +/- 30 BP	-21.8	2.8	3.3	625+/- 30	1295-1395 AD	1280-1400 AD
SUERC 20226	525 +/- 30 BP	-22	4.3	3.3	525+/- 30	1395-1435 AD	1320-1450 AD

2 Table of radiocarbon dates from terrestrial mammal bone courtesy of Drs. Gordon Cook and Philippa Asough of SUERC

These results (from terrestrial mammal bone) were of great help where tephrachronology was not fully resolved, and the results, along with the clear presence of the V 1477 tephra and V 1717 tephra among cultural layers firmly established the long term inhabitation of Skútustaðir. Tephrachronology and radiocarbon dating have allowed us to group our stratigraphic contexts in the following phases (only stratigraphic contexts bearing bone and so far analyzed are listed here):

Table 1 A list of the stratigraphic context excavated and their chronology

Cultural Periods	SKU08 Analytical Phases	Stratigraphic Contexts (excavated 2008 (all) and -2009(161 only)
Viking age (*landnam,*870-930)	9th c.	063
Viking age	10th c.	161
Medieval Period (1000-1550)	1262 – 1300	059, 060
Medieval Period (1000-1550)	14th c	006, 058, 019
Late Medieval to Early Modern period (Early mod. 16th c -19th c)	1477 – 1717	061, 062, 057, 056, 055, 046, 044, 032, 052, 062, 035
Early Modern Period (16th c -19th c)	Post 1717	002, 007, 033, 034, 035, 036 045, 047, 050, 051, 054, 068, 069, 073, 074, 075, 076, 077, 096, 005, 050, 055, 069, 029

The 2009 Field Season

During the 2009 field season, the focus of the excavation was the area south east of area D, where deep midden deposits had been located during the coring survey of 2008. A 13 square meter, L shaped trench was laid first, called trench G, followed later by a contiguous long rectangular (4x5m) trench - called Trench H - extending south east down –slope and toward area F. Trench G was excavated down to the natural lava surface while still there remains approximately 1 meter depth of cultural material to excavate in 2010. The ground surface below the remaining material is very uneven so it is difficult to predict the actual depth of the deposits. The recovery of faunal material from the site in 2009 was very successful and the data resulting from analysis so far is presented below.

2009-2010 Laboratory Analysis and Progress

From October 2008 through May of 2009, analysis was completed of all mammal and bird bones recovered from the 2008 test trenches. Following the arrival of additional material from the 2009 field season, in November 2009, analysis was completed of the entirety of the mammal bones from large, 10th c. context [161] which produced 28 bags of bone. This archaeological layer was an extremely bone rich midden mixed with gravel that was deposited directly on the lava surface at some point during the earliest phase of settlement of Skútustaðir. It was associated with the 10th century V940 volcanic tephra and likely dates closely to this time. The layer appeared to be an intentional in-filling of a fissure in the craggy, once bare lava surface. This inhospitable surface, exposed before human settlement, has been augmented by 1000 years of midden deposition to be a rich and productive infield for the farm. Context [161] would have represented the initiation of this project, the direct deposition of bone and household debris onto the rough lava bedrock. The excellent level of preservation of the context was observable immediately in the field and as a result, it was the first priority for laboratory analysis.

Figure 3 Visible here is the fissure in the natural lava ground surface which was in-filled with bone around the 10th C.

Figure 4 A second view of the natural lava surface after excavation of the overlying midden

The above images depict the craggy lava surface with in-filled context [161] in the process of excavation and after excavation of the bone- rich deposit down to the natural lava surface. The nicely banded midden is visible in the photographed profiles. The profile drawing below depicts the location of context [161] a portion of the west facing profile of area G, behind the excavators in the photograph.

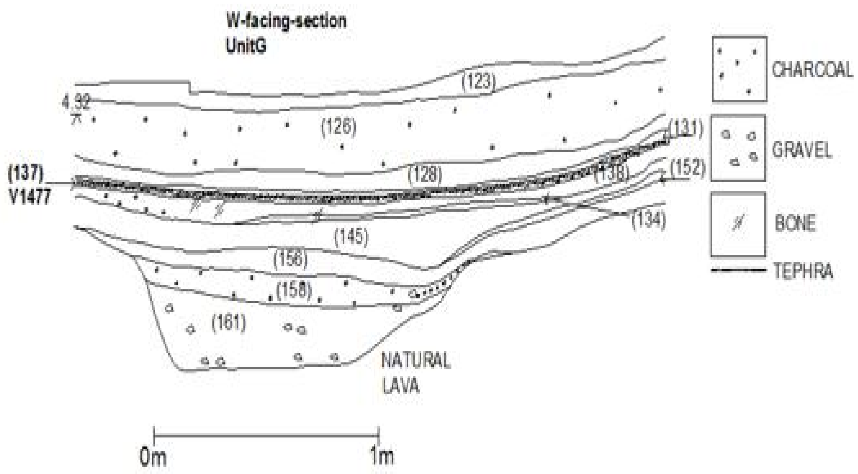


Figure 5 West- facing section drawing showing location of context [161] (Edwald 2010).

During excavation, the following measures were taken in accordance with NABO and FSÍ recommendations to ensure excellent recovery of faunal material and other artifacts the field: all midden material bearing bone was dry-sieved through 4mm mesh. Regular checking of the resulting back-dirt suggests that few elements were missed by the sieving methods. All articulated elements and *in situ* clusters of bird egg shell fragments were placed in one bag or in bulk soil samples in the field and subsequently recorded as one specimen to reduce interdependence. Thorough recovery of the faunal material was further ensured through the careful excavation by several team members with previous zooarchaeological training.

Laboratory Methods

Analysis completed so far was carried out at the Hunter College Zooarchaeological Laboratory and made use of the extensive reference collections there. Analysis of the fish bones recovered in 2008 and 2009 will be carried out at the Brooklyn College and the Hunter College

Zooarchaeological Laboratories. All elements (bird and mammal) were identified as far as taxonomically possible (a selected element approach was not employed) but most mammal ribs, long bone shaft fragments and vertebral fragments were assigned to “Large Terrestrial Mammal” (cattle or horse sized), “Medium Terrestrial Mammal” (sheep, goat, pig or large dog sized), and “Small Terrestrial Mammal” (small dog-fox sized). Only elements positively identified as *Ovis aries* and *Capra hircus* were assigned to the separate sheep and goat categories respectively while all other sheep/goat element were assigned to the “caprine” category potentially including both sheep and goats.

Digital records of all data collected were made following the 9th edition of the NABONE recording package (a Microsoft Access database supplemented with specialized Microsoft Excel spreadsheets). The animal bones excavated will be permanently curated at the National Museum of Iceland. This report, other reports and data are available from nabo@voicenet.com and the NABO website: www.nabohome.org.

Curation followed the NABONE protocols followed for other archaeofauna from Iceland, Faroes, Greenland, and northern Norway (NABONE, 2004, see www.nabohome.org for downloadable version 9). Following widespread North Atlantic tradition, bone fragment quantification makes use of the Number of Identified Specimens (NISP) method (Grayson 1984). Mammal measurements (with a Mituyo Digimatic caliper) followed the approach outlined by von den Driesch (1976), and sheep/goat distinctions follow Boessneck, (1969) and Halstead and Mainland (2005). Tooth-wear stage studies follow Grant (1982) and long-bone fusion stage calibrations follow Reitz and Wing (1999).

Taphonomy

The physical condition of bone transforms multiple times during its journey from a living animal to a laboratory specimen through decay, fragmentation and other processes. This may inhibit our ability to derive information from an archaeofaunal assemblage and may impede its comparison of multiple assemblages (Lyman 1994). On the other hand, the processes that bone has undergone leave traces that contribute to our understanding of human activity at a given archaeological site, such as butchery or burning. It is because of these factors of change that zoooarchaeological evidence is indirect evidence and an assessment of taphonomic (post death) factors is key to any analysis.

Most bone found in middens is significantly fragmented, and burnt bone is especially prone to fragmentation. Specimens analyzed were classed in to size categories to determine the extent of fragmentation of the assemblage. A total sieving regime, as detailed above, often results in a collection with a high proportion of specimens in the smaller size classes and thus, the unidentifiable classes. Where in some cases, a high percentage of small fragmentssignals poor preservation, in this case where total sieving through fine 4mm mesh is used, it is the result of thorough recovery practices.

The taphonomy of context [161] is unusual for Icelandic midden deposits. The first and most noticeable difference between the layer and others is that it contained an extremely low percentage of burnt bones relative to other sites. Analysis of all bird and mammal bones from 2008 demonstrates a levels of burnt bone between 10 and 40 percent. Burnt bone fragments readily, contributing to such high numbers. Context [161], however contained only .005% burnt bone or 21 specimens burnt and 4342 un-burnt. This contrasts with other findings where Icelandic settlement period deposits (ca 870-1000 AD) contained more burnt bone that later deposits (Bigelow 1985).

Another anomaly was the presence in context [161] of a large amount of coprolites- likely dog coprolytes, as well as gnawed bone and partially digested bone. These traces not only point to the presence of dogs but also to a moderate level of disturbance of the faunal collection that we must take into account. Overall, though evidence of the presence of dogs is common, the intensity of gnawing expressed in % of gnawed specimens seems to be relatively low when compared through phases.

Table 2 % of Gnawed bones in the assemblage

SKU Phase	# Gnawed bones	% Gnawed of Total Number of Fragments (TNF)
9^{th} c	0	0
10^{th} c [161]	29	.01%
1262-1300	20	1.23%
1477-1717	128	2.66%
14th c	2	0.06%
post 1717	38	1.08%

Butchery of bones in context [161] was common at levels seen in other Icelandic sites. However, this mammal rich collection, with good preservation allowed for some additional observations of butchery patterns. Several patterns emerged as evidence of regular manners of carcass disarticulation- this included innominates that were frequently chopped and severed distal humeri. This points to a pattern of expedient disarticulation where people were probably using heavy chopping tools to sever the bone, as opposed to attempting to dismember a joint by removing flesh alone, which would be hampered by thick areas of tendons and ligaments. There were several examples of heavily chopped vertebras, both caprine and of cattle. While heavily chopped cervical vertebra seen at the site of Hofstaðir pointed (with other behaviors) toward feasting-related ritual sacrifice and consumption of cattle (McGovern in Lucas ed. 2009), at least one vertebra observed at Skútustaðir, in 10^{th} c context [161] were clearly chopped from the ventral side of the animal, suggesting again an expedient manner of dismemberment. Such patterns demonstrate how the sites residents would break down a carcass into manageable, smaller parts. Other butchery patterns included removal of horns from skulls of caprines and cattle, most likely for horn working; splitting of caprine skulls to access the brain as food (a preparation called svið); as well as the very regular dividing of the mandible between of the last present molar and the ascending ramus which was likely done for tongue extraction. All bones of the axial and apendicular skeleton were present in the midden suggesting that butchery, consumption, and disposal occurred on site- in contrast to outside provisioning which sometimes leaves more narrow categories of species and elements as remnants. Very surprisingly, there were few fish bones present in the 10th c. context [161]- out of 28 bags of faunal remains, there are merely a few handfuls of fish bones . Immediately visible were several Haddock cleithra and several salmonid vertebra. The fish bones from Skútustaðir will be analyzed in the Brooklyn College Zooarchaeology laboratory. (For a full analysis of the taphonomy of the collection excavated in 2008 please refer to Hicks and Harrison 2009).

The composition of context [161] is unusual when compared to most Icelandic midden layers. During excavation it was noted to be unusually bone rich. Bones were packed into this once lava crevice without the normally very predominant inclusion of slowly accreting dumps of ash, fireplace cleaning debris, floor cleaning debris and other discard which normally compose Icelandic midden layers. Excavators noted bones not only densely packed, but also standing and laying at angles against the lava surface and other bone. In contrast, slow successive discard events of bone normally result in bones laying on a ground surface at the same angle as that surface. The lack of large numbers of fish bone, which tend to be small, and burnt bones, which tend also to be small and breakable, may indicate that the bones deposited in context [161] were hand-collected and placed there in a rapid depositional event possibly to in-fill the crevice in the lava surface. A similarly dense, perhaps rapid accumulation of bone was observed during the excavation of the settlement age farm Hrísheimar in an area called pithouse C. The unusual formation of context [161] illustrates how the formation of middens can result from general or habitual human activities like successive cleanings and dumping or unique practices where refuse is put into use by people for shaping and changing their living environments.

SKU 08 and 09(partial): An Overview of Species Present, Number of Identified Specimens and Total Number of Fragments

	Unstr at.	**9th c**	**10th c [161]**	**1262-1300**	**14th c**	**pre 1477**	**1477-1717**	**post 1717**	**Total**
Cow (*Bos taurus*)	8		198	110	13		112	84	**525**
Horse (*Equus caballus*)			1	1			1		**3**
Dog (*Canis familiaris*)								1	**1**
Pig (*Sus scrofa*)	1		11					1	**13**
Sheep (*Ovis aries*)	5	2	57	13	4		78	49	**208**
Goat (*Capra hircus*)			9					1	**10**
Ovis/Capra sp.	22	5	594	159	19		467	380	**1646**
Total Domestic Mammals	**36**	**7**	**870**	**283**	**36**		**658**	**516**	**2406**
Harp seal (*Pag. Groenlandicus*)								2	**2**
Phocid spp. (unident. seals)				1			34	18	**53**
Cetacea (small whales/porpoise)				1					**1**
Arctic fox (*Alopex lagopus*)		1		2				1	**4**
Mouse (*Mus musculus*)							2		**2**
BIRDS (all)	3	9	6	35	11		62	49	**175**
MOLLUSCA			3	3	1		14	2	**20**
TOTALNISP(No. of Ident Specimens)	**39**	**17**	**879**	**325**	**48**		**770**	**588**	**2666**
MM (Marine mammal)							1	3	**4**
STM (Small terrestrial mammal)									
MTM (Med. terr. mammal)	9	49	766	322	43		981	517	**2687**
LTM (Large terr. mammal)	2	25	195	64	14		120	102	**522**
UNIM (Unidentified mammal)	3	299	2384	905	184	7	2928	2277	**8987**
Total Number of Fragments	**53**	**390**	**4221**	**1616**	**289**	**7**	**4800**	**3487**	**14866**
Fish (Preliminary count)	6	175	127	321	272	2	4065	1131	**6099**
Total Number of Fragments (incl. fish)	59	565	4342	1937	561	9	8865	4618	**20965**

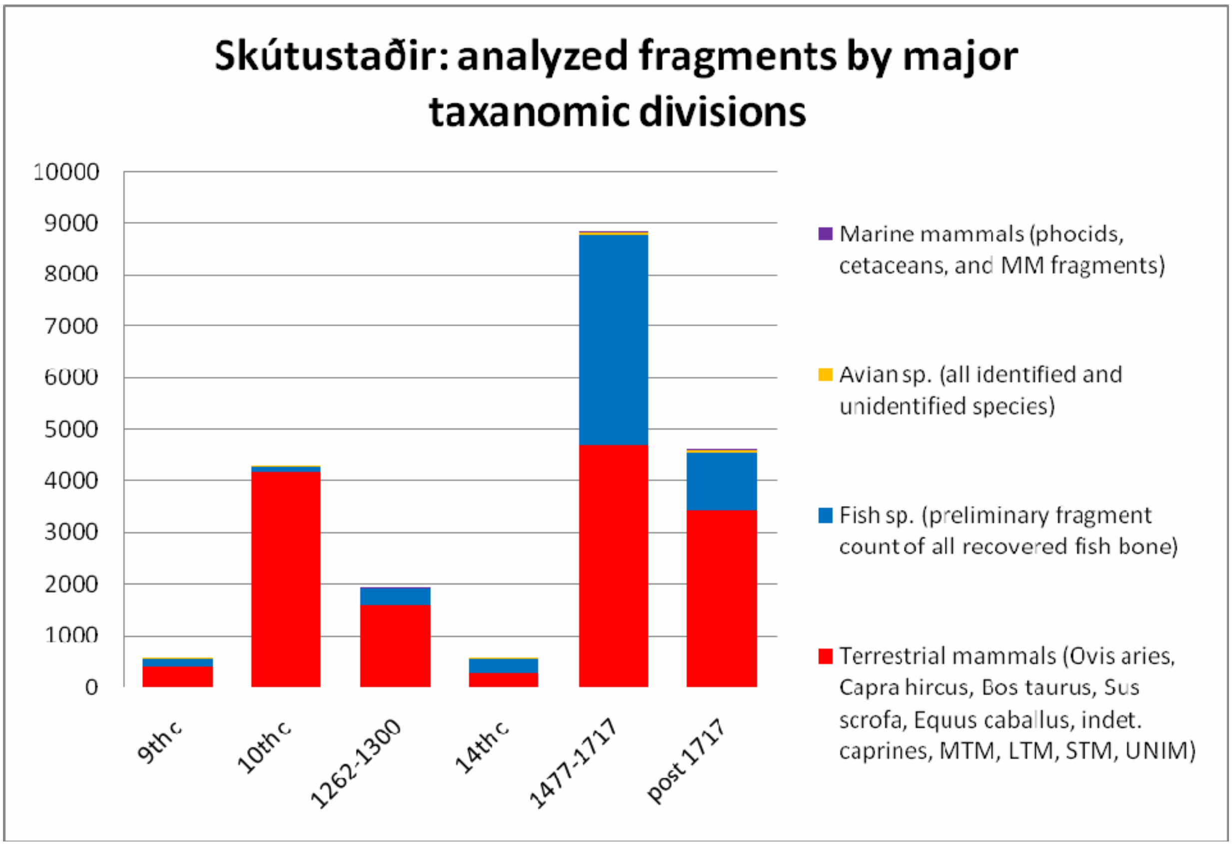
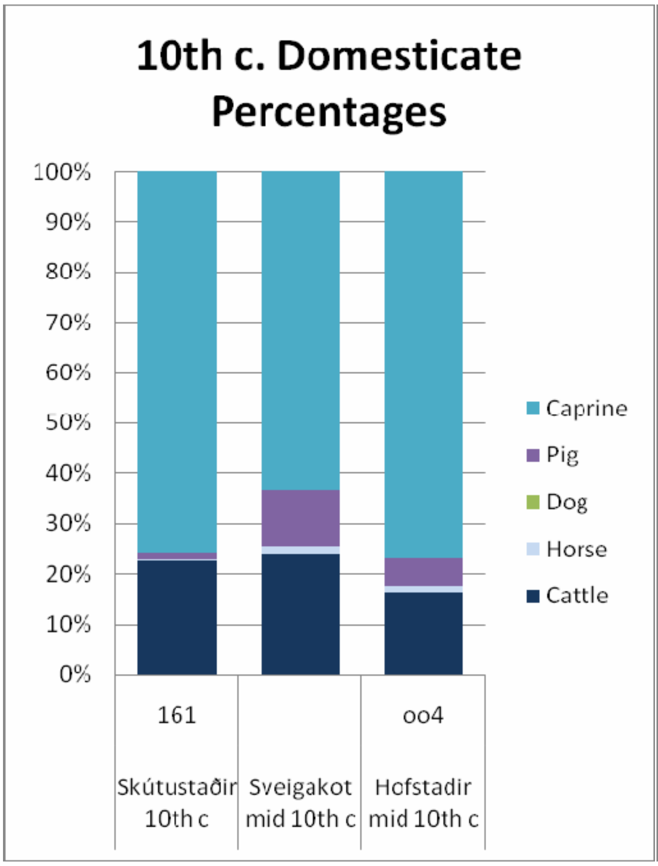
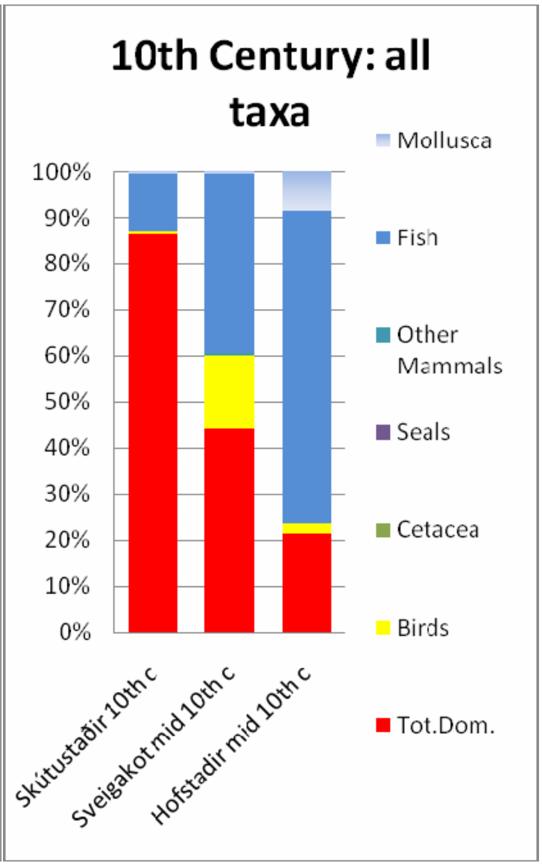


Figure 6 This graph displays the counts of individual fragments of bone grouped by major taxanomic categories





Context [161] is compared to other 10th century assemblages from the Lake Mývatn Area (information is courtesy of The NABO & NORSEC Laboratories. For further detailed information please see reports archived on NABOHOME.org). Hofstaðir is a high status site in nearby in the Laxa river valley and Sveigakot is a relatively high elevation site south of Skutustaðir; both sites were initially settled during the Viking age and are indicated on the map on page 3 of this report. The surprisingly small number of fish bones found in context [161] is well-illustrated by this chart. The use of birds seems to have been variable by site in the 10th century. Seals and *cetacean* species are absent in the data represented here.

Domestic Mammals

Caprines and cattle clearly dominate the domestic fauna assemblages throughout all ages. Previous zoooarchaeological studies have suggested that in Northern Icelandic farms, after ca. 1200 AD, there is a pronounced increase in numbers of caprines when compared to cattle in Icelandic stocks (McGovern 2007, Brewington et al 2004). Preliminary results of Skutustadir's archaeofauna suggest that there is at first a decrease in the number of caprines kept per cattle through time, with the fewest sheep per cattle being kept in the middle ages, followed by an increase over time in the caprine to cattle ratio at Skútustaðir- reaching 5 caprines per every head of cattle in the early modern period. These numbers of sheep per cattle are all comparatively low however when we look at some nearby examples. The 13th c. evidence from the site of Steinbogi

(Brewington et al 2004) shows that the caprine to cattle ratio reaches approximately 22:1. Furthermore, the 18th century farm inventory (Jardabok) describes Mývatn area farms as having approximately 24 caprines per cattle at the time it was written. As a third example, the Viking age high status site of Hofstaðir maintained approximately 4:1 caprine to cattle ratio from 930-1050 CE (McGovern in Lucas ed. 2009). The lower status site of Sveigakot transitioned from a 3:1 caprine to calttle ratio to a 10:1 ratio from the late 9th c to the 11th c. Skútustaðir's archaeofaunal record may suggest that farmers there were apart from the trend of an extreme increase in sheep per cattle going into the high medieval period and continuing through the early modern period.

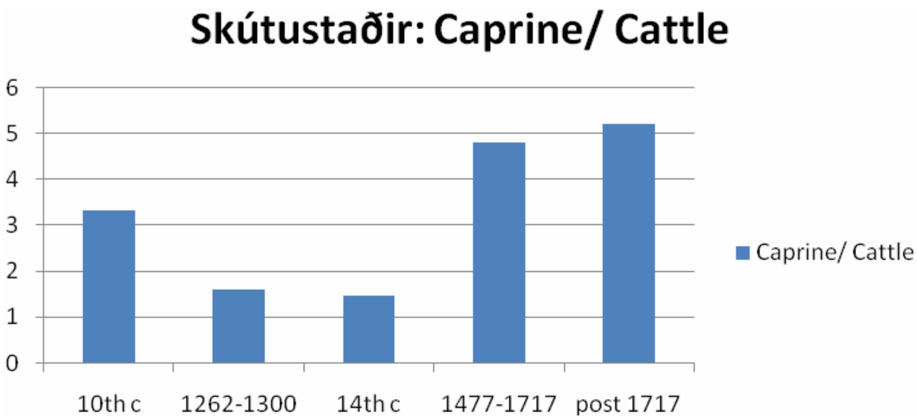


Figure 7 The ratio of caprines to cattle through the various phases of archaeological chronologies as indicated by radiocarbon dating and tephrachronology.

The study of cattle and caprine holdings through time in the Lake Mývatn Area has important implications for an area where the landscape has been significantly impacted by humans and their livestock (McGovern et al 2007). Through archaeological investigation, it has been revealed that the area was subject to extensive deforestation and then extensive erosion which was crippling if not deleterious to farms in the area (Dugmore et al 2005, McGovern et al 2007). In both cases, the application of caprines to the land appears to have played a role.

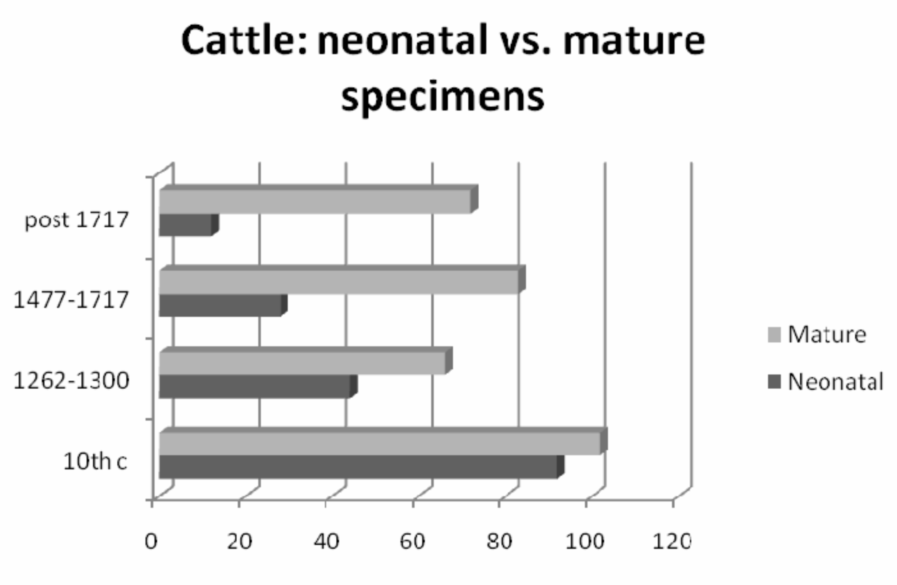


Figure 8 Neonatal cattle specimens versus mature cattle specimens recovered and analyzed thus far

Halstead has argued that where cattle-based dairying has occurred, a large proportion of neonatal cattle bone is found in an archaeological assemblage (1998). By keeping cows in calf-bearing cycles while culling the calves, cows continuously produce milk and calves for human consumption. On the other hand, in a cattle economy based solely on meat production, cattle are slaughtered when they reach mature body size.

Neonatal bone is identified by a variety of traits including size, shape, porosity, state of fusion of long bone epiphyses, tooth eruption stage (where possible), and extensive use of comparative neonatal specimens. The archaeofauna collected in the 2008 field season suggest that past residents of Skútustaðir were killing of many young calves and were likely practicing a dairy economy to some extent. In some contexts, nearly half of the cattle bones recovered are those of newborn calves (see chart below). The proportion of neonatal cattle being killed off appears to decrease in the late medieval to early modern period. It may be best to reserve final conclusions until more specimens are recovered in the following excavations of Skútustaðir.

Horse (*Equus caballus*) remains were represented by three total specimens. It is believed that horses were not eaten approximately after the Christianization of Iceland around 1000 CE as Icelanders increasingly adopted alternate customs alongside their new religion (Karlsson 2000, p 46). Horse burials hove been well documented in Iceland which may suggest that horse specimens will not commonly be found in household middens.

During the settlement period and at least into the 10th c., pig husbandry was more common than in later periods (McGovern et al 2007). The 10th c. context from Skútustaðir [161] contained eleven pig specimens: seven metapodials, one third phalanx (hoof), one first phalanx, one tibia, and one tooth. Of the phalanges, metapodials and tibia, (total 10 specimens)- only two were fully fused which may indicate that the residents of Skútustaðir preferred to consume young pigs. As analysis continues, we hope to contextualize a larger data set of pig remains among other evidence of pig husbandry in the north Atlantic as only 13 specimens of pig remains have been found at the site so far.

Domestic Mammal Tooth Rows

The eruption and wear stages of teeth in an archaeofaunal collection can help us establish more precisely the age at death of animals present. As a group, this information may convey a "kill-off pattern". The broad literature on this topic is aimed at determining the specific stock management strategies applied by herders (Payne 1973, Driesch 1985, Munro 2004, Mainland and Halsted 2005). The meaning of kill of patterns (i.e. how they relate to peoples economic, dietary and other social motives) is highly specific to environmental and economic contexts. Demands of a market (consumers) can dictate kill-off patterns as well as notions of efficiency applied by the herder (Payne 1973). Seasonality of birth, seasonality of plant growth, winter, or drought can also play a role in timing and age of kill-off patterns (Driesch 1985). Production of hides, wool, meat, and dairy products can all contribute to different culling strategies, thus, there is no one-to-one universal correlation between age- at- death patterns and specific economic strategies, but local hypotheses should be investigated and ethnographic information is helpful.

Though management strategies are highly specific to their culture and environment, general knowledge regarding livestock development and age is useful. Sebastian Payne's work in Asvan Turkey suggests that a kill off pattern focusing on efficient meat production (from sheep), might include a majority of animals killed around 18-30 months of age, as this is when they reach their full size there (1973). Additional feed and pasturage need not be dedicated to their growth as returns would not increase (Payne 1973). Icelandic studies have suggested that caprines reared there reach their maximum body size between 3.5 and 4.5 years of age (Harrison et al 2008).

Kill-off patterns with large number of lambs can indicate a preference for lamb meat (Dreisch (1985), dairying practice (Halstead 1998), hardship and disease, or herd size management. Worldwide, a limitless variety of desired products might influence kill off patterns; using information from historical and archaeological literature in Iceland and the greater Norse north Atlantic (Halstead 1998, Mainland and Halstead 2005, McGovern 2009), we can focus on a few specific hypotheses concerning the economic motives that formed the age-at-death patterns in our archaeofauna from Skutustadir .

Tooth eruption stages can provide very detailed data on age. Each mandible's teeth has a range of ages at which it emerges, erupts, wears away due to grit content of food, and if deciduous, falls out.

There are a number of qualitative ways of calculating age via eruption and tooth wear (See Grant 1982, See also Hillson 1986 (Appendix B) which displays dental eruption stages for sheep and goats).

Very complex data sets can be derived from this qualitative data, and sometimes overlapping qualitative criteria and qualitative values expressed in ranges (such as ages of eruption per tooth) can be daunting. The following evaluation looks only at mandibular teeth, and is interested in specifically defined age classes, which are exclusive, and are defined here based on what previous literature suggest may be relevant (this analysis follows McGovern, personal communication, and Harrison 2008). Then, considers this data in relation to what it may indicate about age at death and further, herd management. By using eruption rather than wear stage, we hope to temporarily circumvent methods that age animals using wear stage while we study how they may be best applicable in Icelandic contexts. The age categories devised for this interim assessment are as follows:

Caprines
Newborn - deciduous premolar 4 (dp4) is unworn
<3 months – dp4 worn only
5-6 months – dp4 + first molar (M1) are present
15-18 months – dp4 + M1 + second molar (M2) present
>24-30 months – P4 or M3 (third molar) have erupted and have been worn

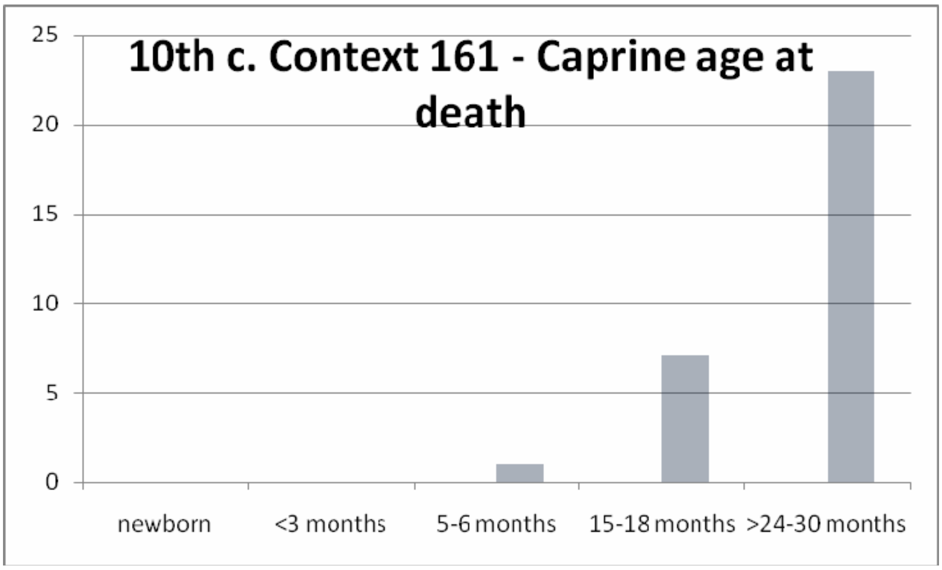


Figure 9 Caprine age-at-death patterns from the site's 10th century context [161]. The data is presented in NISP (number of identified speciments)

The relationship between wear stages and age is to be examined further in the Myvatn area and Iceland in general. The chart above looks at mandibles from the 10^{th} century context 161 with regard to the above criteria. (Some mandibles were broken and could not be included in the histogram but are nevertheless listed in the table below). The presence of old individuals with wear on the third molar (M3) suggests that wool production may have been a core herding strategy. This would account for animals being kept well past the age at which they reach their full size – i.e. “prime age” for meat harvesting- in a locale where fodder was carefully rationed. Further, the presence of relatively few immature caprines could potentially reflect culling to maintain appropriate herd size, but does not likely represent intensive dairying (mentioned in Karlsson 2003), nor is there indication of an exclusive preference for lamb meat.

Peoples past use of upland summer pastures could also provide a reason for the lack of young caprines at being killed- off the farmstead site. Caprines are ethnographically known to have been managed to have a birthing season in Iceland in May, when more food soon becomes available in at the inception of the growing season. Further, farmers in this area were known to graze their sheep in the upland pastures- where additional vegetation is available for a shorter time- during the summer and to have dwellings (*sels*) there for community members to supervise their stocks, and to harvest secondary products such milk. This may mean that the youngest sheep would be found in upland pastures, having been born there or immediately relocated there from the farmstead shortly after birth. It may be helpful to compare an archaeofauna from a summer upland pasture dwelling to see if the age-at –death information is different there- including more young sheep. The question of the lack of young sheep being killed off at the farmstead may be a question of an emphasis on wool production as described above, but also the seasonal movement of caprines and their birthing patterns- it is a possibility which may be addressed in the future by comparing data sets of age-at death patterns between upland *sels* and lowland farmsteads.

Table 3 Toothrows from 10th c. context 161. "OVCA" refers to caprines, "CRA" refers to Capra hircus (goats), and "OVI" refers to Ovis aries

Context	*Species*	*Ref#*	*Dp4*	*P4*	*M1*	*M2*	*M3*
161	*CRA*	*907*		*G*	*G*	*F*	*E*
161	*CRA*	*908*	*G*		*C*		
161	*CRA*	*909*		*G*	*G*	*G*	*F*
161	*CRA*	*914*		*G*	*G*	*G*	*E*
161	*CRA*	*959*		*G*	*BROKEN*		
161	*OVCA*	*905*	*G*		*C*		
161	*OVCA*	*910*		*L*	*M*	*K*	*H*
161	*OVCA*	*911*		*L*	*N*	*K*	*H*
161	*OVCA*	*916*	*N*		*G*	*E*	*IN CRYPT*
161	*OVCA*	*918*		*J*	*L*	*H*	*G*
161	*OVCA*	*919*		*WORN TO ROOT*	*O*	*K*	*G*
161	*OVCA*	*920*	*M*		*G*	*E*	*IN CRYPT*
161	*OVCA*	*921*	*N*		*BROKEN*	*D*	*IN CRYPT*
161	*OVCA*	*922*	*M*		*G*	*E*	*IN CRYPT*
161	*OVCA*	*923*	*BROKEN*	*BROKEN*	*G*	*E*	*IN CRYPT*
161	*OVCA*	*924*	*N*		*G*	*E*	*BROKEN*
161	*OVCA*	*925*	*N*		*G*	*E*	*BROKEN*
161	*OVCA*	*926*	*M*		*G*	*E*	*IN CRYPT*
161	*OVCA*	*927*		*H*	*G*	*G*	*E*
161	*OVCA*	*928*		*F*	*J*	*G*	*F*
161	*OVCA*	*956*		*H*	*K*	*G*	*F*
161	*OVCA*	*957*		*F*	*G*	*G*	*B (ERUPTING)*
161	*OVCA*	*958*					*C*
161	*OVCA*	*960*		*F*	*G*	*G*	*B (ERUPTING)*
161	*OVCA*	*961*		*G*	*K*	*G*	*BROKEN*

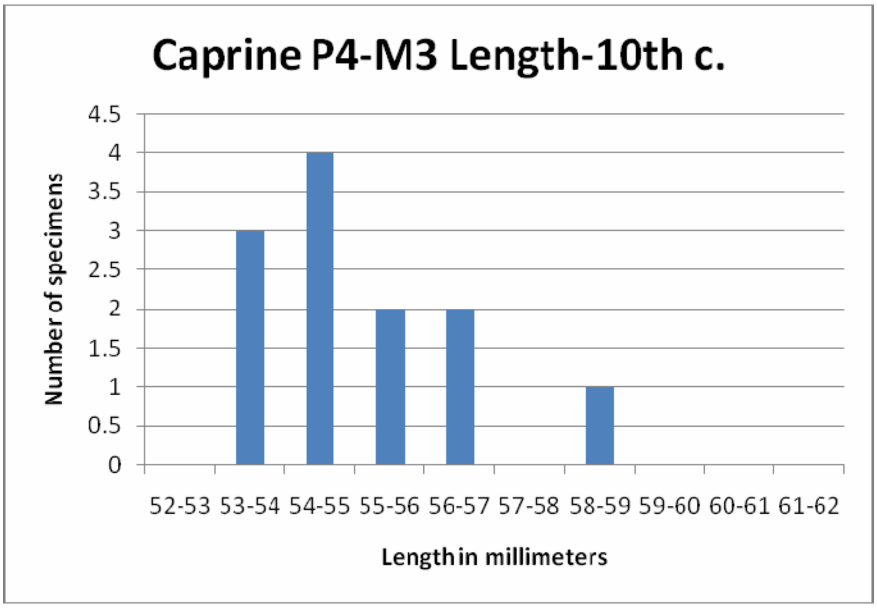
161	*OVCA*	*962*		*BROKEN*	*M*	*N*	*BROKEN*
161	*OVCA*	*964*		*F*	*G*	*G*	*BROKEN*
161	*OVCA*	*976*				*D*	*IN CRYPT*
161	*OVI*	*901*		*G*	*F*	*F*	*B*
161	*OVI*	*904*		*B*	*J*	*G*	*F*
161	*OVI*	*906*		*K*	*M*	*G*	*G*
161	*OVI*	*912*		*G*	*G*	*G*	*F*
161	*OVI*	*913*		*H*	*J*	*H*	*G*
161	*OVI*	*915*		*G*	*G*	*G*	*F*
161	*OVI*	*965*		*G*	*J*	*G*	*BROKEN*

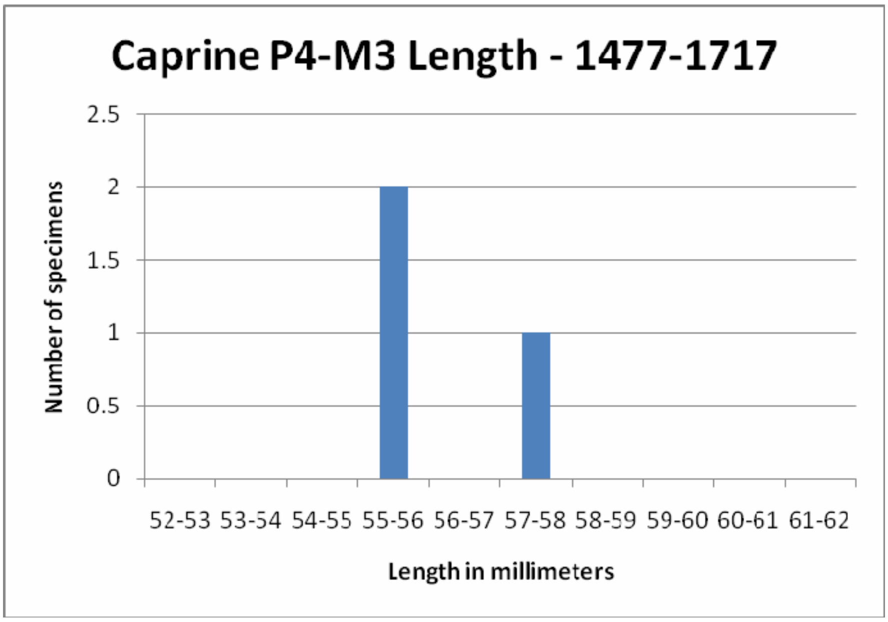
Figure 10 an assortment of caprine and cattle tooth rows from Skutudstadir context [161]

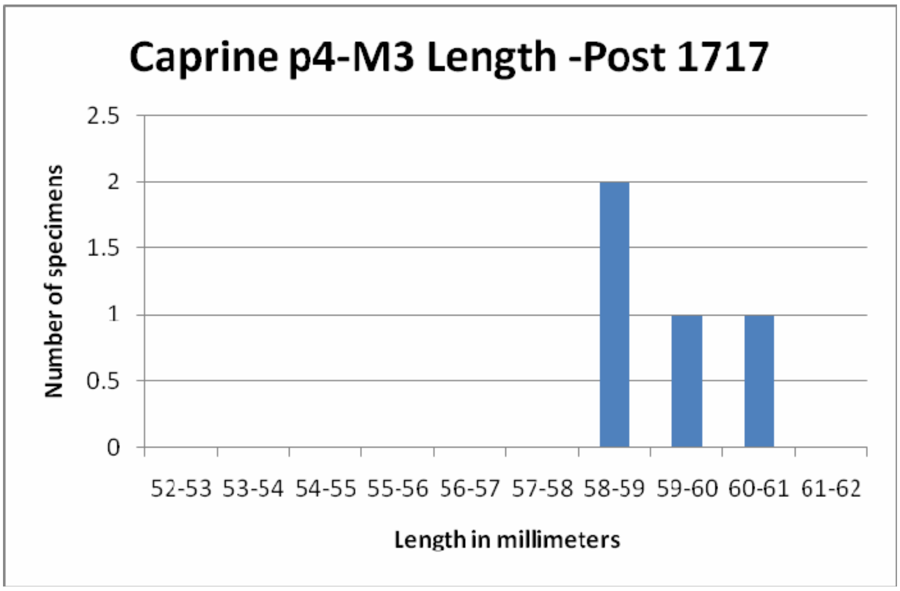
Dental morphology measurements were taken on from caprine mandibles following von den Driesch (1976), with an interest in the possibility that domestic caprine stocks may have undergone "breed improvements" such as this described by Thomas in his 2005 work, "Zooarchaeology, Improvement and the British Agricultural Revolution". Thomas suggests that economic and social transformations may have co-evolved with incentives and abilities of British farmers to breed larger stocks as early as the fourteenth century (2005). We wonder if this trend of people managing sheep for enlargement is present in the Icelandic archaeological record.

The eventual goals for this data include a multi site comparison through time, to evaluate whether dental morphology (and body size) of caprines has changed over time in Iceland. The small data presented here include the mandibles on which it was possible to measure the fourth premolar (P4) through the third molar (M3). The measurable mandibles come from three phases of the site's occupation: the 10th century, 1477-1717, and Post 1717. After further ongoing analysis, it will be possible to include more mandibles from Skútustaðir and we hope to further contextualize them among numerous Icelandic (and north Atlantic) sites and time periods.

Preliminarily, it appears there may be a shift toward longer mandibular tooth rows when mandibular tooth row measurements from the 10th century are compared with those from latter periods. This might reflect larger individuals over all. Whether this pattern is real and relates to "breed improvement" as Thomas describes it (2005) is premature to conclude without more work to uncover additional contextual information and of course, a larger sample size. Thomas asserts that there is great potential for metrical, zooarchaeological data in addressing the questions surrounding stock "improvement", and a preliminary look at this data (though a small sample) suggests that as the set grows, it may yield significant results.







Seals

While present in other phases, no seal remains were found in the large 10th century deposit [161]. Phocid remains present interesting evidence of the movement of products between the coast and this farming area, approximately 60 km inland. As more of the collection is processed it is hoped that we will gain an understanding of the nature such exchanges or movements of animal products and whether it changed over time.

Birds

Bird species found throughout the site include mallards (*Anas platyrhynchos),* red breasted merganser (*Mergus serrator*), scaup (*Aythya marilla*), swans (*Cygnus sp.)*, swan/goose sized specimens, slavonian grebe (*Auritus podiceps*), long-tailed ducks (*Clangula hyemalis*) and one specimen of gull (*Larus* sp). Another present avian species was ptarmigan (*Lagopus mutus),* a local terrestrial bird. One sea eagle claw (*Haliatus albicilla*) was found in an unstratified context.

Bird egg shell was found but will require analysis at the micro-level in order to be identified to a species level. Bird egg shell previously found in other lake Mývatn archaeofauna has pointed to a long term tradition of sustainable harvest of bird eggs, beginning in the 9th centuries and still carried out today (McGovern et al 2007). The presence of a variety of local (non marine) birds in the midden suggests that the harvesting of local birds as food was not focused on a single local species.

During the 2009 excavation season, very dense, but thin, layers of fragmented bird egg shell were found in the midden. Because the fragments would be too small to be recovered in the sieve, they were sub-sampled directly into small bags or into the soil samples that will be screened through fine mesh and sorted. Their stratigraphic relationships were recorded, and future analysis will help determine the species origin of the egg shell. Overall, the analysis of 10th century context [161] from the 2009 excavation season did not add a great deal of evidence of specific bird species being consumed as food; six specimens of bird bone were recovered and none were identifiable to the species level, though one was identifiable to the gull (*Larus*) family. However the absence of large amounts of bird bones is significant in that it continues to support the apparent pattern of wild eggs, rather than wild birds themselves as food.

Latin name	**Common English name**	**9th c**	**10th c.**	**1262-1300**	**14th c**	**1477-1717**	**Post 1717**	**Un-stratified**	**Total**
AVSP	Avian sp.	8	5	28	10	43	34		133
Gallus gallus	Chicken			2					2
Clangula hyemalis	Tufted/long tailed duck			2			1		3
A. Platyrhynchos	Mallard					1	1		2
Aythya marilla	Scaup	1		3					4
Anas sp.	Duck sp.					2	3	1	6
Bird (avsp)egg shell	Avian sp.				1	15	3		19
Cygnus sp.	Swan sp.					1			1
Lagopus mutus	Ptarmigan						4		4
Mergus serrator	Red-Breasted Merganser						2		2
Padiceps auritus	Slavonian grebe						1		1
Haliatus albicilla	Sea Eagle							1	1
Larus sp.	Gull species		1						1
Total		9	6	35	11	62	49	2	179

11 **A chart of bird specimens from the Skútustaðir archaeofauna**

The 2009 excavation season at Skútustaðir, and the ongoing analysis has so far accomplished several major goals. First, deposits containing bone and artifacts from all periods were located- in zooarchaeological terms, this is the unique site in Mývatnssveit to yield such a long term record. Especially rich deposits from the early modern period and the settlement period were found during 2009 excavations. Analysis of context [161] in addition to analysis following the 2008 field season has added to our understanding of the variability in the use of domestic mammals and bird resources in this well-studied region. Future directions include a full analysis of the fish bone from Skútustaðir. The long term goals of this project include the integration of this information further into interdisciplinary research agendas aimed at understanding long term human and environmental interactions in Mývatnssveit and the north Atlantic.

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