WORLD SYSTEMS AND HUMAN ECODYNAMICS IN MEDIEVAL EYJAFJÖRÐUR, NORTH ICELAND: GÁSIR AND ITS HINTERLANDS

by

RAMONA HARRISON

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Dr. Sophia Perdikaris________________

_________________ Date

___________________________________ Chair of Examining Committee

Dr. Gerald Creed___________________

_________________ Date

___________________________________ Executive Officer

Dr. Thomas H. McGovern

Dr. Andrew J. Dugmore__

Dr. Orri Vésteinsson____

Dr. Gavin Lucas________

Supervisory Committee

THE CITY UNIVERSITY OF NEW YORK

Abstract

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Adviser: Professor Thomas H. McGovern

This dissertation examines the potential connections between the Eyjafjörður region and the centrally located Gásir, home to a medieval trading site and a large church structure. Historical sources document the presence of Icelanders at Gásir and an interpretation of those sources suggests interactions between a seasonal trading community at the trading site made up of Icelanders and non-Icelandic (mainly Norwegian) merchants and sailors in the 13th-14th centuries.

Utilizing data gathered from archaeological and environmental analyses this doctoral research project examines the inter-relationship of the medieval seasonal trading center at Gásir and the surrounding Icelandic countryside. It will contrast a potential Minimalist Scenario (small and relatively un-influential Gásir with little or no actual hinterland effect) with a Maximalist Scenario (a large and powerful Gásir with an impact comparable to a small medieval town) and an Intermediate Scenario (with a real hinterland effect but one different from the post-medieval impacts). The doctoral thesis presents evidence for settlement and economy in the Eyjafjörður-

Hörgárdalur valley systems from Viking Age to Early Modern periods, with a focus upon the 13^{th}-14^{th} century. It is the result of a five year program of site survey and selective excavations, partially funded by an NSF doctoral improvement grant (OPP ARC 0809033, PI: Harrison). This dissertation makes use of a multi-site, landscape based approach aimed at better understanding the complex interactions of local and regional climate, Icelandic economic and social changes between Viking Age and high Middle Ages in the region, and the potential connections between local sites and economic processes to the wider North Atlantic economy of the 13^{th}-14^{th} c. "proto-world system".

The author´s specialty in Zooarchaeology enables utilization of excellent proxy data to provide insight into the issues discussed here. It further helps address broad questions of North Atlantic pathway divergence and the role of cross-regional, inter-scale connection in a context of rapid environmental and social change with reference to one particularly well researched portion of northern Iceland.

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Chapter 1. **Introducing this Doctoral Dissertation**

1.1. Dissertation Scope

This doctoral research project examines the inter-relationship of the medieval seasonal trading center at Gásir and the surrounding Icelandic countryside. It will contrast a potential Minimalist Scenario (small and relatively un-influential Gásir with little or no actual hinterland effect) with a Maximalist Scenario (a large and powerful Gásir with an impact comparable to a small medieval town) and an Intermediate Scenario (with a real hinterland effect but pme different from the post-medieval impacts). It presents evidence for settlement and economy in the Eyjafjörður-Hörgárdalur valley systems from Viking Age to Early Modern periods, with a focus upon the 13th-14th century. It is the result of a five year program of site survey and selective excavations partially funded by an NSF doctoral improvement grant (OPP ARC 0809033, PI: Harrison). It makes use of a multi-site, landscape based approach aimed at better understanding the complex interactions of local and regional climate, Icelandic economic and social changes between Viking Age and high Middle Ages in the region, and the potential connections between local sites and economic processes to the wider North Atlantic economy of the 13th-14th c. "proto-world system".

It further addresses broad questions of North Atlantic pathway divergence and the role of cross-regional, inter-scale connection in a context of rapid environmental and social change with reference to one particularly well researched portion of northern Iceland.

The Gásir trading site and its connection to medieval Europe had been the center of the NABO and Institute of Archaeology, Iceland, research effort from 2001 to 2006, until investigations at

Möðruvellir and several sites in the Hörgá Valley were undertaken between 2006 and 2009 (Harrison & Roberts 2006, 2007, Harrison 2008a, Harrison et al 2009). The Gásir site itself was definitely part of a socio-economic and ecological system that involved not only the Gásir station but extended into a surrounding region that was likely supplying provisions to the visiting traders and their crews. However, while excavation was limited to the Gásir site, it proved difficult to evaluate alternative scenarios for the scale and nature of interaction between the Gásir traders and the potential hinterland beyond.

What was missing was a well-documented and securely dated regional paleoeconomic context for the Gásir site to understand its role within the local communities. Therefore, an investigation specifically aimed at the Gásir hinterlands, and the rural agents involved in the exchange and negotiations was begun. The hope was to learn more about a potential system of primary animal product supply (i.e. milk, meat, butter) and of the production and potential surplus concentration of the most important medieval Icelandic secondary animal product, wool.

It presents data from the sites of Gásir, Möðruvellir, Skuggi and Oddstaðir, centering upon the vertebrate zooarchaeology, but including invertebrate zooarchaeology, new N and C stable isotope analysis, historical sources, artifact and architectural evidence, and current multi-proxy climate reconstruction.

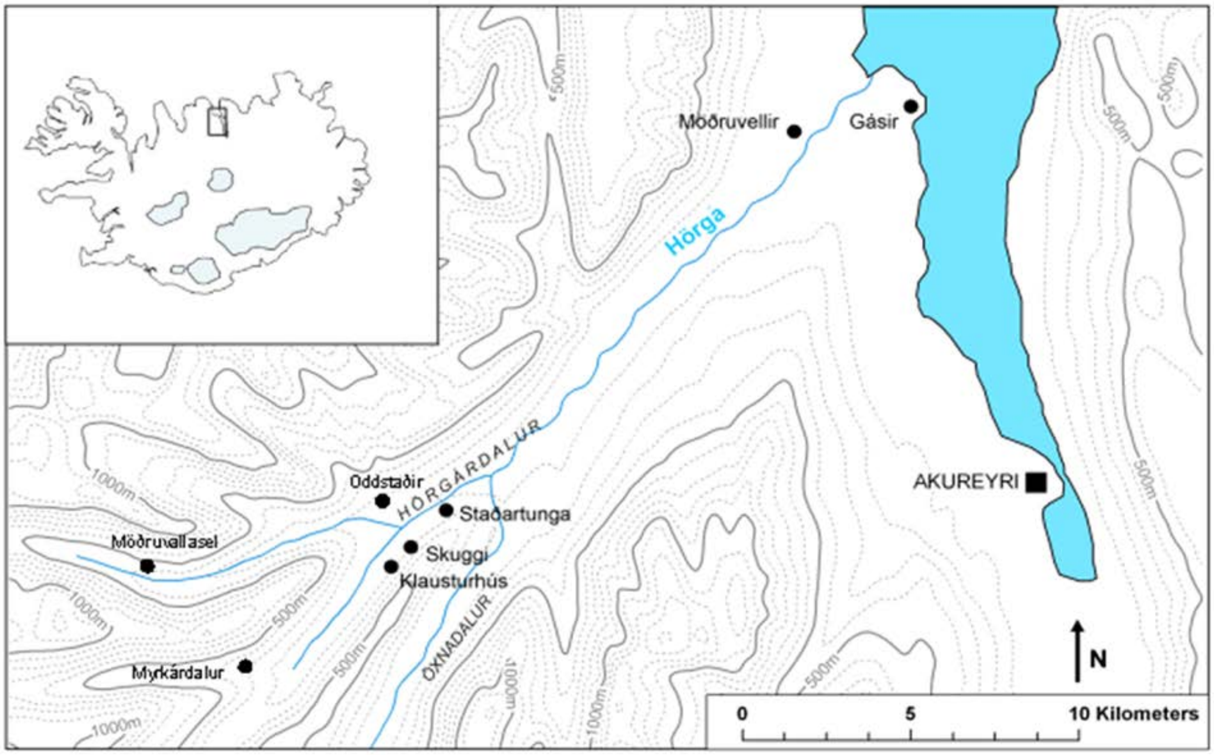


Figure 1.1. Map of the Hörgárdalur research area, indicating sites investigated in Hörgárdalur and their respective proximity to the coast and the Gásir and Möðruvellir major centers (Map after Streeter in Dugmore et al 2008; sites added by author).

This thesis builds upon prior work at Gásir and Möðruvellir by various scholars (Hermannsdóttir 1987, Roberts et al 2002, 2004, 2005, 2006, Roberts & Batey 2003, Roberts et al 2009, 2010, Vésteinsson 2001, Vésteinsson 2009a, b, Vésteinsson et al 2011a, b), including the author (Harrison 2005, 2006, 2007, 2008, 2011, Harrison et al 2008, 2009, Harrison et al 2004) and makes extensive use of comprehensive site survey data collected by the Institute of Archaeology, Iceland (Hreiðarsdóttir et al 2008). Some results of the original Gásir faunal analysis, upon which this dissertation is built, are briefly discussed here.

1.1.1. *The Gásir Zooarchaeology*

This doctoral dissertation is based in part on the author´s analysis of the Gásir archaeofaunal remains, and some of the results from that initial work are presented here and in more detail in the Gásir Data Chapter 4. A detailed and expansive discussion of the Gásir faunal data can be found in the Gásir Data Chapter 4, though some detailed analyses will have to wait for the upcoming monograph project for completion. Zooarchaeology is a well-established tool for creating site economy proxies (i.e. Bigelow 1985, Waateringe and van Wijngaarden-Baaker, Crabtree 1996, Albarella 1999, Perdikaris 1999, McGovern et al 2001, Wigh 2001, Albarella & Serjeantsen 2002, Reichstein 2000, Ervynck 2004, Van Neer and Ervynck 2004, Albarella 2005, Perdikaris & McGovern 2007, 2008) and was applied as such to the Gásir faunal remains following the NABO NABONE recording methods allowing direct comparisons with other Icelandic and North Atlantic archaeofauna (see Harrison et al 2010, Harrison 2006, 2009).

The Gásir domestic faunal remains analyzed by the author provided evidence of a provisioning system that brought animals to Gásir that could have been from the surrounding countryside. Age at death profiles of cattle and caprines suggested a site supply of prime meat-stage mutton and beef, necessitating raising these animals through two winters and then culling them prior to their full sexual maturity. This animal management strategy is a very expensive disruption to the normal dairy production strategy in a place where grass and hay for winter fodder are limited; especially in the relatively marginal Eyjafjörður valley systems (see Environmental History Chapter 3). Initial results of N and C stable isotope analyses carried out for radiocarbon chronology by the SUERC laboratories (Ascough 2012 unpublished report) suggested that cattle consumed at Gásir were drawn from a range of pasture environments rather than a single source. Analysis of marine fish body parts at Gásir indicated the presence of specialized on site processing of fresh fish (a “fishmonger profile”) rather than the consumption of some of the dried headless fish from the stores awaiting export. Finds of Gyrfalcon bones, the bones of tiny imported lap dogs, a fragment of worked walrus tusk combined with evidence for sulphur processing and imported grain all served to document the range of activities at Gásir and the apparent ability of the seasonal residents to gather Icelandic products, store imported grain, and to consume desirable food products requiring special effort by the producers.

The question arose how this supply strategy was implemented and how it impacted the local and regional farmers. The results of the Gásir investigations (especially its complex archaeofauna) thus raised questions that this thesis project was designed to investigate.

1.2. Theoretical & Methodological Approach

1.2.1. *Theoretical Background*

This dissertation examines the potential connections between the Eyjafjörður region and the centrally located site at Gásir where a medieval trading site and a larger church structure stood. Historical sources document the presence of Icelanders at Gásir (Vésteinsson, personal communication May 2013) and an interpretation of those sources suggests interactions between a seasonal trading community at Gásir made up of Icelanders and non-Icelandic (mainly Norwegian) merchants and sailors in the 13th-14th centuries. Similar seasonal trading centers also existed around the coast of Iceland during the same period. The question of the nature and degree of impact of these seasonal trading stations, and potential similarities and differences with the far better documented and better understood impacts of European goods and markets on Iceland after ca. AD1500 thus is of wider relevance to the Historical Ecology of Iceland and the North Atlantic region.

The archaeological excavations at Gásir carried out by the Institute of Archaeology, Iceland represent by far the most extensive and well documented investigations of any of these seasonal trading centers, and in combination with the extensive survey work and the excavations carried out under this thesis project at Möðruvellir, Skuggi, and Oddstaðir we now have a multi-site and multi-disciplinary archaeological data set that provides a unique opportunity to investigate the nature and impact of relations between such a seasonal trading center and the surrounding Icelandic community. While current evidence and analysis raise many questions requiring further directed research, and alternative scenarios for interactions with Gásir remain plausible, the work at Gásir and the associated Gásir Hinterlands Project now provides some important new perspectives on the interaction of local subsistence and inter-regional trade in economic decision making prior to the transformations of the Early Modern period. The three sites of Möðruvellir, Skuggi, and Oddstaðir in Hörgárdalur and especially their archaeofaunal remains are discussed to investigate whether there was an impact by the Gásir trade site and the exchange activities occurring there that left its mark on the Hörgárdalur sites through a "Hinterlands" effect.

The concept of a *Hinterlands* effect of a trading center altering economic decision making on surrounding settlements and wider landscape is not new and these issues have been discussed in the context of other medieval European center and hinterlands studies (Maltby 1979, Crabtree 1996a, b, Albarella 1997, Anderton 1999, Prilloff 2000, Maltby & Hamilton-Dyer 2001, Brisbane and Gaimster 2001, Wigh 2001, Müller-Wille & Tummuscheit 2004, Champion 1989, Albarella 2007, Giles & Dyer 2005). This thesis thus draws upon an active theoretical discussion (where zooarchaeology has often played a key role) and seeks to apply the hinterland concept to this Icelandic case study.

This thesis project follows the growing theoretical research movement within archaeology variously called *Historical Ecology* (Crumley 1994, 1998, 2001, Johnson et al 2005, Hornborg & Crumley 2006), *Long Term Human Ecodynamics* (Redman 1999, Kirch 2007), or the *Archaeology of Global Change* (Amorosi et al 1996, Redman et al 2005, Hardesty 2007, Woollett 2007). It also profits from resilience frameworks applied to the understanding of complex coupled natural/human systems (Gunderson & Folke 2003, Gunderson & Holling 2002, Redman et al 2005, Hornborg 2006, Nelson et al 2006). It attempts to identify and engage with processes working at different scales and rates (siltation/ erosion on the century scale, climate variability on the decadal to annual scale, human decision making on the generational scale) and at different geographic scales (contexts within sites, full site scale, local landscapes, inter-regional connections). It recognizes the importance of establishing chronology as a basis for understanding and integration of multiple data sets, and a major contribution of this project has been the development of a chronological framework making use of multiple AMS radiocarbon dates, volcanic tephra, and available artifact and documentary sources for the Hörgárdalur-central Eyjafjörður region.

This thesis recognizes the challenges of unraveling causation and correlation in understanding trajectories and pathways of change in "complex adaptive systems "(CAS, Crumley 2012), and attempts to integrate new multi-proxy evidence for climate change from the Viking Age through the 14^{th} c. (Mann et al 2009, 2012, Dugmore et al 2012). These new annual scale assessments of temperature deviation from modern (1960-90) means in Eyjafjörður allow a better understanding of the changing environmental context of the farming and land use decisions which leave their records in the landscape and archaeofaunal evidence. These climate data do suggest a transition from a warmer and more stable Viking Age and early medieval pattern favorable to home field pasture productivity and use of upland pastures to a colder and more variable pattern in the 13th century and a more marked cooling and variability in the 14th century. These fluctuations certainly had an effect on the local farming population that could be marked as a change in livestock management as farmers retrenched in reaction to less favorable environmental conditions. However (as discussed in detail in the main body of the thesis), the comparison of the detailed multi-proxy climate evidence and the trajectory of economic change at Oddstaðir strongly suggests that factors other than climate change were playing a major role in decision making. This thesis thus makes use of the extremely valuable new paleo-climate data for the period and area, but is far from environmental determinism in its main conclusions.

On the largest and least tangible scale of analysis, this dissertation, by way of making the connection between Icelandic Gásir and the Norwegian kingdom (see Callow 2010, Jakobsson 2007, Sawyer & Sawyer 1993), suggests a connection between Iceland and the medieval Northern European region, therefore loosely tying this peripheral island to the larger set of the proto-Wallersteinian (2004) 13th and 14th c. early world systems networks that have been discussed by different scholars, notably Abu-Lughod (1989, 1993), Frank and Gills (1993), Chase-Dunn et al (2006), Redman et al (2006), and Marks (2006).

1.2.1.1. A Methodological Approach

While this thesis follows various theoretical themes briefly introduced above, it predominantly utilizes zooarchaeological analysis as proxy for local and regional economic profiles and a scenario of the impact international trade at Gásir may have had on the "hinterlands". It is an initial foray into the broad and rich potential for Eyjafjörður Ecodynamics and investigation on whether or not the sites at Skuggi and especially Oddstaðir could have been part of a hinterlands supply system for Gásir. These two sites are historically connected with the religious site at Möðruvellir (Chapter 5), and the hope is to also include the Augustine House of canons into the Gásir supply system scenario (Chapter 8).

This doctoral thesis does not provide a study in Icelandic economic history and saga analysis. However, rather than reproducing the already existent body of knowledge on Icelandic medieval exchange and connections, this study's approach focuses mostly on the new physical evidence provided by the Gásir and Hörgárdalur excavations presented here. The primary sources are included here as much as possible and are used in combination with the rich new archaeological data collected in the course of field and laboratory work over the past five years to provide a new idea for Icelandic medieval reaction to international trade.

1.2.2. *Methodology*

The excavation methods applied at the Gásir open area excavation and at the Hörgárdalur sites´ midden excavations follow standard methodologies according to the Field Manual of the Institute of Archaeology, Iceland (http://www.fornleif.is/utgafa/handbok). This is an adapted version of the Single Context Planning methodology of the Museum of London (Museum of London, 1994). Following North Atlantic Biocultural Organization (NABO) recommendations, excavation was enhanced by a sampling strategy including materials for flotation, geo-chemistry, and micromorphology to support the study of plant remains, industrial activities and other aspects of the site formation process. On all sites, dry-sieving through 4mm mesh was applied to all midden contexts. At Gásir, faunal remains from non-midden cultural deposits were hand-retrieved due to restrictions of time. The above mentioned sampling strategies were applied to all significant cultural layers (i.e. floor/occupational deposit, special activity area). Gásir site contexts 2076 and 520, where, respectively, extensive fish remains and sulfur materials were found were targeted for whole-soil sampling for post-excavation analysis.

The faunal materials were processed at the CUNY Human Ecodynamics Center (based at the CUNY Graduate School and University Center) and Northern Science & Education Center (NORSEC) laboratories at Hunter and Brooklyn College. Recording and data curation followed the NABONE protocols utilized for other archaeofauna from Iceland, Faroes, Greenland, and northern Norway (NABONE, 2010, 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 follow von den Driesch (1976), and von den Driesch & Boessneck (1974); fish metrics follow Wheeler and Jones (2005) fish identifications follow FISHBONE 3.1 (2006, also at www.nabohome.org); bird identifications follow Cohen and Serjeantson (1996, 2nd Ed.), and Serjeantson (2009); sheep/goat distinctions follow Boessneck, (1969), Mainland and Halstead (2005), and Zeder and Pilaar (2010). Tooth-wear stage studies follow Grant (1982) and long-bone fusion stage calibrations follow Reitz and Wing (1999), with overall presentation of age reconstruction following Enghoff (2003). [1] Research on sheep/goat specimens from the AMNH (American Museum of Natural History) Mammology Department further helped analyze and distinguish ovi/caprine mandibles when possible. The small dog specimens from Gásir and Oddstaðir, and several marine mammals were also identified with help of the skeletal collections available to researchers at the AMNH Mammology Department (especially Eileen Westwig, Collection's Assistant Manager). The avian specimens from Skuggi were compared not only to the extensive

[1] This is the standard protocol for HERC/NORSEC zooarchaeological reports.

bird collection at the NORSEC Hunter laboratory, but also to skeletons at the AMNH´s Ornithology Department.

1.3. Previously Available Information on Impact of Trade on Medieval Icelandic Rural Areas

It is difficult, but not impossible, to discern information about non-elites and their connection to the overseas trade from the relevant saga material (Durrenberger 1992). Archaeology thus provides a more direct and tangible evidence for trade. Although Icelandic Sagas commonly deal with farmers´ issues, in the Sturlunga saga for example, a collection of stories relating socio-political events in 13th century Iceland and Norway, the storyteller's main focus is placed on elites rather than non-elite farmers (Vigfusson 1878, McGrew 1970). Rather, political and physical battles among the Icelandic elites, several of whom were Eyjafjörður residents and their contribution to the Icelanders' surrender to Norway 1262-64 are of central interest.

One way of learning about the impact international trade had on a rural area is through archaeological research of that rural area or region in question, coupled with multidisciplinary specialist analyses. A series of regions in Iceland, and especially in the Icelandic North have been intensively researched for especially Viking Age but also medieval rural archaeology (i.e. Mývatnssveit, Þistilfjörður, Vatnsfjörður, Skagafjörður), but no such project had existed in Eyjafjörður prior to the research presented in this doctoral dissertation.

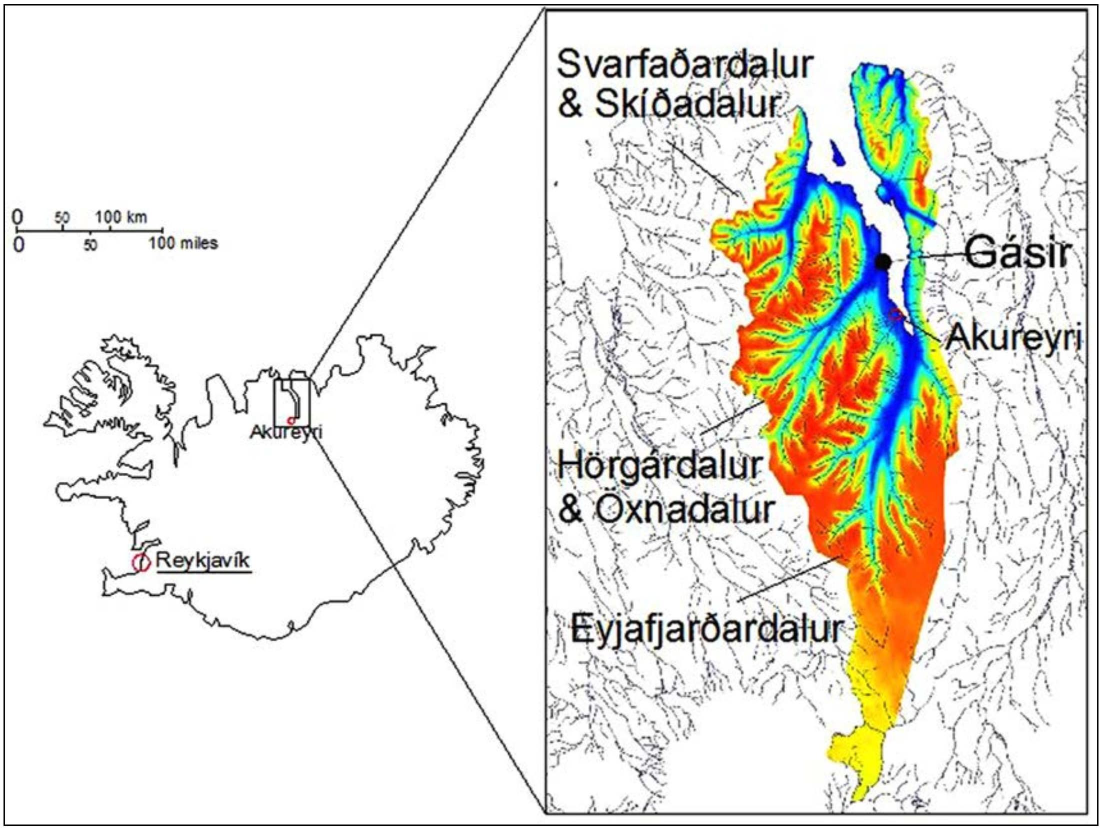


Figure 1.2. Map of Iceland highlighting the research region, indicating the Hörgárdalur and Öxnadalur valley systems discussed, as well as the Eyjafjarðardalur valley system where Akureyri, the modern capital of Northern Iceland, is located. NB: As indicated by arrows, all sites mentioned are located on the western shore of Eyjafjörður. (Original Map on right: FSI ©; adapted by author).

This regional research project had the luxury of building upon a solid basis of prior archaeological research in the region. A large scale, multi season survey project has resulted in a database called ÍSLEIF, containing over 5000 located and surveyed sites across the Eyjafjörður region (Hreiðarsdóttir 2008; Hreiðarsdóttir 2001; Hreiðarsdóttir & Vésteinsson 1999; Vésteinsson and Gunnarsdóttir 1998), but few detailed excavations have taken place in this region before the 2002-06 Gásir and the 2006-2009 Möðruvellir and GHP research: i.e. at the Viking Age sites Granastaðir in Eyjafjarðardalur (Einarsson 1995), and at Klaufanes in

Svarfaðardalur (Eldjárn 1943, Hreiðarsdóttir 2004). In 2010, an investigative examination on farm boundary structures in Svarfaðardalur and Árskógsströnd took place (Hreiðarsdóttir 2010).

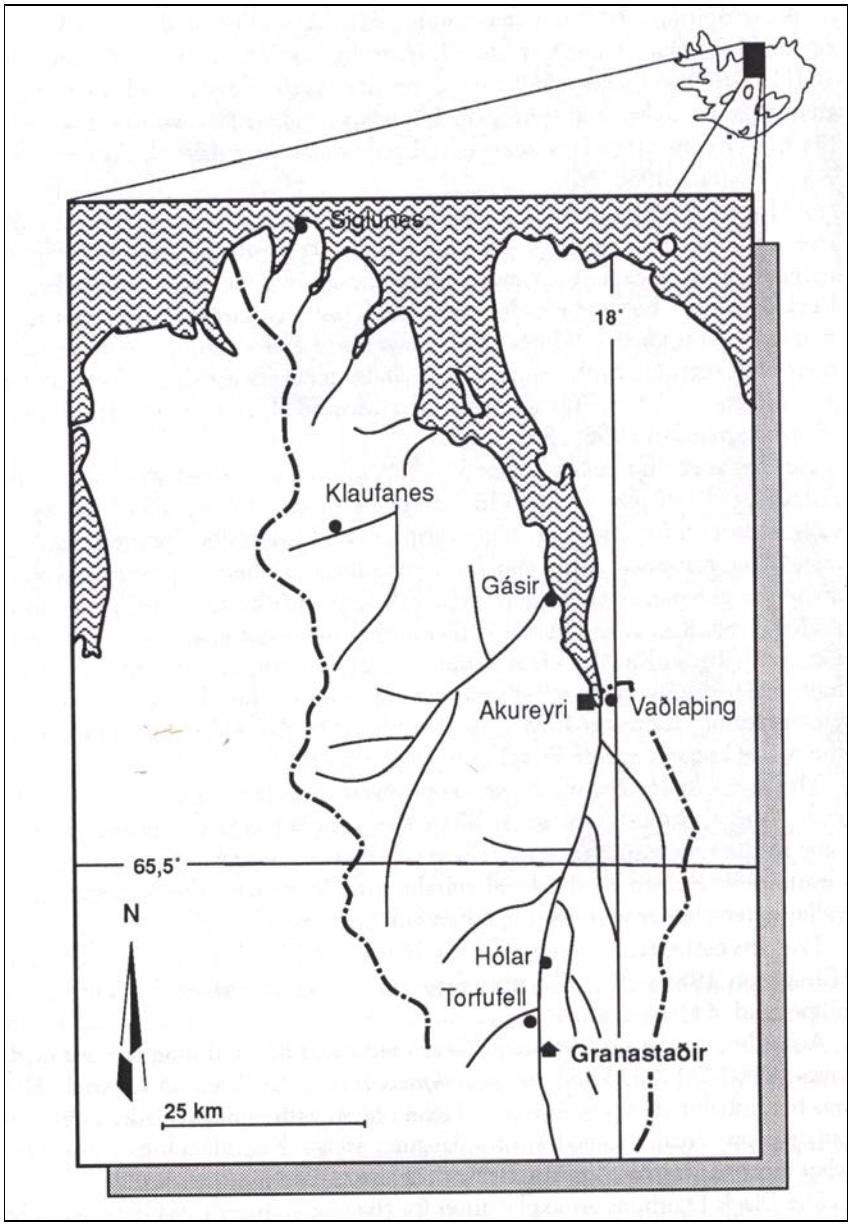


Figure 1.3 Granastaðir location map (Einarsson 1994:71,), margins slightly cropped by author.

B. Einarsson´s excavation of Granastaðir has produced an archaeofauna (Amorosi & McGovern 1994) that comprises the only one from Eyjafjörður not resulting from excavations at either Gásir or Gásir Hinterlands sites. This site from the mid-10th c. is located ca. 50 km south of Akureyri at the head of Eyjafjarðar valley (Einarsson 1994:69).

The dissertation project presented here was designed to enhance our understanding of the trade and exchange between Iceland and Northern Europe between AD 1200 and 1400 by applying archaeological and other specialized methods to examine the actual cultural and environmental evidence, heavily relying on zooarchaeology as proxy indicator for site economy, but also including other lines of evidence (i.e. historical sources, environmental indicators and artifact data).

1.4. Project History

The collection of multi-scalar data derived through interdisciplinary research (see Crumley 1994) has already provided initial information on the entire settlement history of the region. The Gásir Hinterlands Project thus built upon the earlier research in the area (especially the work at Gásir and the ISLEIF survey) and the GHP has since become part of a larger Eyjafjörður Ecodynamics Project including the whole period from first settlement in the late 9th to relatively recent site activities in the 19th c. (see for example Möðruvellir Data Chapter 5, and the Myrkárdalur (Harrison 2011a) faunal report in the appendix). The work reported here will be continued and expanded upon by NSF funded research 2013-14, with additional work by the author and NABO researchers at Skuggi and other sites. The author would like to acknowledge all the help and support given to her from the Gásir excavation and program directors. Archaeology is a collective enterprise, and all progress results from a sustained team effort of crew, supervisors, specialists, and volunteers.

1.5. The Gásir and Hinterlands Archaeology

The information presented below regards several recent archaeological excavations, all having taken place within the past 11 years. The author´s responsibility was the analysis of all these sites´ archaeofaunal remains (except for the 2002 Gásir faunal report: Woollett & McGovern 2003). The author (in collaboration with Howell M. Roberts from FSÍ) further was responsible for the research design, testing, and directing the excavation of the Hörgárdalur site middens for the supplemental information collected from the Möðruvellir and Gásir Hinterlands Projects.

1.5.1. *Gásir excavations*

The Gásir site was highly specialized in structure and layout, and functioned as a collection point and possibly as place of on-site finishing of Icelandic (and other North Atlantic) products for export and import (Harrison et al. 2008). Gásir certainly also served as a point of periodic culture contact between urban Europe and rural Iceland. Data gathered from collaborative interdisciplinary investigation aims at examining whether there was a considerable economic and social as well as a certain ecological impact upon Gásir´s surrounding region (Harrison et al 2008).

The 2002-06 open area excavation of the Gásir Trading Site and its Merchant Church in 2004 & 06 had as goal the recovery of a broad synchronic picture of site conditions during its later and possibly terminal activity phases (14^{th} - early 15^{th} c.). Artifacts , and ecofacts, with special focus on the faunal remains are thus all from the same time period, dated by volcanic tephra and radiocarbon analyses to the 14^{th} c.

1.5.2. *Möðruvellir, Skuggi, and Oddstaðir – general information*

1.5.2.1. Möðruvellir

Möðruvellir, an ecclesiastical institution since the mid-12^{th} c. became an Augustinian House of Canons in 1296, operated under the control of the northern bishopric at Hólar. The results from the Möðruvellir Midden excavation, revealing midden deposits dating from the 13^{th}

to early 20th c. are presented in chapter 5. While faunal materials from all the midden layers providing faunal materials are discussed, only the medieval data are used for a final discussion (chapter 8) on the site's potential involvement with Gásir activities its connection with hinterland surplus production. This high status farm estate at Möðruvellir seems to have drawn certain produce from its valley sites i.e. butter (see discussion in the Möðruvellir chapter; also: personal communications w. O. Vésteinsson, in 2011 and 2012; for more information on the manorial sites in medieval Iceland see Júlíusson 2007).

The estate had several animal winter shelters (i.e. Klausturhús, close to Skuggi in Hörgárdalur), tenant farms (possibly Skuggi in Hörgárdalur during the early medieval period), and also shieling sites (i.e. Möðruvallasel, also in Hörgárdalur). It is not known if Möðruvellir owned Skuggi while the latter was still being farmed. The earliest available property registry for Möðruvellir is from 1447, and it is mentioned there that the monastery owned Staðartunga land where Skuggi and Klausturhús are located (Diplomatarium islandicum IV: 710-12).

1.5.2.2. Skuggi

Skuggi was a Hörgárdalur farm established some time in the late 9th or early 10th c., long before Gásir was in operation, but this site (or its midden remains as of yet) sheds light into the organization of rural economy before the 13th c. Archaeological remains suggest an abandonment of the site some time in the 12th c. The site was likely a tenant farm and from its location, the archaeofauna, its material record, and its currently exposed ruins, Skuggi most likely was a small farming establishment.

1.5.2.3. Oddstaðir

The second non-elite Hörgárdalur farmstead investigated is called Oddstaðir, located on the land owned by Öxnhóll, and was likely a subsidiary holding on the Öxnhóll estate where there was a parish church since medieval times (Hreiðarsdóttir, Head of Survey Department, Icelandic Archaeological Instiute, personal communication, May 2012). The Oddstaðir data set from the associated midden deposits give a chronology of activities spanning several centuries, from the farm´s likely establishment in the late 9th or early 10th c., through to farm abandonment in the late 14th c., around the same time when Gásir's use as harbor area and place of exchange seems to have come to an end. Just like Skuggi, Oddstaðir could have been a subsidiary farm; its faunal remains and its size based on its visible archeology hint towards a farm of higher economic standing than the one at Skuggi.

1.6. The Dissertation Layout

1.6.1. *Dissertation Organization / Chapter Breakdown*

This section explains to the reader how this doctoral dissertation is organized and where the various sets of information can be found that all contribute to the final discussion and conclusion in Chapter 8.

Chapter 1: Introducing the Research Project

This chapter is meant to set the stage for the reader and situate the thesis project in a wider methodological and theoretical context. The chapter also provides a capsule research history of the study area and a preliminary discussion of the major topics under study and the role of this doctoral research in the wider program of sustained international, interdisciplinary research in Iceland. It attempts to identify the main contributions to knowledge provided by this work and the wider contribution of archaeology to the investigation of relations and interactions between Gásir, Möðruvellir, and the Gásir Hinterlands. This investigation makes use of a multi-disciplinary research framework, but its main contribution is to bring the evidence of archaeological excavation and laboratory analysis to a discussion (see Chapter 8) previously based on written sources alone.

Chapter 2: Socio-Economic Background Chapter

The second Chapter briefly discusses the socio-economics of Iceland from Settlement through the end of the Gásir trading site operation by around AD1400. Icelandic trade in general, and specifically in Eyjafjörður are elaborated on, as well as a thorough introduction to the Gásir trading site. The medieval House of Canons at Möðruvellir is also introduced and research there described, as is done for the inner Hörgá Valley farm sites called Oddstaðir and Skuggi.

Apart from all these sites' background information and excavation details, a discussion on the artifacts from all sites and on the textiles from Gásir and Möðruvellir is presented.

Basic chronological information about all the researched sites' occupational phases and inter-site temporal overlaps are provided in support of the idea that these sites' activities are connected throughout specific periods in time. More detailed information on radiocarbon and tephra-based dating is offered in the individual sites' data chapters.

Chapter 3: Environmental Background Chapter

This chapter presents a general background on Iceland's natural history, and a more specific one on the research area, Eyjafjörður, with focus on the Hörgárdalur valley system and the coastal area situating Gásir. The geographical/geological information will be presented in combination with recent results on climate multi-proxy reconstructions and long-term temperature estimates.

Chapter 4: Gásir Zooarchaeology Chapter

This chapter presents a complete analysis of the Gásir faunal remains from the excavation years 2002-2006. Beyond basic NISP (Number of Identified Specimens) tables, detailed discussions on the various aspects of the archaeofaunal remains from the Gásir Trading Site /Area A late 13th to early 15th c. archaeological excavations are presented. An in-depth analysis of the fish remains from Gásir is presented, as well as a detailed discussion on the age-at-death estimates of cattle and ovi-caprine skeletal element retrieved from the site. All unusual species, for example the gyrfalcon and lap dog remains are highlighted at length, as well as certain ethnographic indicators in the ovi-caprine bone assemblage.

Chapter 5: Möðruvellir Zooarchaeology Chapter

This chapter discusses the results from the Möðruvellir Midden excavation campaign as initial part of the author's research into the Gásir Hinterlands Region. The Möðruvellir Midden Mound Excavations from 2006 until 2008 have produced an archaeofaunal collection whose NISP is about half of the one from the Gásir Trading Area.. The chapter provides a complete discussion on the entire archaeofauna from the Midden Mound. This site's faunal assemblage from various time periods allows for a discussion on Taphonomy and the intra-site long term economic profile made possible by the midden sampling approach applied here are important comparative tools allowing a focus on medieval Möðruvellir. The scope of this dissertation only allows for an integration of the medieval data (13th to early 15th c.) for a final discussion on Möðruvellir's potential involvement in the Gásir and Hinterlands provisioning and exchange system.

Chapter 6: Skuggi Zooarchaeology Chapter

This chapter discusses the Skuggi archaeofaunal remains from the 2008-09 GHP field seasons Skuggi was likely a tenant farm, possibly for the larger farming estate called Staðartunga, which was likely under control of the wealthy Möðruvellir church and later monastic estate. Radiocarbon Dating done on terrestrial mammal bones and also the presence of volcanic tephra layers helped divide the midden layers into several distinct temporal phases, spanning a time from ca. 950 to the mid-to late 12th c., thus providing information on the site's economic profile from the Viking Age through the transition to later medieval Iceland.

Skuggi, despite its inland location, has produced a certain amount of marine species in its midden contents. The bird bone assemblage is also somewhat atypical, as it includes skeletal elements from several Ravens.

Chapter 7: Oddstaðir Zooarchaeology Chapter

Chapter 7 presents a discussion on faunal remains retrieved during the 2009 Oddstaðir midden excavation, also part of the GHP. This assemblage is very important in many ways as its well stratified cultural deposits contain faunal remains that could be radiocarbon dated from the early time of Icelandic Settlement, likely the late 9th/early 10th c., to the currently known terminal period of the Gásir trading activities in the late 14th/early 15th c. Thus, a direct comparison between Skuggi, Möðruvellir, and Gásir and the various Oddstaðir occupation phases is possible and this opportunity is utilized at length to provide many regional comparisons and an initial discussion on Oddstaðir's role in Hörgárdalur. As is true for Skuggi, the Oddstaðir midden samples need to be followed up with further midden excavation. The samples are nonetheless large enough to provide us with some very important clues on the site's livestock management strategies over several centuries, and also its potential role in supplying the Gásir trade operation with prime beef and mutton, possibly under orders of Möðruvellir or Öxnhóll, a church farm that belonged to Möðruvellir and on whose property (at least according to the 18th c. land register, Jarðabók), Oddstaðir is located.

Chapter 8: Discussion/Conclusion Chapter:

Chapter 8 is used for summary discussion of all the data presented in the chapters above, including artifact analysis, invertebrate and vertebrate zooarchaeology, climate data, and isotopic analyses. It will draw together the evidence collected from 2002 to 2011 but also outline work planned for the next set of field seasons: excavations at Skuggi in 2013-14; snow modeling, further investigation of Hörgárdalur and Öxnadalur and the rest of Eyjafjörður for a more effective comprehensive regional research across all time periods.

This chapter will also use the information provided from the many data sets to present a scenario based assessment of the range of probable interactions among the Gásir, Möðruvellir, and the Hörgárdalur potential hinterlands sites. It will contrast a potential Minimalist Scenario (small and relatively un-influential Gásir with little or no actual hinterland effect) with a Maximalist Scenario (a large and powerful Gásir with an impact comparable to a small medieval town) and an Intermediate Scenario (with a real hinterland effect but one different from the post-medieval impacts).

Chapter 2. **Social and Economic Background**

2.1. Introduction

This chapter briefly discusses the settlement of Iceland from an economic standpoint and the country's social and economic background from time of settlement through the later medieval time.

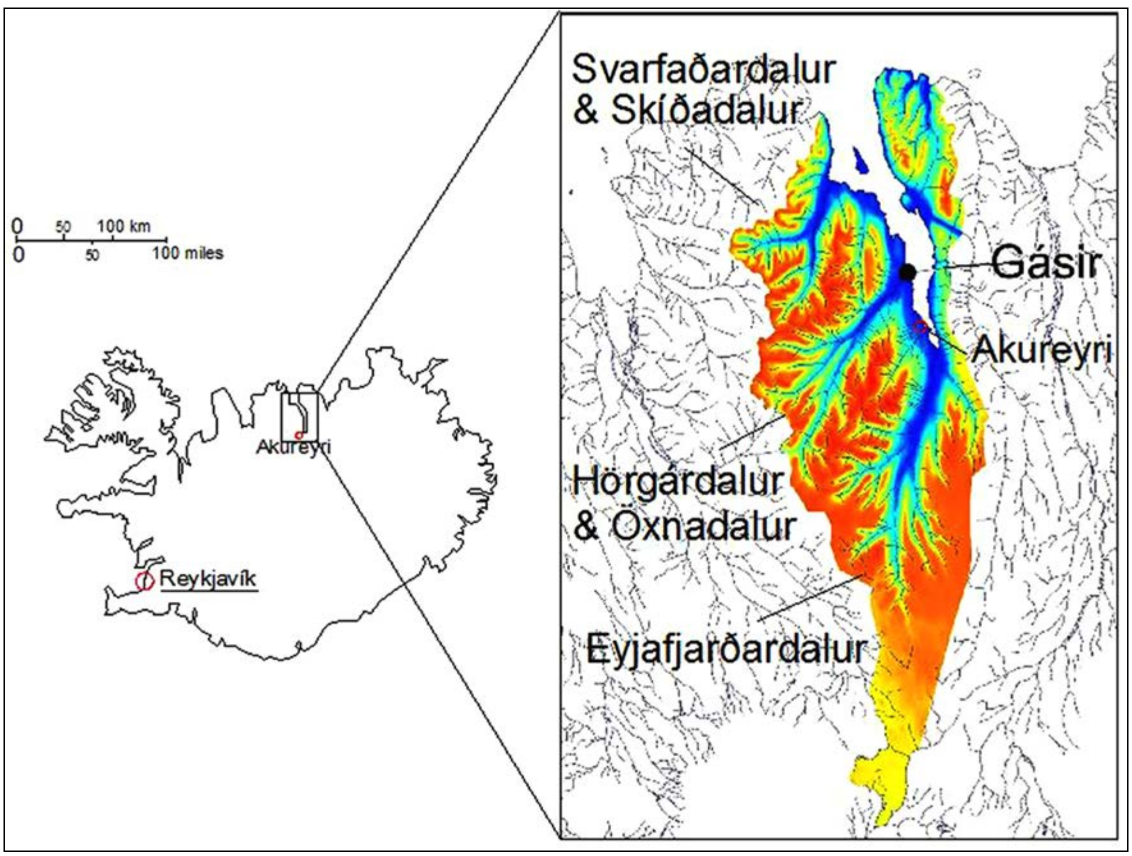


Figure 2.1. Iceland and the research area, Eyjafjörður, highlighting the western part of Eyjafjörður, especially Hörgárdalur, where the Möðruvellir and Gásir Hinterlands Projects took place. The two hinterlands sites, Oddstaðir and Skuggi, serving as case studies are also located in Hörgárdalur (Original Map on right: FSI ©; adapted by author). See map in figure 1.1 in chapter 1 and 2.3 and 2.10 this chapter for site locations.

Then the focus will be brought to the Eyjafjörður region in the NE of the country with a thorough introduction of the Gásir site and the three Hörgárdalur midden sites whose middens were producing substantial enough faunal collection, allowing the author to take the research from a single-site to a regional investigation. All the Gásir 'Hinterlands' sites have varying occupation chronologies, but Möðruvellir and Oddstaðir produced faunal remains in midden deposits dating to the 13^{th} and 14^{th} c. AD, thus providing direct comparatives to the Gásir later medieval archaeological and environmental record, albeit from midden excavations rather than time consuming, large scale, open area excavations. The Skuggi site abandonment took place at some time during the 12^{th} c. All currently available archaeological materials are sealed by a H1300 tephra layer and almost all of them also by a H1104 layer. Though it is not strictly contemporaneous with the Gásir archaeofauna, it provides valuable insight into the dynamics of small-scale farming and possibly the eventual wool surplus production development between the 10^{th} and 12^{th} c. Extensive excavations of the farmsteads associated with these middens are important and desirable, but far beyond the scope of this dissertation research.

The sparse (although not necessarily in a medieval Icelandic context), but nevertheless highly informative groups of artifacts retrieved from the various sites' excavations will be discussed here with focus on the Gásir material culture. Presenting general information on the Gásir finds materials will allow for a better understanding of this site's "internationality".

Additionally, the monastic site at Möðruvellir and its power over the Hörgá Valley through rent on its extensive land holdings involving subsidiary farms and shieling and/or specialized animal shelter sites will be discussed, with some questions raised on whether and how the sites at Skuggi and Oddstaðir may have been connected to the Möðruvellir estate (see Júlíusson 1996 for discussion on the Möðruvellir House of Canons) The two sites could have also belonged to different communities as they belonged to different parishes: Skuggi may have been a subsidiary farm of Staðartunga which may have had its own parish, but later on belonged to the Myrká parish (Vésteinsson, personal communication May 2013). Oddstaðir on the other hand was part of the Öxnhóll parish (see for example Vésteinsson 2000 on a discussion of what forms parishes could have in the Icelandic Middle Ages and later).

The main part of this chapter will deal with the influence the Gásir trading site might have had on its hinterlands, and what role the monastic estate at Möðruvellir might have played in the local and international exchange system.

The North Atlantic Territories under the Norwegian kingdom - General international setting in the 13th and 14th c. AD

The 13th and 14th c. were politically significant ones for Iceland, since they marked the time of the end of Iceland's Independence by the 1260s, its submission to the Norwegian Crown, and its eventual inclusion into the Danish Kingdom in the 1390s. The Norwegian King Hákon had plans to annex Iceland and make it part of his expanding North Atlantic Kingdom ever since the earlier 13th c. (Karlsson 2000:79). Coinciding with the Age of the Sturlungs discussed below, the 13th c. was a time when Icelandic chieftains became ever more competitive and ambitious, hoping to represent the Norwegian King in their country or to even become rulers of Iceland themselves, plunging the island into civil war.

Norway had experienced a bout of civil wars in the 12th c., fought by contenders to the Norwegian throne. In the early 13th c., Hákon Hákonarson managed to bring peace to Norway, by concentrating on expansion politics, with the goal of adding the North Atlantic islands into his Norwegian or North Atlantic Kingdom (Karlsson 2000:79, Saywer & Sawyer 1993). At the time of Iceland's incorporation into the North Atlantic realm under Norwegian power in 1264, that

Kingdom was at its largest extent (Karlsson 2000:104, Sawyer & Sawyer 1993:66), and trade at Gásir was at least in its early phases, if not the location of continued international exchange from the early 13th c. onwards (Vésteinsson 2009a).

After Hákon's reign ended, the North Atlantic Kingdom no longer saw such expansion to the west, (though its continued eastward expansions resulted in conflicts with Novgorod in the early 14th c. - Vésteinsson, personal communication May 2013), and during the 14th c., the center of power was moved to Denmark. Erik of Pomerania who was the nephew of Queen Margarethe, inherited all three Scandinavian kingdoms in the 1380s, sealing Denmark's rule over the by then diminished North Atlantic Kingdom (Karlsson 2000:102), making Norway a dependency of Denmark. Iceland was under Danish control from then on, a situation which would last for many centuries until Icelandic Independence in 1944.

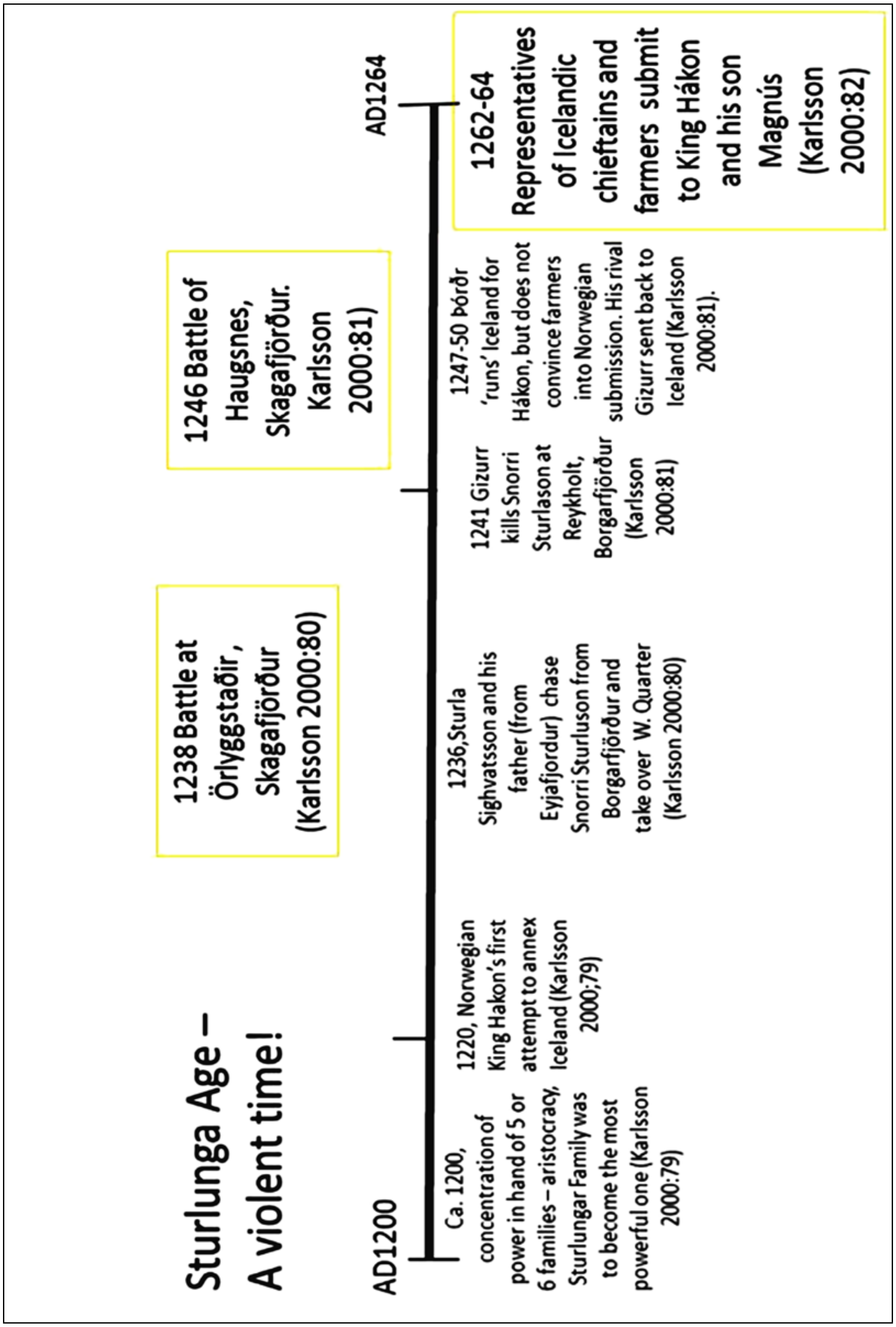


Figure 2.2. Time line depicting the first 60 years of the 13th c., often referred to as "Age of the Sturlungs" (historic source: Karlsson 2000:79-82).

2.1.1. *The Age of the Sturlungs*

When discussing archaeological remains from the 13th and 14th c., the historical and socio-political setting of that time need to be considered. The above timeline (figure 2.2) demonstrates how the 13th century was a time of great social and political unrest in Iceland: power was in the hands of a few families, with the Sturlung family being the most prominent and also most powerful one at that time, engaging in violent civil wars and vengeful actions against each other, and at the same time either trying to serve the Norwegian King and the Church, or attempting to keep Iceland an independent country, the latter approach ultimately turning out to be futile (i.e. Karlsson 2000, Vigfusson 1878, McGrew 1970). Only the most important incidences are related above, as this doctoral dissertation does not aim at providing a full account of the period‘s history of Icelandic and Norwegian/North Atlantic relations during the 13th and 14th c., but rather provide a general social and political, as well as economic setting in whose context the archaeological data should be viewed.

At the same time, Iceland became more and more connected to the Norwegian Kingdom´s North Atlantic Territories, and by by the time Iceland became subjugated to Norway, trading activities at Gásir were likely underway and were likely towards the Norwegian market. The trading site was mentioned in the sagas in connection with trade and ships from about the second half of the 12th century on (see sources listed in Harrison et al, but also Roberts 2002). The last time it was mentioned in a written source, the Gottskálks annal, was in 1391, just around the time when site activities seem to have come to an end (Roberts 2002, Vésteinsson 2009a).

2.1.2. *Brief discussion of Icelandic socio-economics during the Settlement era*

Traditionally, the settlement of the North Atlantic islands during the Viking Age (ca. 750-1050 AD) has been viewed as search for new farming settlements. One theory is based on the assumption that the colonizers would be Nordic chieftains and their clients, who were not able to keep up with chiefly competition in their Scandinavian homelands (e.g. Karlsson 2000:15, Harrison et al 2008).

Iceland has an area of circa 103.000km2 and lies in the middle of the North Atlantic, situated west of Norway and southeast of Greenland. It was populated from Scandinavia and the British Isles in the late 9th to early 10th centuries AD (Vésteinsson1998). Originally, the only indigenous land mammals present on the island were arctic fox, and the only grazing animals were migratory ducks and geese. The Viking Age Scandinavian colonists introduced a package of domestic plants and animals from their homelands, and it is very likely (with significant indication from faunal data supporting this assumption) that they initially supported themselves by extensive hunting of wild birds and marine mammals (McGovern 2000, Vésteinsson et al 2002). The imported domestic mammal package initially consisted of sheep, goat, cattle, horse, pig, and horse. Sheep and goats seem to have been managed initially for milk and meat, with wool a secondary product. Cattle were probably status markers, as larger farms with higher quality pastures tend to produce higher percentages of cattle bones. By the 13th century, the original diverse package of domestic mammals had become simplified, with pigs and goats becoming rare and sheep becoming more common than cattle in all districts, and beginning to show signs of management primarily for wool production (McGovern et al 2001). By the 14th-15th centuries, Iceland's economy in most districts had developed from animal husbandry and agriculture to almost solely animal husbandry, with the probable exception of the West Fjords region which appears to have had a strong maritime orientation from first settlement onwards (Edvardsson 2005, Edvardsson & McGovern 2005). Perhaps beginning in the West Fjords by the mid-13th century, specialized fishing of the cod family (Gadidae) eventually spread to most of the coasts of Iceland, with dried fish replacing wool as the main export product by the later Middle Ages (Amundsen et al 2005, Gelsinger 1981).

While early Viking Age international trading patterns are still poorly understood, in the medieval period international trade and exchange had begun to become localized at regularly re-occupied seasonal trading centers which provided a structured context for interactions between Icelanders and merchants from Scandinavia, Britain, and Germany (see below). By the 14th century, Icelandic sites thus included farms of varied size and prosperity, monastic and other ecclesiastical manors such as Möðruvellir in Eyjafjörður, seasonal upland herding stations or sel, seasonally occupied fishing stations, and seasonal trading centers like the site of Gásir in Northern Iceland.

2.1.3. *Post-Viking Age Icelandic Socioeconomics*

By the 11th c., Settlers in Iceland (and Greenland) had developed a system of individual farmsteads, creating a very dispersed settlement pattern, seemingly reflecting the importance of agriculture and the use of a series of natural resources in the general, local, and individual subsistence strategies, resulting in the Icelandic cultural landscapes of that time (Vésteinsson et al 2002, Vésteinsson 1998, 2000, Vésteinsson & McGovern 2012).

Although no towns or permanent exchange centers had developed during the Viking Age in Iceland, the early farms were definitely connected through local or inter-regional exchange; archaeofaunal analysis have revealed marine fish, sea mammal, and shellfish remains from far inland sites, located on the properties of Settlement farmsteads (McGovern et al 2006, 2010, Harrison 2010, Harrison 2012, Snæsdóttir & Harrison forthcoming). While the idea of exchange is put forth in this dissertation, because there is a trading site at its center, it does not necessarily provide the only possible explanation for these different farms' connections with each other (O. Vésteinsson, personal communication 2012).

Icelandic farmers produced some barley when climate and local soils permitted, but animal husbandry based upon grazing provided the core of the farming economy, (Simpson et al 2004, 2002 2003, 2001, Vésteinsson 1998, Vésteinsson et al 2002, McGovern et al 1988, 2001, 2007, Brown et al 2012). By the 13th c., the original Viking age mix of pigs, sheep, goats, cattle and horses managed for meat, milk, hide, and fiber had become reduced to a concentration upon cattle (managed for dairy production) and sheep (increasingly managed for wool production, but with a strong secondary milk/meat off take, see McGovern et al 2007, 2003b).

Around the beginning of the 13th century, climate changed and weather became more unpredictable across the North Atlantic. Coinciding with lower temperatures, and potentially lower grass and hay yields (see Chapter 3 for a discussion on this issue, i.e. Dugmore et al 2012, Mann et al 2009, 2012), there were a few magnate families involved in intense feuds, eventually causing Iceland to become subject of the Norwegian Kingdom in 1264 (Karlsson 1990, 2000, Foote & Wilson 1970). After that date, although this North Atlantic Island was now officially no longer independent, Icelandic elites still heavily dominated the local secular and religious hierarchy (Júlíusson 2007:6), a system intermixed with initially continental influence through Norway, as remarked upon above.

Norwegian merchants had been in the country since the 12th c., and in the 14th c., also English fishermen began trading with the Icelanders (though not in significant numbers until the 15th c.) (Þórsteinsson & Grímsdóttir 1989:61) and by the later 14th c., medieval continental fashions in literature had long been included into Icelandic vernacular sagas. Wine and beer were available to the elites, and the churches were decorated with imported materials from as far away as England (Karlsson 2000, Snæsdóttir & Harrison 2012).

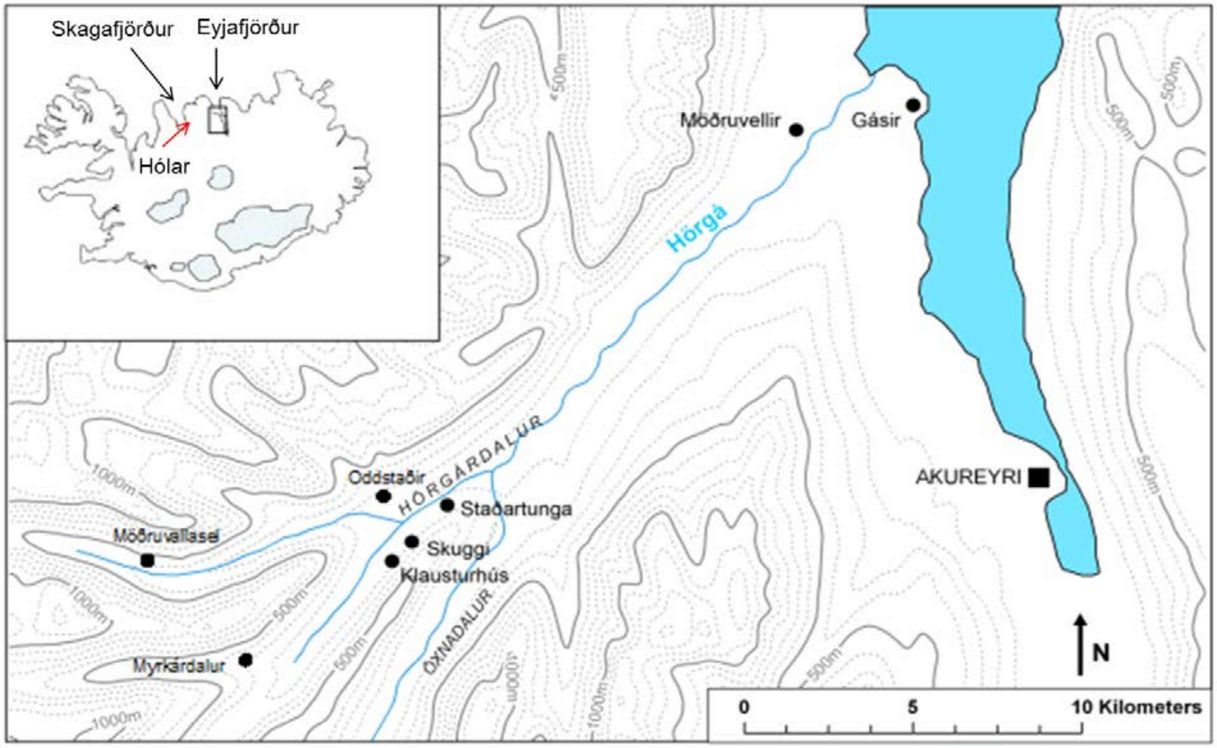


Figure 2.3. Map of Iceland, locating Oddstaðir, Skuggi, and other sites investigated as part of the GHP, in Hörgárdalur, and Gásir, located at a coastal inlet in Eyjafjörður. (Map after Streeter in Dugmore et al 2008; sites added by author). Iceland map in inlet shows Skagafjörður and Hólar locations.

Gásir is located on a coastal inlet on the western Eyjafjörður shore, circa 11 km north of the modern town of Akureyri. The Eyjafjörður valley systems off the western shore form the eastern half of the Tröllaskagi Peninsula (see figure 2.4 below). Tröllaskagi divides Eyjafjörður from its westerly neighbor Skagafjörður, where just across the mountain ridge, the northern bishop see at Hólar in Hjaltadalur was located until circa 1800.

2.1.4. *Eyjafjörður*

This dissertation is interested in the Eyjafjörður region, which had attracted substantial influx of people from since the initial settlement in the Viking age (Einarsson 1992:1994). The monastic estate at Möðruvellir was a large landowner and House of Canons (Júlíusson, 1996, Vésteinsson 2001); closely connected to the northern bishop´s seat at Hólar in Skagafjörður, on the other side of the mountainous Tröllaskagi Peninsula that divides Skagafjörður from Eyjafjörður (Harrison et al 2008).

Figure 2.4. Tröllaskagi Peninsula separating Skagafjörður (west) and Eyjafjörður (east) (© googleearth.com, accessed: 3/01/2008).

As mentioned, Möðruvellir came to extensive land holdings in Eyjafjörður (Júlíusson 1996, Vésteinsson 2001) after it was established as House of Canons in 1293. The Hörgárdalur valley system is Gásir's immediate hinterland area and the Möðruvellir estate was located only 3 km west of it. Dependent farms as part of the Möðruvellir estate were likely situated even closer to Gásir (for more information, see survey by Vésteinsson 2001). Hörgárdalur has a distinct valley floor defined by steep valley walls and apart from the Svarfaðardalur valley system to its north was the main overland route from Eyjafjörður to Hólar in Hjaltadalur, Skagafjörður (see figure 2.5 below, medieval map of Eyjafjörður from the Akureyri museum, also discussion in Chapter 1).

The main focus area of this project is thus Eyjafjörður, Hörgárdalur in particular, with predominant interest in political, socio-economic, and ecological developments of that area in the years between AD1200 and 1400. The two centuries represent an especially dynamic period, marked by climate change, accelerated human environmental impact on vegetation and soils, civil war, and the already mentioned loss of political independence in the 1260s to Norway and subsequently Denmark in the 1390s (Karlsson 2000, Júlíusson 2007). Eyjafjörður as a region is not well represented in the archaeological record (at least until recent history), but it is by far not the most under-represented region in the Icelandic archaeological record, since for one it has been thoroughly surveyed (Hreiðarsdóttir et al 2008). One aspect of the archaeological record has been rather well examined: The excavation of mostly isolated pagan burials dating before the year 1000 (Roberts, personal communication 2010). The research presented here thus not only contributes to the understanding of medieval international trade, it also provides new archaeological data, and especially faunal collections informing on the management of social and environmental landscapes throughout Eyjafjörður's settlement history.

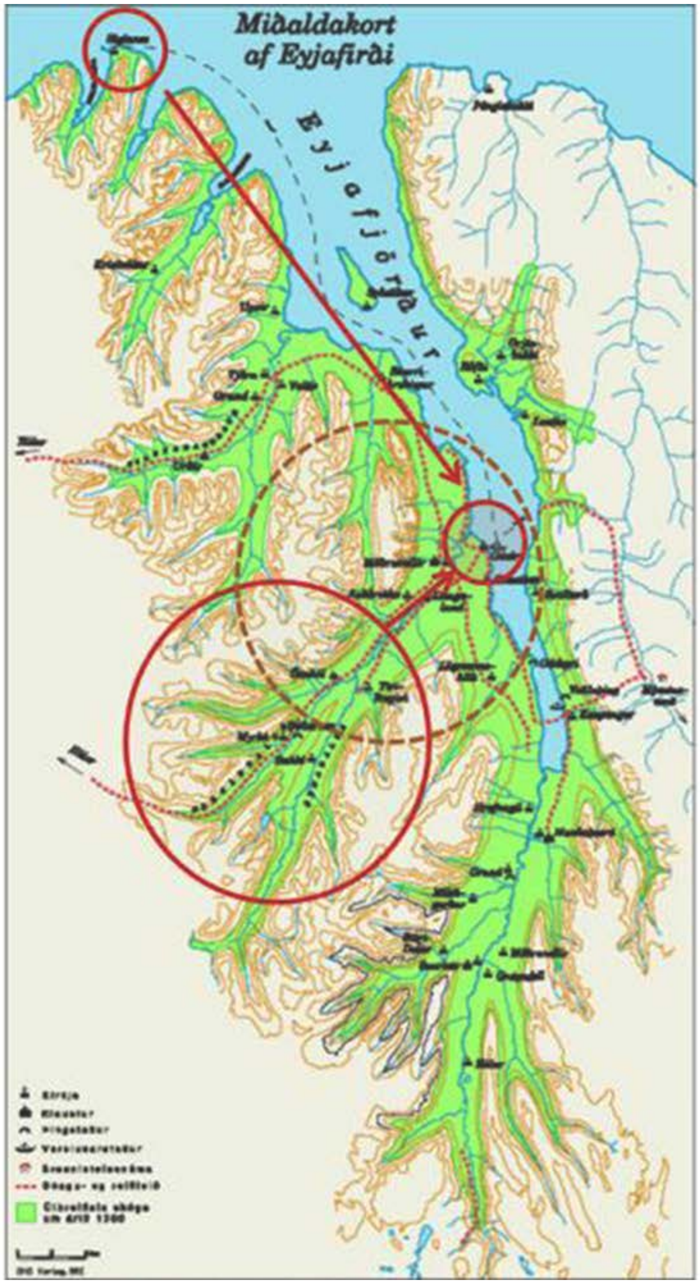


Figure 2.5 Map of medieval Eyjafjörður, by the Museum of Akureyri (circles and arrows added for emphasis). Sites mentioned in this dissertation: Gásir, 13th & 14th c. trading site, seasonally occupied; Möðruvellir (in Hörgárdalur), monastic farm estate, largest landowner in the area, possibly controlling trade and exchange of hinterland with Gásir and foreign merchants. Hörgárdalur, immediate hinterland supply region; beef and mutton, likely some wool for standardized export product. Siglunes, fishing station; likely provided standardized cod fish product for commercial export (faunal materials under analysis) (Map © Minjasafnið Akureyri, map date 2002).

2.2. Eyjafjörður and Gásir Trade

This part first discusses general ideas on Icelandic international trade connections in the Middle Ages, and then focuses on trade related to the Gásir trading site, as well as a description of the site itself.

2.2.1. *International Icelandic trade*

In the later Middle Ages, English traders operating out of Bristol and Hull were active in Icelandic international trade and but were largely replaced by German merchants of the Hanseatic League in the 15th c. (Capelle 1982, Marcus 1957, Carus-Wilson 2005 (reprint edition). Currently, only sparse archaeological remains from contemporaneous Icelandic trading sites exist (see Vésteinsson 2009a for a mention of other known Icelandic trading sites), and the Gásir excavation therefore provides valuable clues on trade impacts on 13th and 14th c Iceland/Eyjafjörður.

This lack in comparative domestic archaeological materials necessecitates a search elsewhere for clues on general information regarding medieval trading sites. A site possibly comparable to Gásir in the later medieval Northern Europe was the Skane Fair in Oresund (Sawyer & Sawyer 1993:158-159), where it seems a lot of the goods originated from the Scandinavian and Baltic countries, likely transported and traded by the merchants of the Hanse, though maybe not exclusively so. Those trade items included goods from Iceland, i.e. wool, vaðmál, and sulphur. The authors mention Norwegian stockfish (as well as herring from other Scandinavian countries), but it is now widely assumed that stockfish was also produced commercially in Iceland by the 13th and 14th c (Perdikaris & McGovern 2007, 2008, Perdikaris 1996, Perdikaris et al 2004, Krivogorskaya et al 2005). Sawyer & Sawyer also indicate that Norway was actively providing the English with falcons, from Greenland, Iceland, and Norway (Sawyer & Sawyer 1993, Callow 2010). The German Hanse merchants were not yet trading in person in Iceland until the 15th c, but they were certainly handling the goods coming from Iceland to Norway and vice versa, especially at Bergen (Karlsson 2000, Brorsson in Roberts 2009).

Comparisons with Viking Age trading places such as Birka, Ribe, Hedeby, Dorestad, etc. are not very helpful when imagining the nature of a later medieval coastal trading site of seasonal character. These mostly Viking Age Trade Emporia show fortification measures and exhibit town-like characteristics (Clarke & Ambrosiani) that do not relate to Gásir. The archeological report from the Gautavík trading site in Eastern Iceland may offer a better example for an Icelandic medieval trading station, although that one was potentially operated by the German Hanse in the 15th c. 'The most important trading places naturally were situated along the coast, i.e., in places where the foreign goods could have been brought to land during the summer (Capelle 1982:91).' Capelle suggests that it must have been hard for the goods to be brought to those sites, since there may have not been roadways [in a medieval sense] and animals were used to transport [the goods] on trampled paths (1982:91). Gautavík may be a trading station representative for the east of the island, while the western Icelandic trading site at Búðasandur (Maríuhöfn) may have been in operation between at least 1339 and 1403. Capelle notes that Gásir was the trading place in the North, consisting of a cluster of booth buildings, as well as a church (91). The assumption is made by Ellmers (in Cappelle 1982:91) that the booth structures may have been used by the same traders over and over again. Ellmers further mentions that each group of Gásir's interlinked booth buildings belonged to one boat/ship and goes as far as suggesting a fairly stringent regulation of ownership over those booth structures in place at Gásir (Ellmers 215:1972, see also Vésteinsson 2009b). These regulations likely were implemented by the local authorities or elites. According to Gelsinger, in places where it was possible for ships to come to shore fairly easily, markets were established. Gásir was one of the most important market places, together with Hvítá in the southwest, and Eyrar in the south (Capelle 1982:32), and also at Maríuhöfn (Búðasandur), in the Southwest, a site which was very close to Thingvellir (Þingvellir), as well as the afore mentioned Gautavík in the Southeast (Capelle 1982). According to Gelsinger, during the High and Later Middle Ages, chieftains had control over the markets as well as the prices for the goods traded there. Especially in places where more than one ship was able to lay anchor at one time (see also Callow 2010). Kolkuós in Skagafjörður was a contemporary medieval trading site (it was in operation before the Gásir operation, and was still utilized after Gásir´s decline (Vésteinsson, personal communication May 2013, associated with the Hólar bishop´s see. Eventually, Hólar also seems to have relied on Gásir for trade and exchange, especially during the High and Later Middle Ages (see Vésteinsson 2009b, Kristjönudóttir 2005).

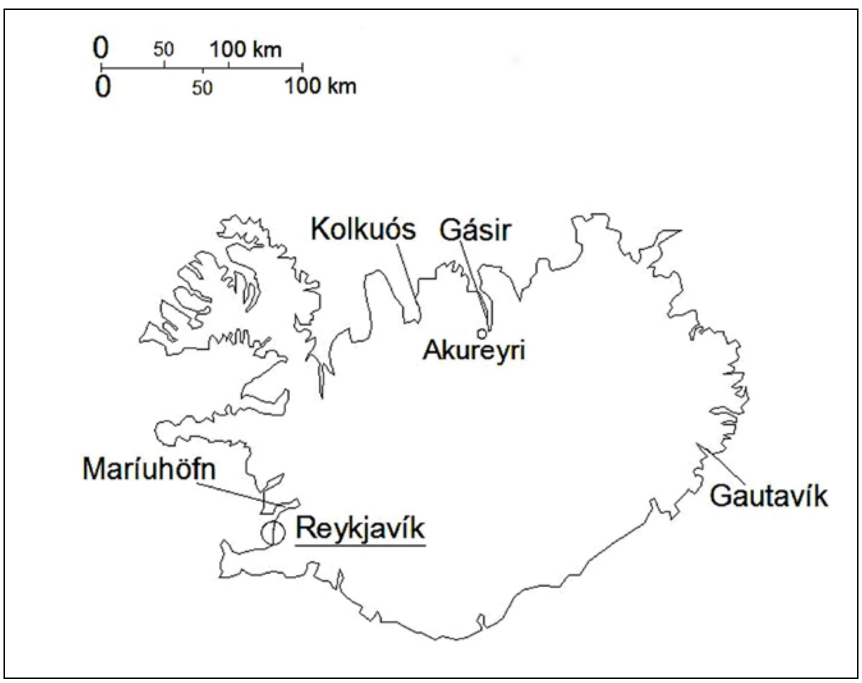


Figure 2.6. Gásir Location map (map source: Harrison et al 2008:100).

2.2.2. *Gásir Trade*

The Saga about Priest Guðmundur góði, 1163, is the earliest known documentary source mentioning trading activity there (Roberts 2002:2, also Vésteinsson 2009a:159). The Gottskálks Annal from 1191 further mentions Gásir (-ar) in connection with ships and a trading station. Gásir's trade activities may have included the export of sulphur and falcons, since those were major trade items in the medieval North Atlantic (Gelsinger 1981:13-14). The presence of both these items in the site's archaeological record demonstrates Gásir's involvement in the later medieval international exchange. '[It is not known ...] to what extent the right to acquire sulphur (and falcons) [... can be understood as ...] a token in a much larger and more complex political adjustment in the aftermath of Iceland's submission to the Norwegian crown (Roberts et al 2002:26).'

Gásir can be viewed as an exchange station, seasonally occupied, and possibly not frequented by many boats at a time (Vésteinsson et al 2011a, Vésteinsson 2009a). This medieval site whose later 13th – early 15th c. archaeological remains will be discussed below and its archaeofauna elaborated on at length in Chapter 4. Gásir was a very important institution, influencing local and regional economic decisions, especially associated with food supplies from its hinterland area (see Oddstaðir data chapter, 7). Gásir´s existence and operational success were potentially dependent upon a local power force in control of market organization, settlement of prices, and driving market activities (Harrison et al 2008, Vésteinsson 2009a, 2011). This local power brokers, among them potentially the monastic estate at Möðruvellir, were likely also collecting surplus goods (i.e. sheep wool) for export and influencing local farms in terms of livestock management, either directly or indirectly.

Gásir may have been more than just a place where goods were either unloaded from or loaded on to a ship, it could have very well been a center of social exchange for the local population, from as early as the time of Guðmundar saga dýra on: “Gásir, [...] formed the backdrop to a handful of events in Guðmundar saga dýra ... (Callow 2006:78).” Apparently, the saga and other narratives suggest that courtship, or arranged marriages between some well-known persons took place at Gásir. As Callow suggests, it is possible that Gásir represented a central space where local chieftains as well as the general public could have met and convened (see Callow 2006:78, Vésteinsson et al 2011a, see also Vésteinsson 2006 on central places in Iceland). While they were discussing local and likely also international politics and business, these elites may have set market prices and decided upon distribution of imported goods and the honor of hosting the merchants in the winter (Vésteinsson 2009a) the same time, they might have also decided upon what goods were to be collected from the community to be either exchanged among locals or shipped abroad by way of Gásir.

The idea is then that while there was active cultural and physical exchange happening at the Gásir site, it was also a place where boat repairs may have taken place (but see discussion in material record from Gásir) and where passengers for trips to Norway or elsewhere gathered, and where social exchange took place.

It is plausible that international medieval trade in Eyjafjörður was conducted by the local elites and the foreign merchants they were hosting during the long winter months after the summer season and before the merchants´ journey back to presumably Norway and beyond, as suggested by the historic sources and suggested by Helgi Þorláksson (Þórláksson 1989, also Vésteinsson et al 2011a, Vésteinsson 2009a, Karlsson 2000, Gelsinger 1981). One of the wealthiest estates in Eyjafjörður, and the largest landowner in Hörgárdalur was the monastic estate at Möðruvellir, located in very close vicinity to Gásir (Júlíusson 1996, Vésteinsson 2001, Harrison et al 2008, Harrison 2011b). The landed wealth and its status as a religious institution put Möðruvellir into a position of power over the surrounding landscape and the pastoral agriculturists inhabiting and shaping it.

Möðruvellir´s involvement in the international trade conducted at or through Gásir and its influence on the rural hinterlands especially with regards to surplus production will be discussed further below and also throughout the dissertation as one of the main data sets presented in the data chapters stems from archaeofaunal materials collected from this site and also from farms likely owned by the estate (see Júlíusson 1996 for a list of Möðruvellir-owned farms). One idea about Möðruvellir´s involvement with the Gásir trade and exchange of goods and also the social reproduction there involves the results from the Gásir and Hinterlands faunal analysis: it is possible that Möðruvellir impressed locals and foreigners alike by providing the best cuts of beef and mutton possible and even may have provided (imported) wine or beer for a demonstration of its wealth and power.

2.2.3. *Brief research history*

The Gásir site was first excavated in 1907 (Bruun & Jonsson, 1908), with further archaeological work done in 1986 (Hermannsdóttir 1987). In a collaboration between the Icelandic Archaeological Institute (FSÍ) and the Akureyri Museum (Minjasafnið Akureyri), an initial topographical and geophysical survey (Horsley in Roberts et al 2002, 32-38), re-excavation of old evaluation pits in 2001, and archival research at the Danish National Museum were undertaken and followed up with major open-area excavations from 2002-2006. Howell M. Roberts from (FSI) directed the 2002-06 excavations for area A, the Trading Station, and Orri Vésteinsson from the University of Iceland (and FSI) directed the 2004 and 2006 excavations of the Merchant Church and Churchyard in Area B. The result of this open-area excavation strategy was the recovery of a broad synchronic representation of the site in the late 13th-early 15th c., with artifacts and ecofacts recovered from that time period (Roberts 2001, 2002, Roberts et al 2002, 2004-2010, Roberts & Batey 2003, Pálsdóttir & Roberts 2005, 2006, Vésteinsson et al 2011b), Harrison et al 2008, Harrison 2005, 2006, 2009, Harrison et al 2004).

2.2.4. *Site location and layout*

The following map shows the location of Gásir in the Eyjafjörður coastal inlet (Roberts 2002:2). It suggests the site's situation optimal position as a harbor for trading vessels.

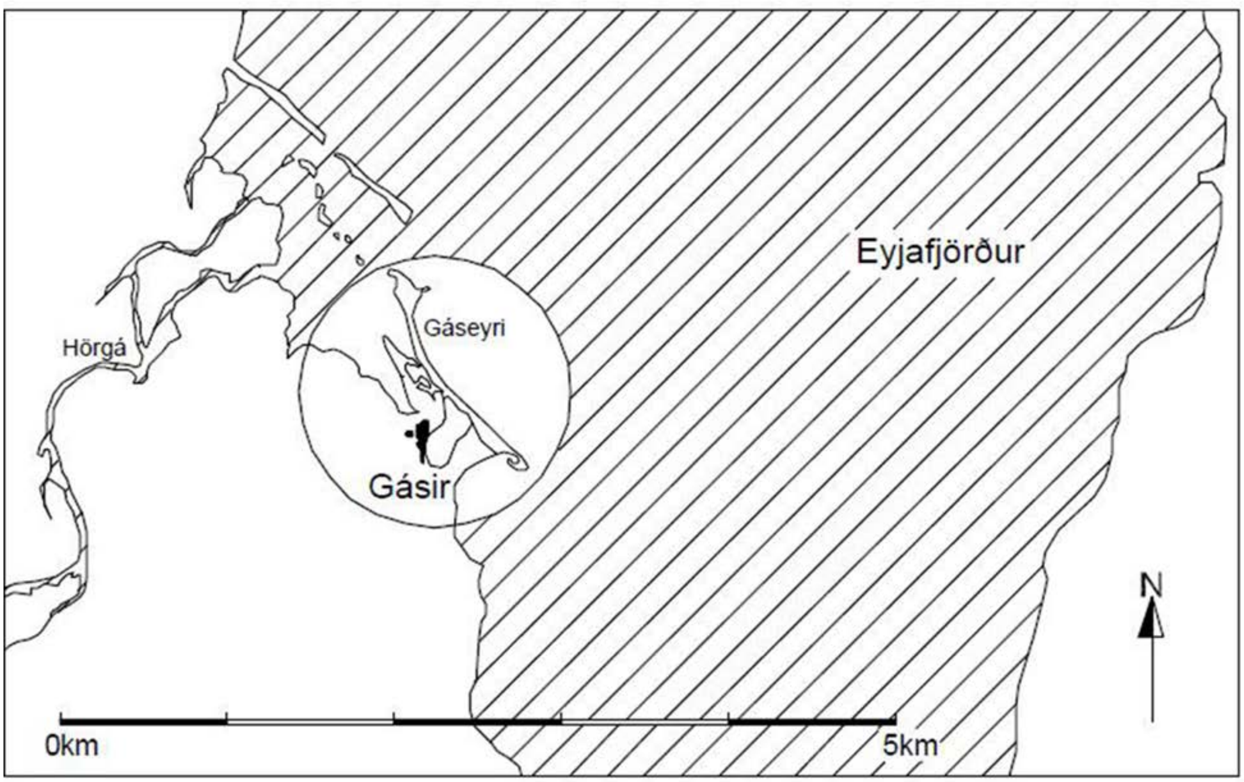


Figure 2.7. Location map showing the Gásir site as it is situated in Eyjafjörður and how it is located in relation to the Hörgá (map source: Roberts 2002:2, © FSI/HM Roberts).

As viewed in figure 2.7 above, Gásir is located on an inlet on Eyjafjörður´s western shore with direct access from the sea to the beach at Gásir via the long fjord (see map 2.5 above). Gásir is about 11 km north of Akureyri and 3 km north east of the Möðruvellir farm estate and former monastic manor mentioned in the text. The site, comprised of the church/circular churchyard and the trading area with its numerous, clearly visible rectangular earthworks (see figure 2.8 below) is just west of a salt marsh, which is protected from the sea by a sandy bank. The visible ruins are located in grass and low shrubbery land, at an elevation between 1 m and 7 m above sea level, and measure a total of ca. 10, 000 m^2 (Roberts 2002:2). Arctic terns reside here in the spring and summer and every year archaeological activity had to wait until the breeding season was over.

Figure 2.8. Gásir excavation, area A to the right (black arrow), and area B on the left (red arrow) or western side, picture facing northeast (Picture © Hörður Geirsson, 2006, arrows added by RH).

The aerial photograph above was taken durng the last daysi of the 2006 Gásir excavation season, the last season of the most recent and most extensive archaeological expedition. This picture shows the actual location of the trading site in Area A, the church yard and ruin in Area B, and the proximity to the Hörgá river estuary just north of the site, with the light blue river waters mixing with greenish-blue sea water.

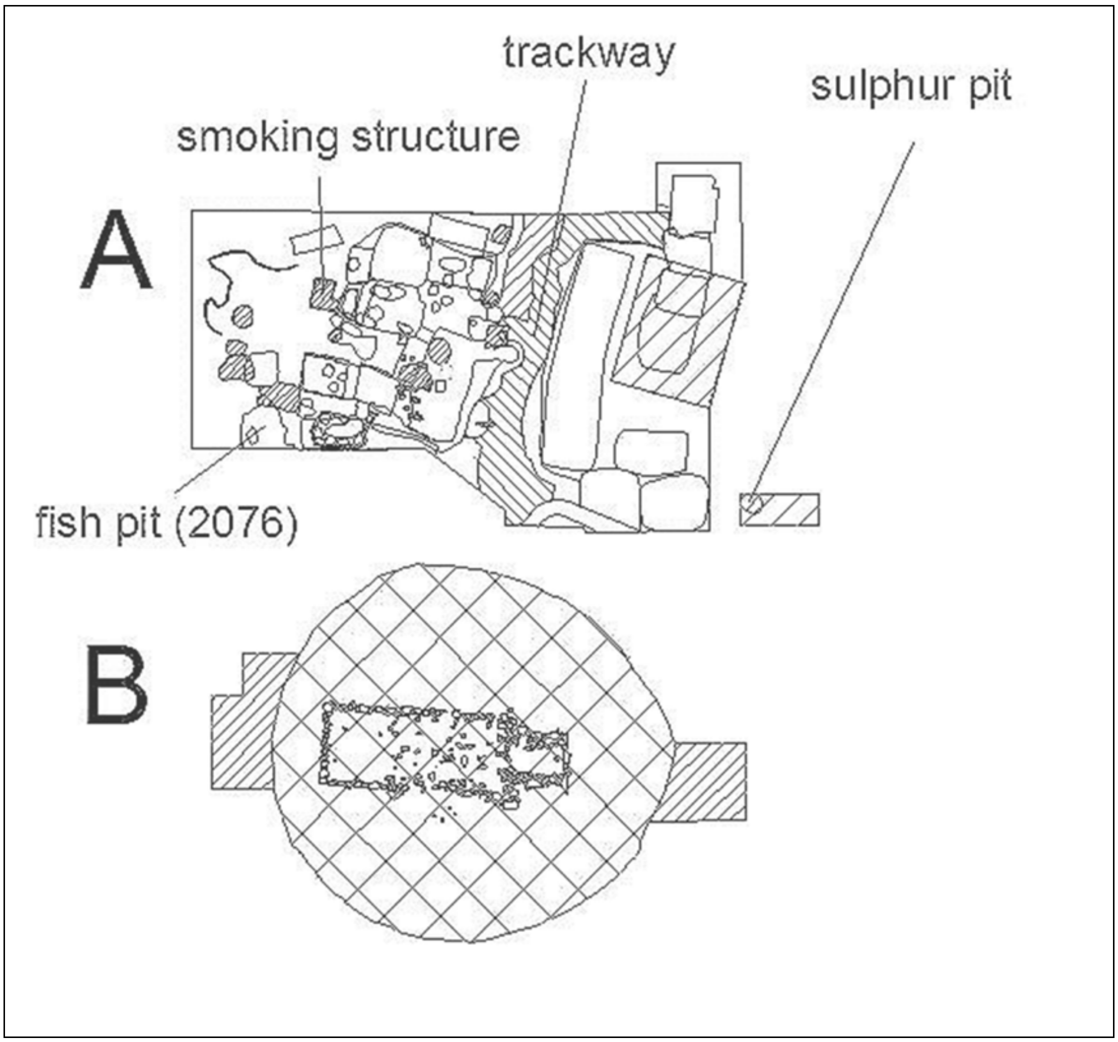


Figure 2.9. Gásir site layout (map source: original version: HM Roberts, (c) FSI; edited version: Harrison et al 2008:101). Area A, the limit of excavation of the trading site, and Area B, the Church with Churchyard. Location of areas does not reflect their actual position, see figure 2.8 above. The drawing highlights some specialized activities areas mentioned in the text.

Area A, the booth area (see figs 2.8 & 2.9) is a construct of multiple groups of booth-like structures, interlinked, and aligned along several linked trackways. These are different types of large, sunken features placed deep in the ground, slightly terraced and rising gently toward the trackways. The structures' insides were divided into rooms of varied sizes and functions. The walls were built up by different shapes of turves and saw multiple phases of reconstruction. Most of the rooms contained hearths of temporary and simple make, indicating localized burning. Some of the rooms had rough stone floors; others had series of fine layers of trampled soil and ash serving as occupation surfaces (Harrison et al 2008).

The full extent of the medieval market area is unknown: out of an area of circa 10,000 m^2, a total 600 m^2 were opened up during the recent archaeological excavations, and thereof only the upper portion of the archaeology excavated.

Beyond the market area, the church and churchyard at Gásir, Area B, were re-excavated (Vésteinsson in Pálsdóttir & Roberts 2006). In the late 13th c, , during the last one of what were in total 3 building phases, the church was extended to 16 m total length, which is quite large for Icelandic churches. No graves were found within the churchyard which might have functioned as occasional sanctified assembly area (Harrison et al. 2008) rather than graveyard. If any foreigner staying at Gásir died, the deceased's body was likely buried possibly at one of the local parish churches nearby: Glæsibær, Laugaland, or Möðruvellir (Harrison et al 2008). The church itself was an impressive timber structure and was built by and for merchants to express religious associations, for mercantile/administrative purposes, to impress the visitors and traders at Gásir, to store some of the trade goods, and to give the merchants a certain degree of independence (Vésteinsson 2009a:168).

Considering the effort it took to keep this church in good repair and rebuild it several times (see Vésteinsson 2009a), it becomes clear that there was a lot of interest in keeping this exchange between the relevant local elites and the international merchants going.

It is not always easy to determine the function of the Gásir structures from Area A. A lot of overlap may have existed between what are in modern times understood as public, commercial, private, and working areas (Hall & Hunter-Mann 2004). A few of these rooms more clearly served a specific purpose, such as a smoking room, a room 2.4 m long, 1.6 m wide, and 1.2 m deep. This room's floor area was made up more or less by a hearth filled with charred horse dung. A substantial midden deposit (context 2076) was filling either a sunken feature building or a pit. This midden deposit was largely composed of haddock and cod cranial remains, suggesting a deposit resulting from on-site fish butchery and preparation. The amount of fish head elements dwarfs the number of postcranial bones in this pit (Harrison et al 2008, Harrison 2009.

Similar combinations of structures of semi-subterranean character arranged around open spaces and also relatively clear movement corridors are not unique to Gásir: they have also been found at other Icelandic trading sites. Gautavík and Maríuhöfn would be examples thereof (Capelle 1982, Þorkelsson 2004). These sites whose structures have such varied functions that are not always clearly defined are very different from other known Icelandic settlement types, especially farmsteads.

It is not known when or exactly why people stopped using Gásir for international and likely local trade purposes, but according to Roberts, the latest mention of Gásir stems from 1391, and is found in the Gottskálks Annal (2002). The sandbank that was actually offering shelter to the market place seemed to become ever more silted up and one theory is that eventually it was no longer possible for the trade boats to land at the inlet (Pétursson 1999). There is no good dating evidence for this however, so is not known if this silting of the harbor actually happened during the 12th or 13th c. Another possible, though still partial explanation for disuse of Gásir as harbor could have been because merchant boats became larger after the 14th c. and required different mooring conditions than those available at Gásir. There was a complete change in trade organization at the same time, with the boats returning back to their port of origin the same year instead of overwintering in Iceland as was done previously (O. Vésteinsson, personal communication October 2012). Another reason for the major Eyjafjörður port moved to presumably Akureyri, formerly Oddeyri (Karlsson 2000:133) after the Gásir site likely became unused, could have been changing power structures in the region. And last but definitely not least, the supply in prime beef provisions could have dried up due to either political and/or climatic changes. As is commonly the case when trying to reconstruct the past, there may have been multiple factors contributing to an end of Gásir trading.

2.2.5. *Ethnicity and Foodways*

One way to finding clues on possible presence of foreigners is through foodways in form of a consumption pattern analysis as was done with the Gásir archaeofauna: From about AD 1150-1200 on, a method of marrow extraction from the lower leg bones (metapodials) of sheep and goats started spreading across the North Atlantic, although it did not seem to have taken hold in Greenland (Bigelow 1985). This way of bone marrow extraction consists of drilling two holes on opposite ends of the leg bone and then sucking out the marrow, keeping the bone intact. This issue will be discussed further in the Gásir data chapter (Chapter 4). This method was not employed in the Viking Age, and also did not take hold in England and Continental Europe. It should be mentioned here though that at 14th c. Gásir, a great percentage (ca. 70 %) of the total leg bones that were likely used for bone marrow extraction were split open, leaving behind bone splinters instead of an intact bone to be expected from Icelandic medieval marrow extraction (see Gásir Data Chapter 4 (also Harrison 2006, 2009, Harrison et al 2010). This low number of bi-perforated, or 'intact' sheep and goat lower leg elements suggests foreign food ways employed at Gásir. In the Gásir artifact section below, imported Norwegian baking plates will be discussed as they support foreign/non-Icelandic food ways employed at the trading site. In this case, the people engaged in extracting the bone marrow and possibly baking the bread on site were either Norwegian, or heavily influenced by Norwegian food ways of (Gísladóttir & Snæsdóttir 2011:68).

2.3. Möðruvellir in Eyjafjörður

One of the main relevant local elite institutions competing for control over international trade and control over the exchange and market organization at Gásir was very likely the monastic estate at Möðruvellir. Möðruvellir at the same time had the power over its landed property and its subsidiary farmers to produce a certain surplus in (export-) goods of interest to the foreign merchants. Möðruvellir also collected a large amount of preserved fish from the 6 properties it owned on Grímsey in the 1300s (Júlíusson 1996:102; O. Vésteinsson, personal communication October 2012). Grímsey was an important fishing site and as it could have been one provider of stockfish (author´s assumption), this island possibly together with the Siglunes fishing site in the outer fjords of Eyjafjörður (Harrison 2013, unpublished report) may have been one of the reasons why the international merchants were keeping the Gásir church and trading structures in good repair for repeated visits and procurement of this highly sought after preserved food item. (This idea will be explored further in the Discussion Chapter, 8). Also, The House of Canons at Möðruvellir was subject to the bishop at Hólar who was the abbot there (Hreiðarsdóttir & Pétursdóttir 2008:15) which may have been attracted to Möðruvellir because of its proximity to Gásir. The bishopric might have used the monastery as local representative for exerting power over the regional exchange organization from the 13th c. on when the House of Canons was established. Hólar could have had control over Möðruvellir from as early on as the mid-13th c., and de jure control from around AD 1200 (see Vésteinsson 2001:11 for information on the relationship between Hólar and Möðruvellir in the 13th c.).

2.3.1. *Möðruvellir Midden Excavation*

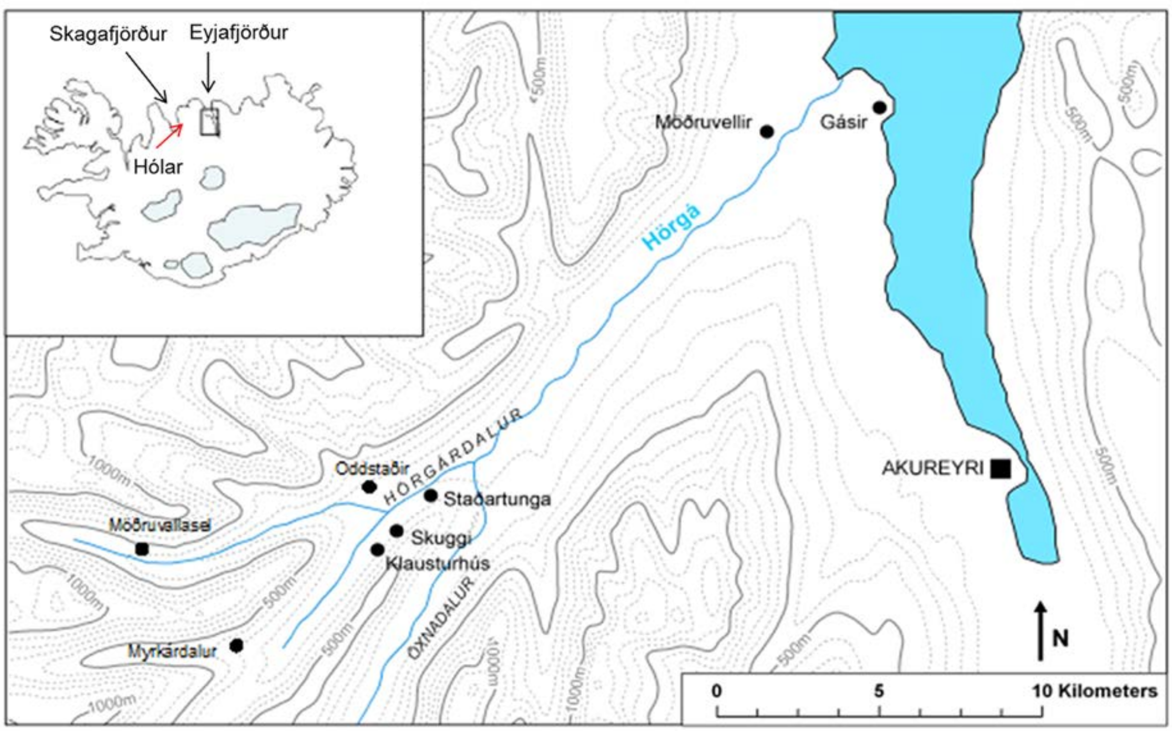


Figure 2.10. Map of Iceland, locating Möðruvellir, other sites mentioned located in Hörgárdalur, and the Gásir trading site (Map after Streeter in Dugmore et al 2008; sites added by author).

2.3.1.1. General Information

Möðruvellir is located in Hörgárdalur, Eyjafjörður, North Iceland. It is situated on an open lowland pasture, just north of the river Hörgá, and ca. 13 kilometers north of the modern city of Akureyri (figure 2.10 above). The site lies close to the Hörgá river delta, and thus its eastern property is remotely part of a coastal environment. It was hypothetically established around AD 900, possibly by a person who wanted to become chieftain over a small but important initial settlement at the Hörgá Estuary (Vésteinsson 2001:11 – Eng. translation by Harrison). There is no evidence suggesting the site was a major center before the 12th c. (Vésteinsson 2001:10). Möðruvellir became a church farm during the 11th c., but was at that time still operated by lower status chieftains. Möðruvellir was a parish church farm from about the 1150s on (Vésteinsson, 2001:10), and sometime during the first half of the 13th c., Möðruvellir was placed under control of Hólar, the northern Icelandic Bishopric in Hjaltadalur, Skagafjörður (Hreiðarsdóttir & Pétursdóttir 2008:20). In 1296, Möðruvellir, an Augustinian establishment, was made House of Canons (Vésteinsson 2001:10). In 1316, the monastery burned down and was not rebuilt until 1326 (Hreiðarsdóttir & Pétursdóttir 2008:20). This was not the only time either the monastery or the church burnt down (see below). No major changes in ownership or administrative structure seem to have taken place at Möðruvellir until the Reformation in the 1550s, and after that Möðruvellir was leased as a sort of rent-farming operation (O. Vésteinsson, personal communication October 2012) from the Danish King until 1784, when the estate became the seat of the Regional Governor (Hreiðarsdóttir & Pétursdóttir 2008:20).

As mentioned already, Möðruvellir was the wealthiest landowner in Hörgárdalur (Júlíusson 1996, Harrison 2010) and its position at the eastern exterior of the valley system between the river Hörgá and Skípalón, in whose estuary boats were once kept, position it very well in the landscape. The property is roughly L-shaped and can be divided into hillside slopes, homefield, and wetland pastures (Vésteinsson 2001:8). Möðruvellir's pasture-rich land holdings were extensive both in highland and lowland areas and it acquired Gásir in 1452 from the monastery at Munkaþverá which might have owned it during the height of its trading activities. Möðruvellir also owned other neighboring farmsteads at one time or another, thus at least sharing a property boundary with Gásir during the time the latter was used for international trade and seasonal market fairs (Vésteinsson 2001, personal communication May 2013).

The deeper into the Hörgá Valley´s interior one ventures, the narrower the valley floor becomes and the steeper the slopes get. The physical lay-out of the valley system itself created conditions promoting a certain hierarchical structure, ranking Möðruvellir highest in this area (Environmental Background Chapter 3, see Vésteinsson 2000 for discussion on various social systems typical for various Icelandic landscapes).

2.3.2. *Möðruvellir Monastery Midden excavation*

In 2006, as advised by Orri Vésteinsson who had surveyed the Möðruvellir farm in 2001, a targeted midden assessment and excavation was undertaken in an effort of gaining more insight into the medieval economy of this important estate (i.e. Harrison & Roberts 2006, Harrison 2008 a, b, Harrison 2011b). The three-year excavation project resulted in midden remains dating from the 13th c. to the early 20th c., allowing for a detailed and long-term analysis of the materials from the deeply stratified Öskuhóll or Ash Hill, initially surveyed in 2001 (Vésteinsson 2001:34). Only the medieval remains are discussed here, but the Möðruvellir data chapter will present the entire archaeofaunal data to provide intra-site comparisons of the long-term farm economy as can be extrapolated from a relatively small sample of the entire midden (Gísladóttir et al forthcoming, Harrison et al forthcoming).

2.3.2.1. Research History

This is a brief summary of the Möðruvellir (excavation) history presented elsewhere (Vésteinsson 2001, Roberts 2005, Harrison & Roberts 2006, 2007, Harrison et al 2010).

- Danish historiographer Kristian Kaalund undertook archaeological and historical research of the farm as early as the 19th c (Vésteinsson, 2001:7)

In the 19th c., a pagan burial (Kuml) was unearthed, suggesting the area was settled (at least that people were buried there) before the year 1000 AD (Vésteinsson, 2001:10).

- Guðmundur Ólafsson of the National Museum of Iceland surveyed the area in 1985 and registered a series of archaeological sites.

- 2001 – Orri Vésteinsson, Extended archaeological survey and site registration that includes a summary of Möðruvellir´s history (Vésteinsson, 2001).

- 2005 - Howell Roberts, excavation of an evaluation trench in the churchyard; investigative work prior to planned ground works for central heating and path construction (Roberts, 2005)

- 2006 – Howell M. Roberts and Ramona Harrison, excavation of an evaluation trench (TR 1) into the Öskuhóll (Harrison & Roberts 2006).

- 2007 – Howell M. Roberts and Ramona Harrison, extension of evaluation trench (TR 1) (Harrison & Roberts 2007).

- 2008 – Howell Roberts and Ramona Harrison, continuation of excavation in evaluation trench TR1, and evaluation of TR 2/2b.

This portion of the 2008 Möðruvellir Midden Excavation project was part of the 2008 – 2009: Gásir Hinterlands Project (GHP), directed by Harrison and Roberts (Harrison 2008a).

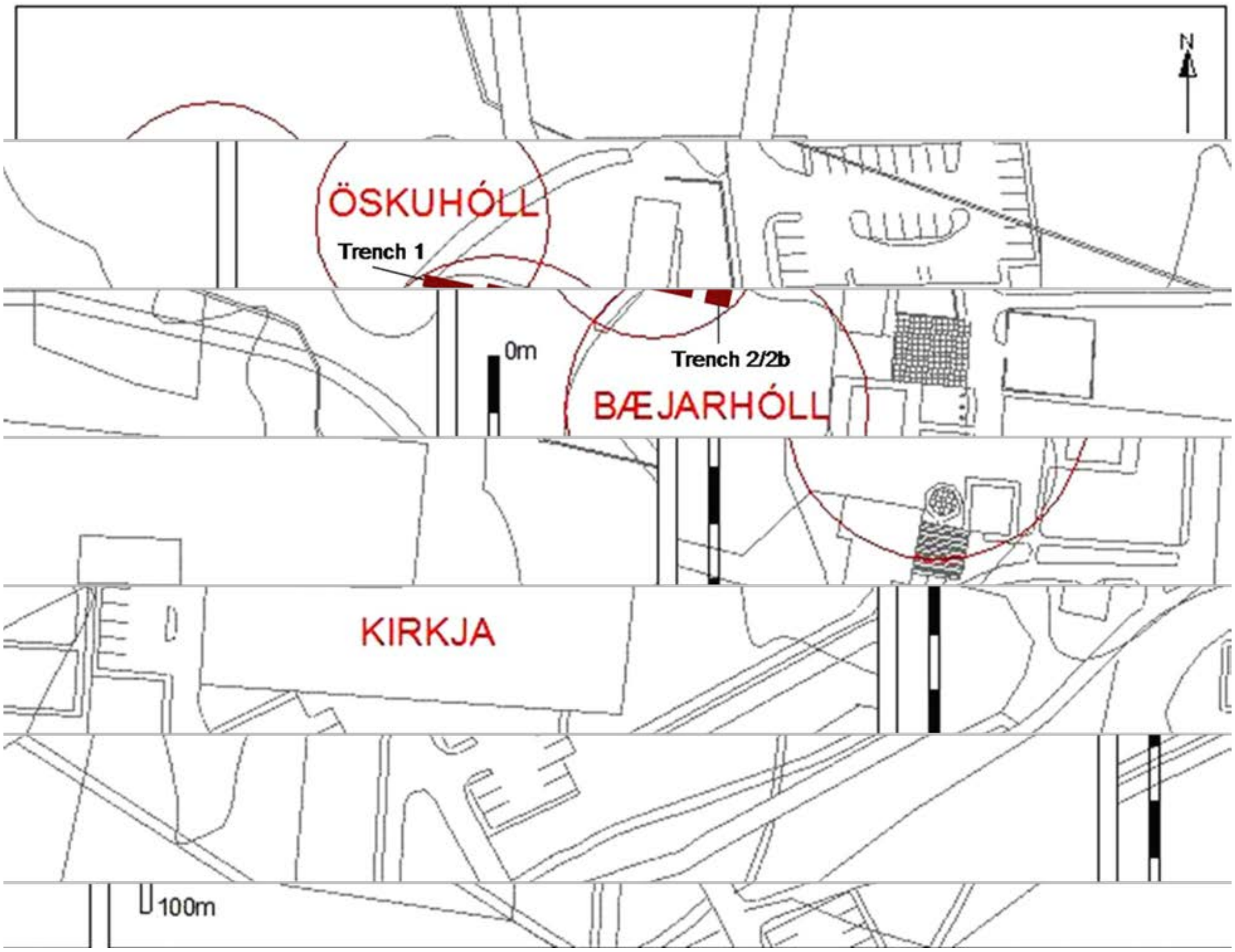


Figure 2.11. Approximate Möðruvellir midden trench locations. Öskuhóll = Ash hill/Midden Mound, Bæjarhóll = Farm Mound. Kirkja = Church; modern building from 1865. (Map © FSI/HM Roberts, trenches added by author).
Approximate midden trench locations

It should be pointed out that, just as the Möðruvellir Midden Mound´s post-medieval and early/modern deposits will be omitted here and in the Discussion Chapter, so will the faunal materials from another site, also producing post-medieval and early modern midden materials. That site called Myrkárdalur was part of the Gásir Hinterlands Project and its midden materials investigated and tested in both 2008 and 2009. The results from the faunal analysis are appended to this dissertation (see also Harrison et al 2010, Harrison 2011a).

2.3.3. *The 2006-2008 Möðruvellir Midden Excavation*

Möðruvellir, formerly a medieval House of Canons and for centuries a high status farm was undoubtedly connected with the high medieval Gásir trading site during that site's active period and throughout its own history maintained a central role in the Eyjafjörður economy and politics. The original farm and religious buildings have not been located with precision, but it is generally assumed that their remains are beneath the historic farm mound (*Bæjarhóll*) adjacent to the well-known Midden Mound or Ash Hill (*Öskuhóll*). The Möðruvellir farm mound and historic buildings represent a major cultural and archaeological monument with tremendous potential for future research. The farm mound itself measures some 80 m in diameter and centuries of occupational and construction remains have raised its top 4 – 5 meters above the surrounding farm land. The mound has seen continued use down to current times (Vésteinsson 2001), certainly a factor causing some minor disturbance to underlying archaeological deposits, not only to the structural deposits, but also the midden remains as is evidenced in the medieval midden phase (see Chapter 6).

Still, this large mound potentially can offer testament to a large portion of the estate's activities throughout its long history. The map above locates the Möðruvellir historic farm mound and the midden mound to the north west of the modern church. The two areas are connected and therefore associated with one another. Prior to excavation, the midden mound was thought to have consisted of series of midden layers deposited over several centuries (Vésteinsson 2001), which turned out to be correct. The location of the midden trenches TR 1 and TR2/2b excavated between 2006 and 2008 at the edge of the mound(s) was chosen after thorough coring of the area and with the intent to avoid any structural remains.

Evaluation trench 1 or TR1, excavated since 2006, had reached depths of over 2 meters and allowed the recovery of a substantial archaeofauna dating from the high medieval period (see regional chronology for medieval Möðruvellir midden dates) to the 19th/20th c. Following upon well preserved materials from the most recent occupation period, the TR1 midden unit encountered a dramatic rise in soil acidity (a general local pH value around 6 dropped to a highly acidic 3.5) resulting from a massive concentration of peat ash in the lower layers.

While this acidic environment effectively preserved several textile fragments, very little bone survived from the lowest excavated layers dated to the 12th to 14th c. The horizontal expansion of TR1 in form of TR 2/2b succeeded in recovering additional 18th and 20th c. artifacts and well preserved animal bone, but rapidly encountered substantial structural remains probably associated with 19th and 20th c. farm buildings. A trench dug to for a power line for the metrological research station at Möðruvellir was encountered and TR. 2 had to be moved 1 m further north. The few TR 2 materials retrieved were not found to have been compromised by the placement of the power line. The new trench, TR2b, revealed Early Modern structural remains and excavation had to be discontinued to avoid damaging these extensive and well preserved structural layers. Trench 2/2b, placed further toward the center of the midden and farm mound, measured a total of 3 m (width) and 2 m (length). It was placed six meters east of TR 1 and provided a good source of evidence for Modern midden activity at Möðruvellir.

An excavation of structural remains from Möðruvellir is very desirable, but it was not part of the project goals, as an open area excavation of the farm mound would require far more funding than was available at that time.

Figure 2.12. Möðruvellir Farm and Midden Mound, indicated by red, interrupted line. On the left, indicated by black arrow: the modern church (and churchyard). On the right, indicated by black arrow, one element of the modern farm complex. Center of the mound, indicated by red arrow: midden trench, with sieves for retrieving the most extensive amount of archaeological remains possible (bulk-sampling and Kubiena tins, as well as a sampling column for archaeoentomological analysis also employed). Note: Mound has a radius of ca. 20 m. Picture facing south.

2.3.3.1. Medieval remains from the Möðruvellir Midden Mound (Öskuhóll)

Only the medieval, or ca. AD 13th to early 15th c., midden deposits from the Möðruvellir Midden Mound will be utilized for a discussion on this high status estate farm and its site economy. Despite serious taphonomic issues (see Möðruvellir Data Chapter 5) and the fact that the sample from this huge mound was limited in size (as it comes from a 2 m by 8 m trench), certain patterns extracted from the archaeofauna can still be utilized as they suggest certain live-stock management practices in place at Möðruvellir while Gásir was in operation. The profile drawing of the north facing section below does not include all the midden contexts excavated but gives an idea of how many different dumping events are recorded, with deposits in and below context (074) dating to the middle ages (see Möðruvellir Data Chapter 5). The Möðruvellir Midden Mound Harris Matrix is appended to the Möðruvellir Data Chapter, and the various chronological midden phases are discussed in that chapter.

Figure 2.13. Möðruvellir TR1, Segment of northern profile.

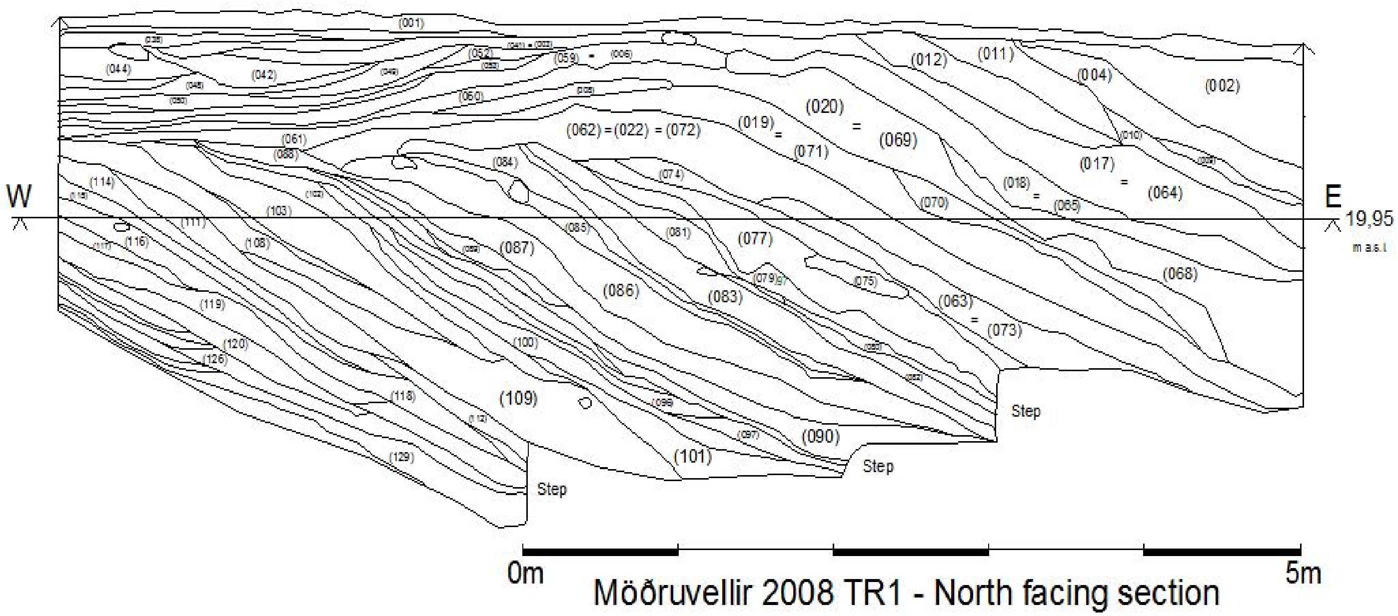


Figure 2.14. Möðruvellir Trench 1, North facing Section.

2.4. The Gásir and Möðruvellir Hinterlands

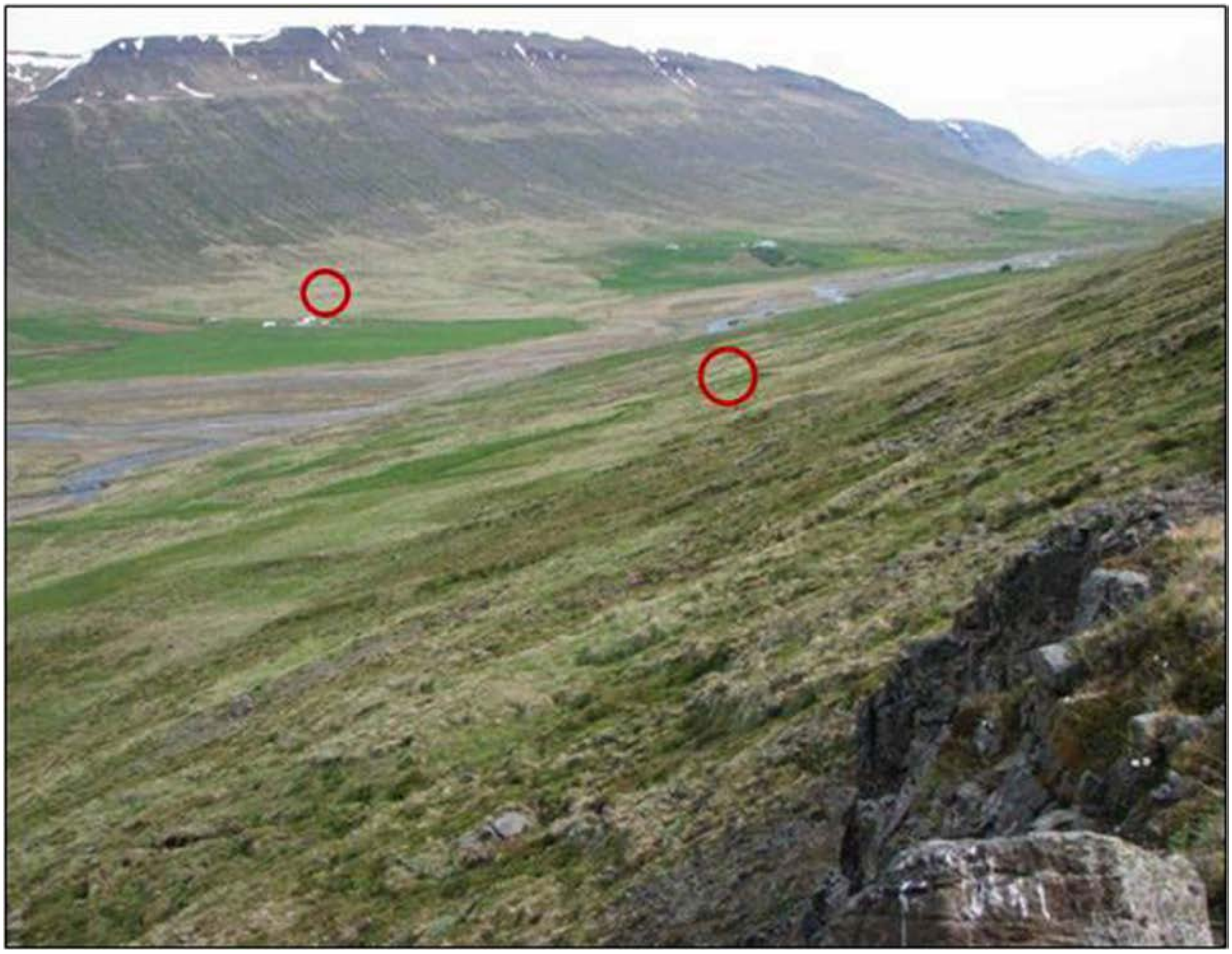


Figure 2.15. Northern and southern Hörgárdalur slopes. Red circle on the left indicates Oddstaðir location on the floor of the valley's northern side, red circle on the right indicates Skuggi location, situated on the valley's southern slopes. Picture direction: ENE.

The following two sites were successfully targeted and sampled for midden materials in 2008 and 2009 and provide the relevant data from the valley system where Möðruvellir is located and which is connected to Gásir. Skuggi was established some time in the late 9^{th} or early 10^{th} c., long before Gásir was in operation, but this site (or its midden remains as of yet) sheds light into the organization of rural economy before the 13^{th} c. It is suggested by the author that the final abandonment of the farm site some time in the 12^{th} c. (see Skuggi Data Chapter 6) and its possible replacement with a large specialized sheep herding station or sel (shieling) nearby is connected directly to larger scale economic developments associated with Gásir. The shieling site is called Klausturhús and is located less than 1 km northwest of the small farm site called Skuggi or ´shadow´.

The second site investigated is called Oddstaðir, located on the land owned by Öxnhóll, and was possibly a subsidiary holding on the Öxnhóll estate where there was a parish church since medieval times (Hreiðarsdóttir, Head of Survey Department, Icelandic Archaeological Institute, personal communication, May 2012). The Oddstaðir data set from the associated midden deposits give a chronology of activities spanning several centuries, from the farm´s potential establishment in the late 9th or early 10th c., through farm abandonment in the late 14th c., around the same time when Gásir trading activity seems to have slowly found an end. Just like Skuggi, Oddstaðir could have been a subsidiary farm, but its faunal remains hint more towards a medium ranked farm that may have had some independence in its decision making regarding live-stock management. Alternatively Oddstaðir may have also been heavily dependent on Möðruvellir and was a part of the monastic estate´s organization of its hinterlands tenants to secure the food supply for the Gásir operation (see Oddstaðir Data Chapter 7). Oddstaðir could have even been a subsidiary farm owned by Öxnhóll which could in turn have been connected to the Gásir prime meat exchange via Möðruvellir.

2.4.1. *Skuggi in Hörgárdalur*

2.4.1.1. General Information

Skuggi is located in Hörgárdalur, ca. 20 km southwest of the medieval trading site Gásir in Eyjafjörður, N Iceland (figure 1). The site lies south of the river Hörgá that names the entire valley system and whose waters traverse the Hörgá Valley, or Hörgárdalur, to eventually drain into Eyjafjörður just slightly north of Gásir. Positioned on a little plateau at an elevation of about 160 - 170 m asl, Skuggi is a mid-to upper highland site and may have originated as a small subsidiary farm, that may have been incorporated into the larger landholdings of Staðartunga farm. Staðartunga farm itself became eventually owned by Möðruvellir (Hreiðarsdóttir et al 2008:230). In 2008, the author together with Þóra Pétursdóttir from FSÍ cored the Skuggi site and located and tested a medieval midden. In 2009, a larger scale midden excavation was carried out. The trenched midden and especially its underlying structure are remains of the original site settlement, with other structures possibly associated with later site activities (Hreiðarsdóttir 2008:233, some information in English in Harrison et al 2010).

Radiocarbon analysis dates the Skuggi midden deposits to ca. AD 970 – 1208; Tephrochronology further aids in dating this site: All midden deposits are sealed by H1300, and most of them by H1104 volcanic ash layers. The turf structure under the midden contains tephra layers deposited during the volcanic landnám eruption (LNS) that largely coincided with Icelandic settlement in AD 871.

The Skuggi midden excavation in 2009, directed by the author, was the latest in a series of archaeological projects that are all part of a larger Eyjafjörður Ecodynamics program (Harrison et al 2010, Harrison 2008a).

2.4.1.1. Skuggi Midden Trench 1

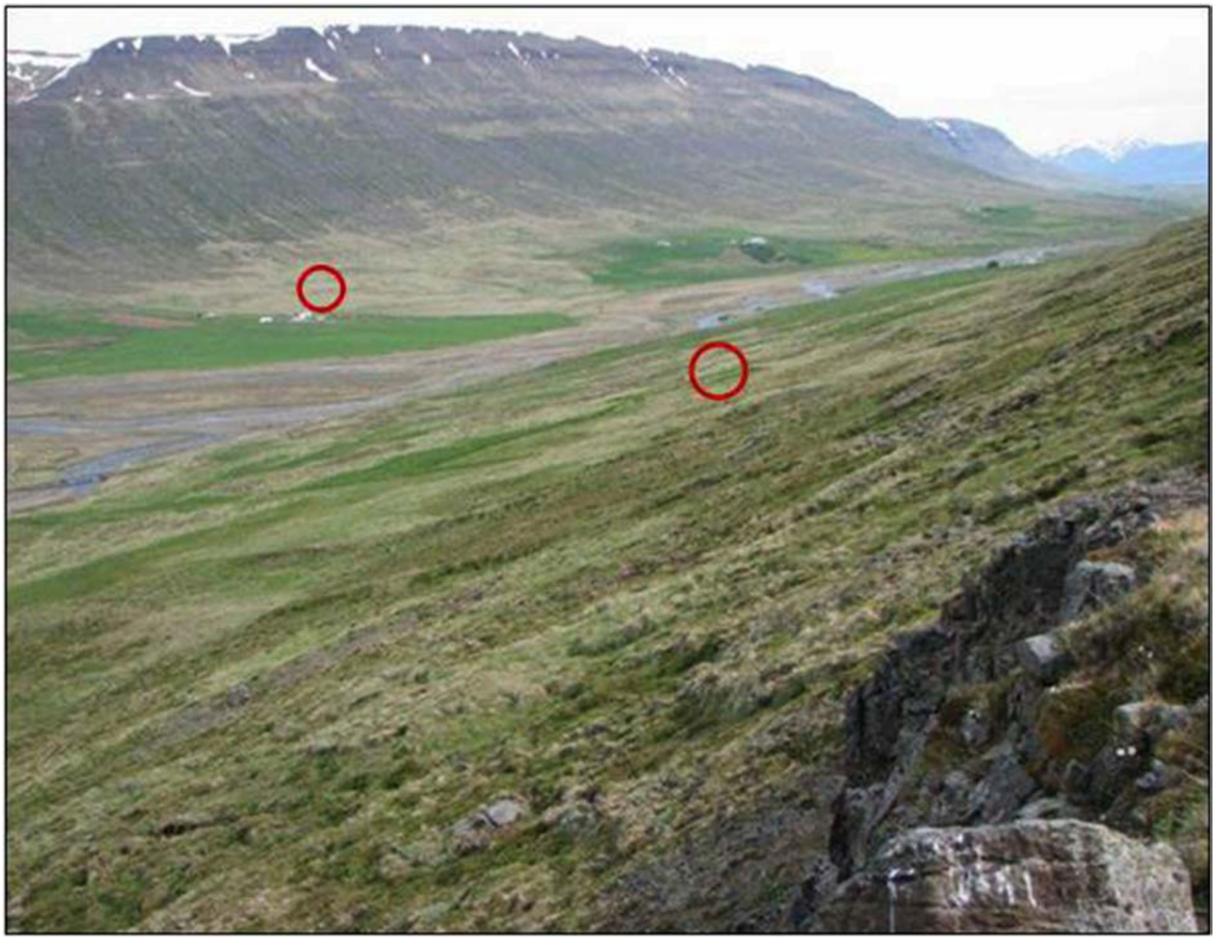


Figure 2.16 The Skuggi site (rectangle), located uphill from Hörgá and Skuggabrú (arrow). The picture also shows linear drainage ditches to the north and west of the site that were dug in the late 20th c. The mountains across the valley form part of its northern edge (facing NNE).

Skuggi is located up-slope from the road down in Hörgá Valley. At an elevation of 170m asl, it is a 10 minute from Skuggabrú, the bridge leading the road across Hörgá. The slope levels out slightly in the area of the archeological ruins, but just south of it continues again uphill to Staðartunguháls, a peak belonging to the mountain range dividing Öxnadalur from Hörgárdalur.

The survey plan below outlines two structural remains and a potential midden observed at Skuggi during the 2004 Hörgárdalur survey (Hreiðarsdóttir 2008:232, cropped by RH). The midden labeled C may be contemporaneous with at least one of the visible ruins. Mound C´s partial excavation has resulted in TR 1 and the discovery of at least one structure below the series of household refuse layers which may have accumulated over a 250 year time span. Future excavation plans include an investigation of the ruins labeled A and B following an open area excavation of the Viking Age structure filled by TR1 midden deposits.

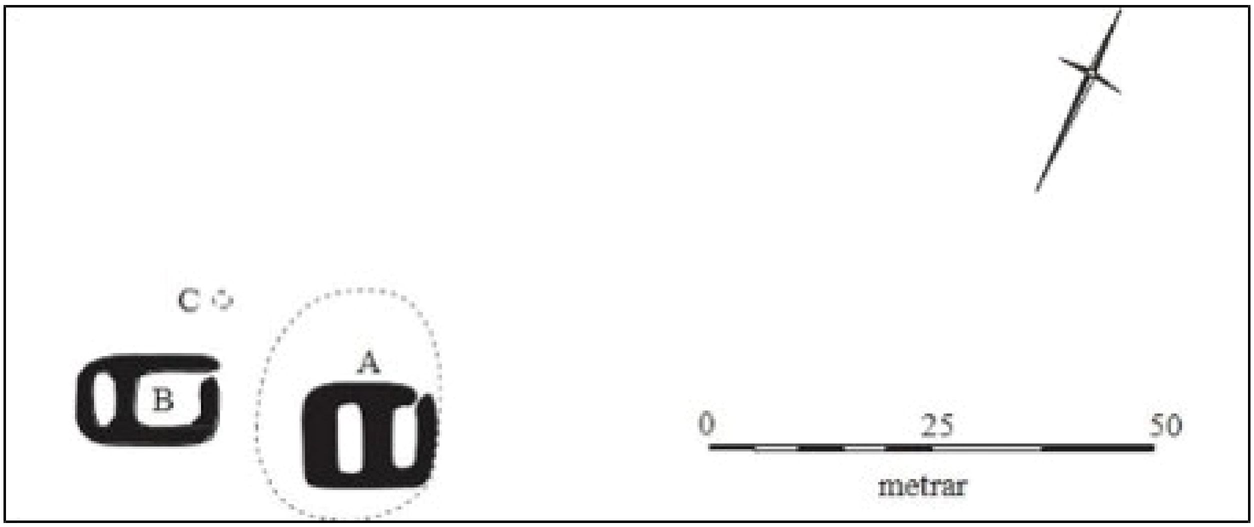


Figure 2.17. Survey map of Skuggi ruins A, B and midden C where TR 1 was placed (© Hreiðarsdóttir/FSI 2008: 232).

All faunal remains recovered from Skuggi in 2008 and 2009 were collected from Trench 1 (TR1), a 4 m (N - S) by 3 m (E - W). This trench contained midden deposits that were about 1 m to 1.30 m deep. While most of the eastern and northern extent of the midden has been determined, the midden possibly extends at least two more meters to the west, and further to the south. A future expansion of the midden trench is planned in the near future.

Figure 2.18 below is a close-up picture of the intact wall remains belonging to the structure under the excavated midden layers in TR 1. The turf blocks used for wall construction contain the olive green and purple volcanic ash layers generally related to as the landnám tephras. Coring of the structural remains also indicate that the structure was built after deposit of LNS 871 tephra.

Figure 2.18 Skuggi structure, eastern wall containing purple and olive green tephra layers from volcanic ash deposits remains intact. Wall in this close-up is 1.50 m long. Depth of the wall is not known because the structure is still filled with collapse from the roof. Picture faces east.

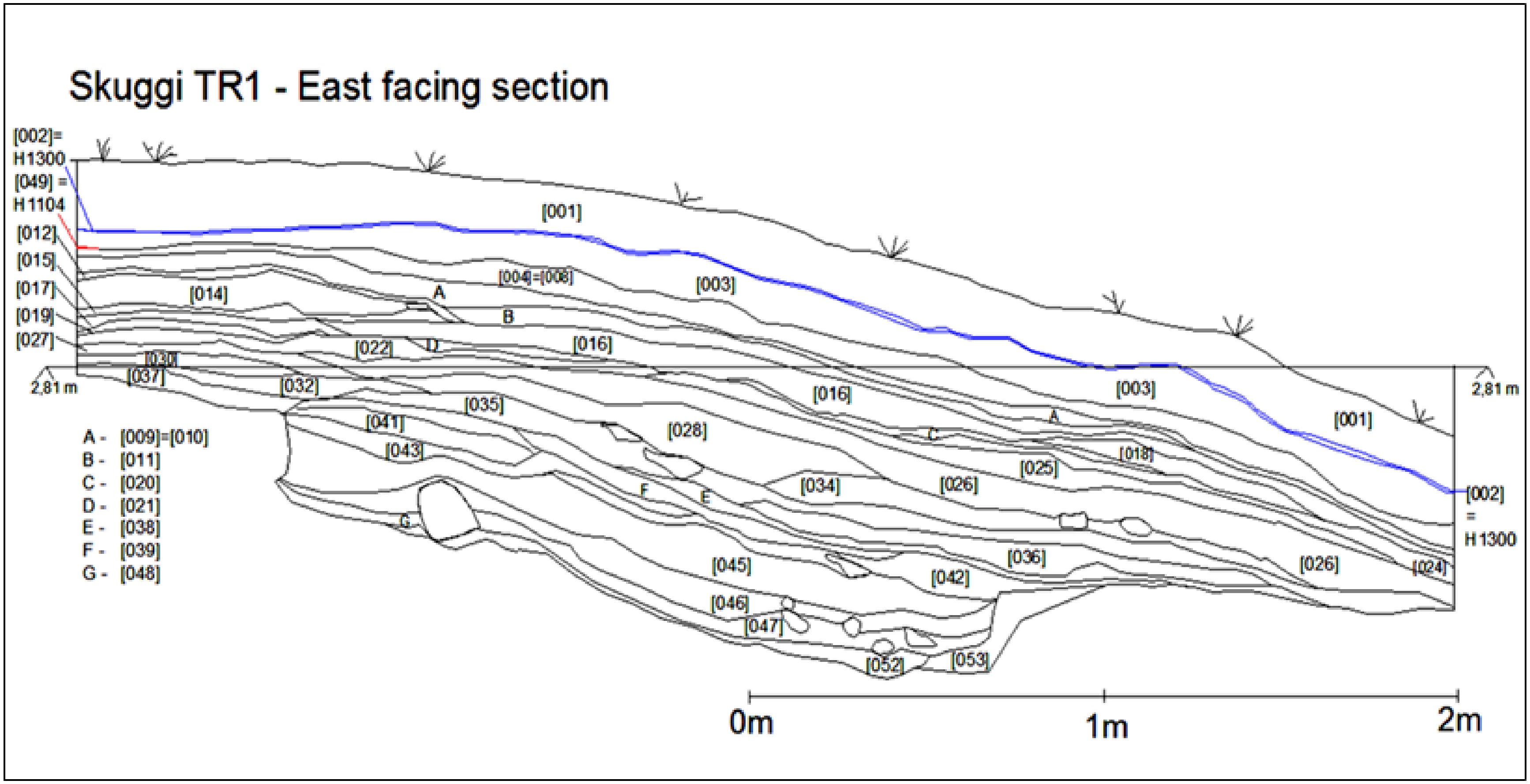


Figure 2.19. Skuggi, Trench 1. East facing section; tephra layers H1300 in blue and H1104 in red. Letters indicate context numbers that did not fit into the drawing.

The digitized profile drawings in figures 2.19 and 2.20 present the trench's east and north facing sections. These profiles contain most contexts whose faunal remains were analyzed for the Skuggi data Chapter, 6. H1300 is visible in both profiles and marked in blue. H1104 was very faint and could only be picked up clearly in the SW corner of TR 1. It overlaid context [004=008] and thus all midden layers underneath. The Harris Matrix in Chapter 6 outlines tephras and contexts sampled for C14 analysis. The east facing section drawing above demonstrates the sloping of the terrain and cultural deposits towards the North.

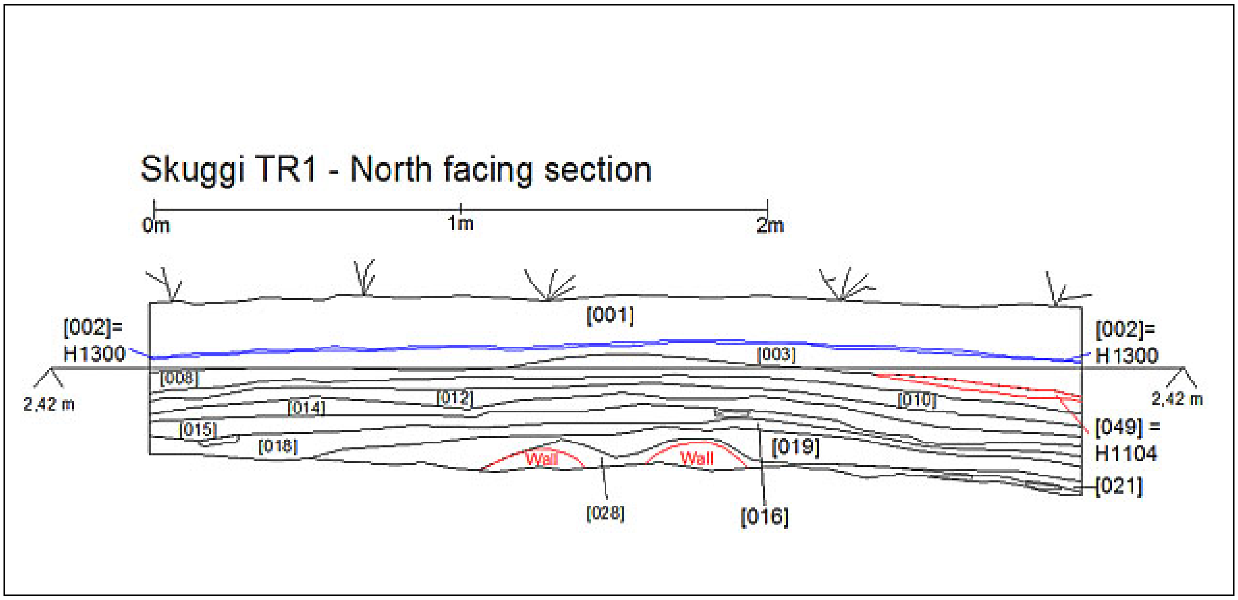


Figure 2.20. Skuggi, Trench 1. North facing section; tephra layers H1300 in blue and H1104 in red.

2.4.2. *Oddstaðir in Hörgárdalur*

2.4.2.1. General Information

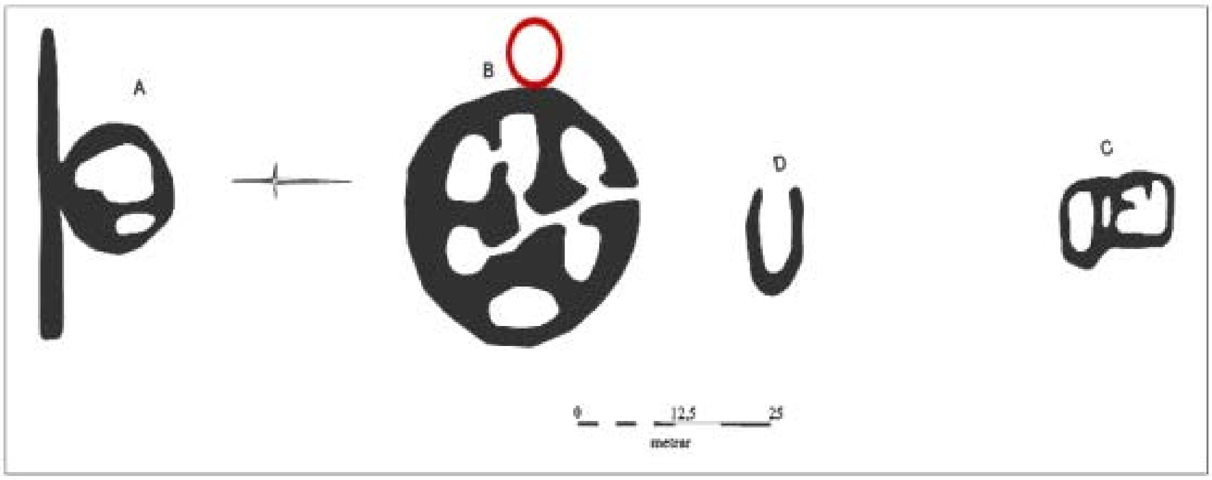


Figure 2.21. Survey plan of the Oddstaðir ruins, TR1, the midden trench excavated in 2009 is located on the eastern slope of ruin B, indicated by a red oval (survey plan (c) FSI/ Hreiðarsdóttir 2008:97; North arrow direction adjusted and midden indicator added by RH).

The ruins of the former Oddstaðir farm, together with other farm ruins (i.e. Uppsalir ruins, cored for midden materials in 2009 (Harrison et al. 2010, see appendix to Chapter 3) are located on the present property of the farm Öxnhóll which used to have a parish church until 1575 (Vésteinsson, personal conversation, March 2012). The farm (and the church) was owned by the Öxnhóll farmstead located about 1.2 km southeast of Oddstaðir. As indicated by the survey plan, there are several ruins at Oddstaðir on Öxnhóll land north of the Hörgá and west of Oddstaðaá. The second river mentioned, Oddstaðaá, delineates the property boundary between Öxnhóll and Barká, on its west. The modern farm house at Barká is situated at approximately the same altitude and on the same alignment (N - S line) as the ruin of outhouse building C at

Oddstaðir, about 50 m south of the Oddstaðir farm mound. The ruin mound is about 3 m high and represents an accumulation of structural remains and midden materials.

In 1712, the Icelandic land register Jarðabók mentions that the ruins had been abandoned longer than men could remember (Jarðabók Árna Magnússonar og Páls Vídalíns 1943, Vol.10:141). Öxnhóll itself seems was a church farm with a small parish and it is unclear whether Oddstaðir was an independent farm that at some point was abandoned and became part of Öxnhóll property, or whether it had been a dependent farm of Öxnhóll at some point. It is possible that Oddstaðir was once an independent farm, since its name ends in '-staðir' rather than '-kot', but the name alone of course does not suffice to make an assumption on the farm´s status (Hreiðarsdóttir, personal communication, May 2012). The Oddstaðir archaeofauna from the midden feature that fell out of use by the late 14th c., indicates this farm indeed could have been an independent farm, at least at the time of its settlement in the late 9th to early 10th c. When Jarðabók was written in the early 18th c., ownership of Öxnhóll was still owned by Möðruvellir, which, together with all its possessions, had become property of the (Danish) king after the Reformation. The king however rented out the monastery´s possessions as portfolios so these could be kept together, despite the fact that the monasteries had been dissolved by then (Vésteinsson, personal conversation, May 2013).

Figure 2.22. Oddstaðir ruin complex, indicated by the red arrow. Oddstaðir is situated at the western end of Öxnhóll land with the river, Oddstaðaá (black arrow), creating a natural boundary between the Öxnhóll and Barká farms.

2.4.2.2. *Oddstaðir, Midden Trench 1*

In summer of 2009, after cores placed into the Oddstaðir farm mound indicated the presence of deeply stratified midden materials, a 1 m (N-S) by 3m (E-W) evaluation trench was put into the eastern side of the ruins depicted as farm mound B in the survey plan (Coordinates: 65°40.617'N, 18°29.107'W, Elevation 158 m ASL). This midden trench excavation was supervised by Howell M. Roberts (FSÍ). Within two days, the Oddstaðir Trench 1 had produced several substantial and discrete midden contexts, many contained well preserved faunal remains (i.e. context [104]). TR1 was extended to 2 m (N-S) by 3 m (E-W) to maximize recovery of artifacts and faunal and other environmental remains. Upon a second coring transsect placed to pinpoint the midden extent even further, the trench was extended by another meter along the eastern section, resulting in its final extent of 2 m by 4 m. This trench not only contained a large and well preserved archaeofauna and several artifacts but also revealed structural elements (Harrison et al 2010, Harrison 2012).

Figure 2.23. Oddstaðir, multi-context picture: stone lined wall, post holes with a rectangular feature emerging. Picture facing west.

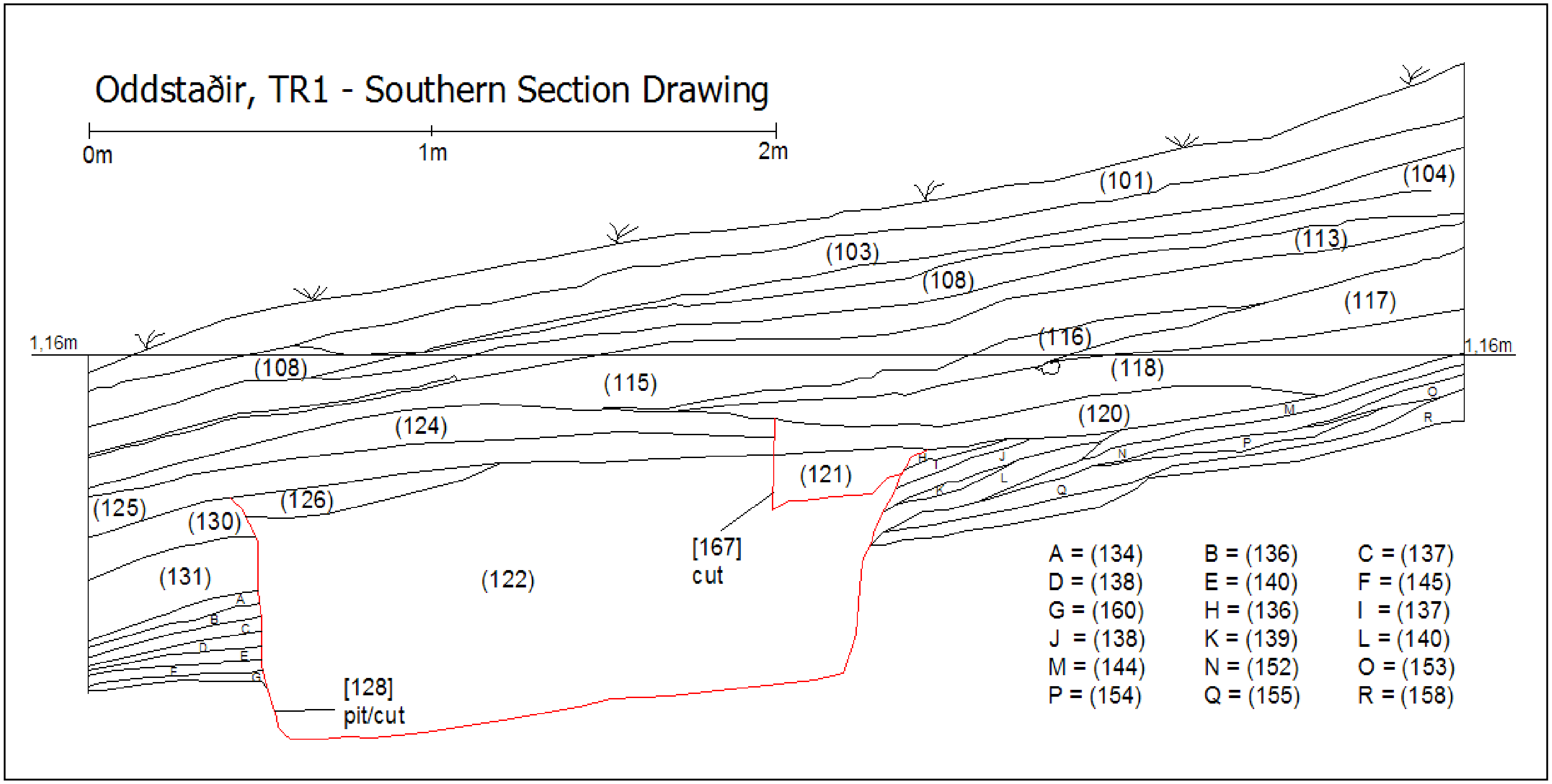


Figure 2.24. Oddstaðir, TR1 – Southern Section Drawing. Letters in the section drawing are given appropriate context numbers in the legend.

2.4.3. *Regional Chronology*

The figure below highlights the occupational phases of the sites researched for this dissertation project and the temporal overlaps of the various occupation phases. All radiocarbon dates are from terrestrial animal bones and are thoroughly explained in the individual site´s data chapters and zooarchaeological discussions. All sites listed below are situated in Eyjafjörður, and with the exception of the coastal site at Gásir, are located in Hörgárdalur, as highlighted by the regional map in figure 2.7 above.

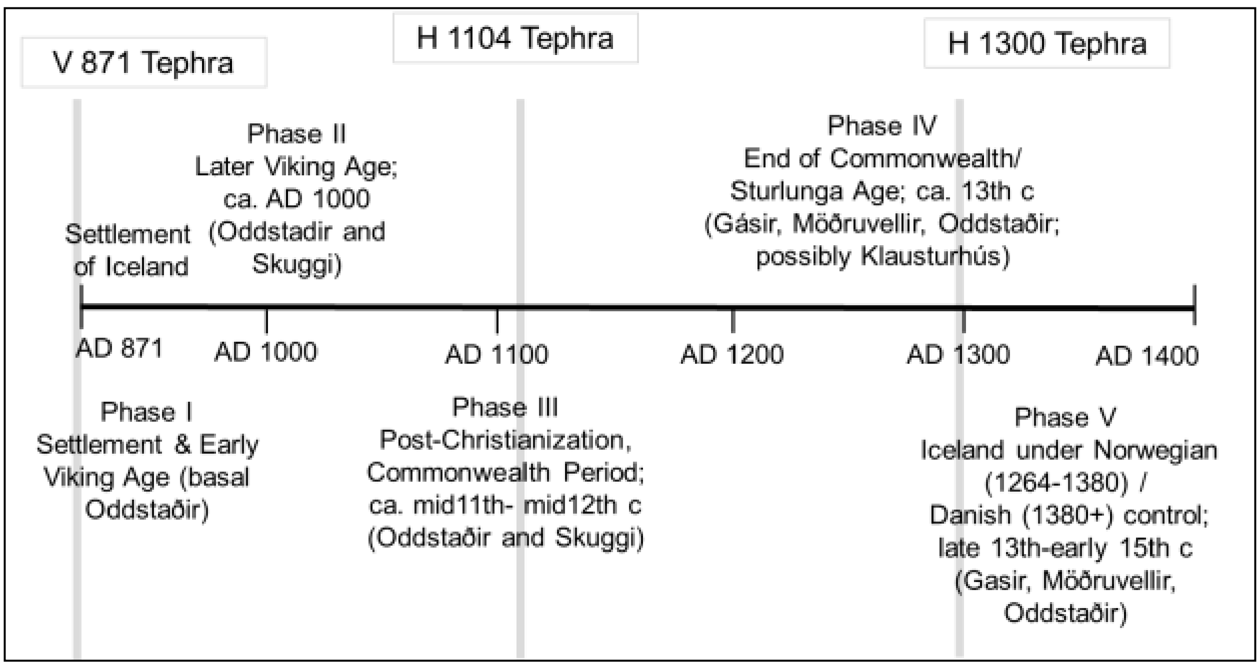


Figure 2.25. Time line highlighting regional Hörgárdalur/Eyjafjörður site activity from Icelandic Settlement until the end of Gásir site activity in the late 14th / early 15th c. The different phases are based on Tephrochronology and Radiocarbon dates (see Data Chapters for more site specific phasing and dating information).

2.5. Artifacts

The trade in both prestige and staple goods within Iceland during the high Middle Ages has been primarily investigated through historical documentary records relating to gifts, taxation, and tithing, without much contribution from the archaeological record (e.g. Marcus 1957). One exception is a comparative study of imported pottery shards from older (pre 1990s) archaeological excavations of all Icelandic sites excavated up to that time (Sveinbjarnardóttir 1996). In other European regions, archaeological and historical investigations integrating trading center and supporting hinterland sites have allowed for a far better understanding of this subject. As the multiple studies have revealed, interaction of town and country/coastal market and rural customers is understood better through multiple site investigation than by a focus on one single site (i.e. Giles & Dyer 2005, Müller-Wille & Tummuscheit 2004, Andren 1989, Clarke & Ambrosiani 1995, Meier 1994, Hamerow 2002, Newman 1999).

The artifacts resulting from excavations of Hörgárdalur midden sites and those from Gásir are discussed below. The Gásir finds will be the main focus here, as that site has produced a series of material remains from a large scale, open-area excavation. The sparse artifacts from the midden excavations at Möðruvellir, Skuggi, and Oddstaðir are presented for completeness. The most important finds are presented here (for more thorough discussions see finds specialists´ reports in Roberts et al 2009, 2010, Harrison et al 2010, Vésteinsson et al 2011a, Gísladóttir & Snæsdóttir 2011, Gísladóttir et al forthcoming).

2.5.1. *Gásir artifacts*

2.5.1.1. Export Goods

2.5.1.1.1. Bulk Export Goods

As mentioned earlier in this chapter, after AD 1250, the main Icelandic goods exported in bulk were stockfish and vaðmál (Karlsson 2000, Þorláksson 2008). Providing relatively new insight into the nature of vaðmál, the heavily regulated woolen cloth from sheep wool that was utilized as legal currency by the 11th c., results from the Möðruvellir and Gásir textile reports will be discussed in this section (Hayeur Smith 2011 a, b).

It is entirely plausible that stockfish were moved through Gásir and exported from Iceland, despite the lack of proof for on-site processing of industrial amounts of cod fish at Gásir. Since the site was predominantly occupied in the summer, and fishing was primarily a winter activity, a lack in gadid fish and especially cod skeletal elements typical for sites of commercial fish processing activities is no great surprise (see Gásir fish remains discussion in chapter 4, also Perdikaris & McGovern 2007, 2008, Perdikaris 1996, Krivogorskaya et al 2004). Moreover, there were specialized fishing sites that were likely catching and processing the fish destined for export with smaller vessels possibly delivering dried cod filets to Gásir when a foreign merchant vessel was leaving the harbor (i.e. Vésteinsson et al 2011a). It is possible that Grímsey was a potential producer of fish products at least as part of the Möðruvellir site supply. Since the island is not located in waters ideal for commercial scale cod fishing (see Chapter 3), the hope is that recently excavated faunal remains from initial excavations of the Siglunes fishing site in the outer region of Eyjafjörður (see map in figure 2. 5) will eventually provide a better idea on the Eyjafjörður stockfish trade. A large and well preserved faunal collection consisting of predominantly fish bone was recovered in 2011 from deposits contemporaneous with those excavated at Gásir (Lárusdóttir & Roberts et al 2012, Harrison 2013), with preliminary analysis in progress.

2.5.1.1.1.1. Sulphur

Sulphur was mainly mined in Iceland and Sicily for use in medicine, black powder production, as insecticide, and in lotions (Adderley et al 2003, Kramer 2001, Harrison et al 2008). One of the remnants of special activity purpose features was a negative feature with context number (520), producing in situ sulphur samples, located just outside area A, and determined as sulphur processing pit (Adderley et al 2004:60). These archaeological samples were compared with modern raw sulphur samples collected from Icelandic sites historically involved with the mining of sulphur (Harrison et al 2008). Another archaeological sulphur sample from the sunken Hanseatic ship, Darsser Kogge (Dendrochronology dates it to 1277-1293 AD), and the results from a micromorphological analysis of the modern and archaeological Icelandic sulphur samples indicate that all these samples show similar chemical properties The modern Sulphur samples were collected from the Mývatn region, about 100 km east of Eyjafjörður (Adderley et al 2004:60, Þorsteinsson 1972)..

Based on this research it can be deduced that Gásir was involved in the pan-European sulphur exchange (Adderley et al 2004:61).

2.5.1.1.1.2. Textiles

This section discusses the sheep wool fabrics found at Gásir and analyzed by textile specialist Michele Hayeur Smith (Hayeur Smith 2011a, b). Apart from actual sheep wool fragments recovered from the site, there are also some proxy indicators suggesting storage of sheep wool at Gásir: The archaeontomological analysis indicates presence of sheep ked in form of puparia, very likely associated with sheep wool products rather than the live animals. The puparia attach themselves to the wool and are hard to get out while adult sheep keds do not survive for long without the host. There were several adult sheep keds in one sample, which could have been from an area where actual live animals were kept or, where new sheep wool was processed (Konráðsdóttir 2010:68 in Roberts et al 2010).

Hayeur Smith's report on Möðruvellir textiles indicates that most of the collected fabrics were discarded pieces of vaðmál. The assemblage was found to be of very uniform make and could potentially indicate that only one or a few households were producing these textiles. All of the Möðruvellir textiles were recovered from the medieval layers dated to the late 12th to late 14th c. One way of interpreting the above could be that wool, spun or unspun arrived at Möðruvellir and was further processed there. As of yet, there is no firm confirmation of on-site wool processing which could have taken place anywhere in the farm mound or adjacent midden mound area. Structural excavations of contemporaneous contexts might bring more information on wool working equipment such as spindle whorls and loom weights as well as other items associated with spinning and weaving.

Hayeur Smith analyzed a much more diverse textile assemblage from Gásir, and did not discover a clear and uniform vaðmál manufacturing signature, but instead encountered differences in thread counts and especially in the quality of the vaðmál pieces, signifying likely different producers. This could either signify a relatively diverse catchment region employed for surplus sheep wool either in the raw or in processed form destined for the export market, or be indicative a greater variety of uses of the sheep wool recovered from Gásir (including some textiles used as packaging materials) than that from Möðruvellir. The majority of textiles found in the Gásir church yard, or Area B, were indeed vaðmál fragments (Hayeur Smith 2011a:3). The

Gásir vaðmál come in a range of qualities and threads counts. These cloths were legally regulated in Iceland from ca. 11th to 17th centuries (Hayeur Smith 2011a:2).

Figure 2.26. Pieces of roving found at the Gásir trading site, area A (Hayeur Smith 2011 in Vésteinsson et al 2011b, © Hayer Smith/FSI).

Rather than a sizeable collection of vaðmál fragments as recovered from Area B, Area A produced a higher number of pieces of roving. Roving is the name for the strands of twisted wool found in the trading site, potentially serving as indicators of possible measuring standards that might have been used in place of scales (Hayeur Smith 2011a:2-3). This could then provide one explanation for why only two lead weights have been found from the trading sites, indicative of the use of scales (Pálsdóttir & Roberts 2006).

Figure 2.27. Vaðmál fragment from Möðruvellir, context [122] (find number 67, fragment 0037a). Left picture shows magnified view, right picture gives indication of size (pictures: © Hayeur Smith 2011b:14).

In the Möðruvellir textile report, Hayeur Smith writes that nearly all the woven textiles (88 %; or 71 out of 81) are vaðmál fragments and that Möðruvellir contains a considerably higher number of vaðmál than Gásir, with little roving found at Möðruvellir. According to Hayeur Smith, a large amount of Möðruvellir vaðmál fragments seem to have been of relatively fine make (i.e. cloth in figure 2.27 above) and were processed into clothing and household items after having been taken out of circulation as currency items. The fragments found at Möðruvellir were likely sewing scraps that had been disposed of (Hayeur Smith, 2011b:4).

2.5.1.1.2. Luxury Exports

2.5.1.1.2.1. Gyrfalcon

Two Gyrfalcon (*Falco rusticolus*) elements from two different cultural deposits were found in Area A (context 756 and 1632); these were two different birds that likely perished during transport. There is no secure evidence for use of Falcons for hunting in Iceland; but there is good documentation that these birds of prey were exported as hunting birds of highest (royal status) rank in high medieval falconry (Þordarson 1957, Wood 1969, Haskins 1922, Forsyth 1944, Baasch 1889, Harrison et al 2008).

2.5.1.1.2.2. Walrus Tusk

One artifact found during archaeofaunal analysis was a walrus tusk fragment (context 101), likely brought to site already extracted from the maxilla, since there is no evidence of butchered remains of the post cranial or typically present maxillary debris from tusk extraction activity as is typical for Greenlandic collections (McGovern 1985). It was however very likely still unworked when brought to site (McGovern, personal communication, May 2004). This worked ivory tusk could have been an export item and is certainly also an indication for on-site craft working.

2.5.1.2. Imports

2.5.1.2.1. Lap dogs

As discussed in Chapter 4, small "lap" dogs were status items in high medieval Europe (Prilloff 2000) and have been found in other late medieval Icelandic archaeofauna, in monastic contexts (Pálsdóttir 2005) and at the medieval trading station at Kolkuós which was connected to the northern bishop's see at Hólar (R. Traustadóttir, pers. comm. 2004). Visiting traders (and perhaps a few Icelandic aristocrats) made fashion statements with these imported lap dogs, but apparently they never replaced the larger more utilitarian sheep herding breed of the Viking age. What is really interesting is that the layers from the midden excavation at the Oddstaðir farm site in the Gásir Hinterlands area that are contemporaneous with the Gásir faunal remains revealed a skull of a lap-dog sized animal and this may have been an expression of style and status there.

The picture below is from the 15th c. and was painted by van Eyck. The small dog shown here is maybe typical as a pet for medieval aristocracy, women and men. This Italian merchant called Arnolfini and his wife lived in Bruges, the painting was made in 1434 (http://www.nationalgallery.org.uk/paintings/jan-van-eyck-the-arnolfini-portrait).

Figure 2.28. The Arnolfini wedding by painter Jan van Eyck, showing a wealthy merchant couple and their little dog (http://www.ibiblio.org/wm/paint/auth/eyck/arnolfini/arnolfini.jpg, © Nicolas Pioch).

2.5.1.2.2. Food and Drink related items

2.5.1.2.2.1. Pottery

The pottery fragments found at Gásir are few in number, yet still relatively plentiful for excavated medieval Icelandic contexts. All of them are imported and of diverse make, likely status indicators brought out for special reasons. The more usual food and drink implements were likely made from horn or wood and did not survive in the archaeological record. A good number of cattle horn cores were however recovered from Gásir and may be used as indicators for horn working, possibly for drinking vessels (see Chapter 4).

The total number of pottery fragments recovered from Gasir between 2002 and 2006 is 89 (Brorsson in Roberts et al 2009:5), and just for reference: In 2003, the total Gásir assemblage of 19 shards made up more than 16 % of all the 30 pottery fragments found in all of Icelandic contexts from 13th and 14th c. (Mehler in Roberts et al 2002:57). The pottery fragments from Gásir were very typical of medieval North Sea/North Atlantic wares (i.e. East Anglian green glazed redware form of Grimston style, Rhenish Siegburg ware (Mehler in Roberts 2004, Brorsson in Roberts 2009). The vessels found at Gásir were mostly drinking vessels and beakers, most likely utilized for beer and wine consumption. No pottery remains representing cooking vessels have been identified from Gásir, Möðruvellir, or any other medieval Icelandic farm site (Gísladóttir et al forthcoming).

The Gásir pottery is definitely an indicator for contact with Norway, and according to Brorsson, Bryggen in Bergen would be a good comparative site to Gásir in terms of its pottery assemblage. The variety of Grimston ware found at Gásir dates to ca. mid-13th to mid-14th c. (Brorsson in Roberts et al 2009:5-15).

Siegburg Ware: The Hanseatic League was the principle agent for trading German Stoneware to the Nordic countries. The Foundation of the German Wharf at Bergen happened in 1343 and the Hanse merchants were controlling trade to Scandinavia and the Baltic region during the 14^{th} and 16^{th} centuries (Brorsson in Roberts et al 2009:5-15).

The most interesting and exotic piece of pottery from Gásir is a piece of Majolica, likely made in Spain. It was likely an Albarello (a jar) and finding this kind of pottery in Iceland can be seen as part of luxury exchange, according to the pottery specialist. This piece of majolica is of a type made in late 13th and early 14th c in Spain (Brorsson in Roberts et al 2009:5-15).

Figure 2.29. Spanish Majolica, likely an Albarello, form the 13^{th} and early 14^{th} c. (Brorsson in Roberts et al 2009:5-15, © Brorsson/FSI).

Brorsson's conclusion is that the composition of the Gásir ceramics suggests that the jugs were either bought in Norway or brought from Norway by a merchant. The vessels were by no means cheap products and the high portable cost would have meant these were high in status in many contexts (Brorsson in Roberts et al 2009:5-15). The fact that both continental glazed Redware and English Grimston ware found in one place (at Gásir) is very remarkable, as suggested by Brorsson, as the latter are rarely found those northerly latitudes The few pieces of Grimston ware that have been found to date were recovered from mainly the Norwegian North Sea Coast. None of the pottery vessels recovered from Gásir indicate use for cooking but instead for consuming liquids, likely wine or beer (Mehler 2003; also Brorsson 2009). .

A good amount of hammered copper-alloy sheets that could have been remnants from cooking vessels were recovered from the Möðruvellir medieval contexts as well as from those at Gásir. The finds specialist suggests that these vessels - if they were very large vessels - were very valuable, even worth as much as a rowboat (Gísladóttir et al forthcoming).

There were 4 crucible fragments found at Gásir; it is not known whether they were made from stone or ceramics.

2.5.1.2.2.2. Baking Plates

During the Middle Ages, Norwegian baking stones were imported to Iceland, especially Gásir, whose 58 baking plate fragments make out almost 1/3^rd^ of the total Icelandic assemblage. These Norwegian baking stones go with the tradition of baking unleavened flatbread as was done in Norway, Northern Sweden, Shetland Isles, Faroes, and Iceland. In southern Sweden and Denmark, however, baking ovens and leavened bread were introduced relatively early (Gísladóttir & Snæsdóttir 2011:68). It seems then that this large amount of Norwegian baking plates found at 14^th^ c. Gásir is a distinct indication for some Norwegian cooking fashion likely adopted at least by the people who had access to imported grains and it would not be surprising if these grains were mostly accessible to the local aristocracy, either for consumption of flat, hard bread or porridge.

It is also possible that grain was ground at Gásir (Gísladóttir & Snæsdóttir 2011:68), and that not only bread was made at Gásir, but also grain in form of beer imported as luxury import good as well as wine for the parish churches (i.e. Vésteinsson et al 2011a). However, no quern stones have been retrieved from the site so far.

While the barley and possibly oats could have been grown in Iceland, the invertebrate specialist's analysis discussed below suggests that the beetles found as proxy indicators for grain storage/presence from Gásir needed to live in a climate warmer than that anywhere in Iceland. Therefore, the grain stored/present at Gásir came from places with a warmer climate where these grain beetles infiltrated the grains that were then transported to Iceland.

2.5.1.2.3. Grain

So far, the only evidence for imported grains was produced from archaeoentomological analysis. The archaeoentomological analysis indicates the presence of insects specific to environments containing stored grain. Since the beetles need relatively warm temperatures to breed, it is most reasonable to suggest they came into the country with imported grain. These beetles are quite rare in Icelandic excavations, but some were found in high status sites such as Bessastadir and Reykholt; in both cases, the contexts containing those beetles were dated later than those from Gásir (Konráðsdóttir 2010:60 in Roberts et al 2010).[2]

The baking plates mentioned above suggest that grain may have been used for baking bread at Gásir, and the grain beetles are most likely indication for grain arriving at Gásir from abroad rather than from domestic sources.

[2] Also from this report, we learn that dung beetles were present, indicating live animals on site (Konráðsdóttir 2010:60).

2.5.1.2.4. Tools and Equipment

A total amount of 48 whetstones were recovered at Gásir, five of those were found in the church or churchyard. Close to 80% of these tools were made from Eidsborg schist material from the Telemark region in Norway (Sigrid Cecilie Juel Hansen in Roberts et al 2010:75).

A number of unused blocks of schist were found which could indicate on-site working of the whetstone raw material, likely to get more usable shapes and sizes. This then is a sign for on-site stone working taking place, in preparation of a trade item for sale. .A further indication for this on-site activity is the fact that small fragments or cut-offs were found in addition to the larger whetstone blocks (Sigrid Cecilie Juel Hansen in Roberts et al 2010:78-79).

The iron assemblage at Gásir was the largest finds category, the large majority of which were nails and roves. Even materials that had originally been analyzed as iron working slags turned out to be mostly iron nails (Guðmundsdóttir Beck, 2011:3).

2.5.1.3. Bone and Horn Craft working

Several large whale bones and a quite substantial number of cattle horn-cores with cut marks are indicators for on-site craft working activities, such as horn craft working (Harrison et al 2008). See further discussion on this issue in the Gásir data chapter (CH 4).

2.5.1.4. Metal Working

The Gásir excavation revealed a total of four coarsely fired crucibles (Mehler in Roberts 2004:61, initial count of two crucibles in 2004), indicating on-site smelting or at least high burning temperatures. One ceramic crucible was also found at Skuggi (Gísladóttir in Harrison et al 2010).

2.5.2. *Möðruvellir artifacts from medieval deposits, Phase I and II*

The Möðruvellir artifacts were analyzed according to occupation phases (Gísladóttir et al forthcoming). In Phase I, dated to ca. mid-13th to early 14th c., the majority of artifacts retrieved (Trench 1 at Möðruvellir) were textiles. In Phase II, dated to ca. early 14th – early 15th c., about 21 % of the finds were textiles. This phase contained much more fuel ash slag, materials from cleaning out of fireplaces, than the earlier medieval phase. It seems that during the later phase, these materials were discarded on the midden rather than elsewhere as had been done earlier (Gísladóttir et al forthcoming). Alternatively, the presences of large amounts of fuel ash slag in Phase II could simply signify a shift in activity foci (O. Vésteinsson, personal communication October 2012).

2.5.2.1. Tools and utilitarian objects

Some iron nails were found at Möðruvellir, and they were similar to the type of nails found at Gásir (Gísladóttir et al forthcoming). In phase II, there were several hammered copper-alloy sheets found, likely from cooking vessels. Phase II deposits produced one worked bone needle which is similar to one of Bryggen type present before 1170-1332 AD (Gísladóttir et al forthcoming). The latter again is an indication for Norwegian influence, this time at Möðruvellir. Only one whetstone of Eidsborg schist type was found in Phase II, as well as one obsidian flake and several manuports.

2.5.2.2. Craft Work

No obvious indication for iron or metal craft working could be found among the Möðruvellir Midden contents. A great amount of fuel ash slag, but no iron/industrial slag was found, suggesting that iron objects were imported at Möðruvellir, and/or metals were worked elsewhere on the site (Gísladóttir et al forthcoming). Among the Phase II iron finds, only a tong was of interest or could be assigned to specific use.

2.5.3. *The Oddstaðir artifacts*

Fragments of copper-alloy, stones which were mostly manuports, one spindle whorl, bone, glass beads, one perforated rib of a medium sized mammal, a small decayed piece of bone with green color (probably patina) on one side were collected from the Oddstaðir midden trench. Two organic fragments, one a piece of leather, the other made from wood, still await analysis (Gísladóttir 2010:62).

2.5.3.1. Decorative objects

Two glass beads and one sand stone bead (likely of Icelandic origin) were found in the midden trench. The glass beads and one stone spindle whorl are all artifacts typically found in Viking age and early medieval assemblages. None of the other Oddstaðir finds add information useful for site chronology (Hreiðarsdóttir, and Gísladóttir 2010 in Harrison et al 2010).

Oddstaðir bead, Odo2009-026 was most likely made at the turn of the tenth century or a bit later during the 900s. It was most likely produced in the eastern Mediterranean. This type of bead was not found in Iceland before (Hreiðarsdóttir 2010:43-48 in Harrison et al 2010).

Figure 2.30. Glass bead, find number 026, context [140], Oddstaðir midden Phase II (Hreiðarsdóttir in Harrison et al 2010, © Hreiðarsdóttir/FSI).

Again, the two glass beads indicate Viking Age dates (contexts 140 and 161). The stone bead (context 134) and a spindle whorl (122) also suggest Viking Age and early medieval dates (Gísladóttir 2010:64 in Harrison et al 2010).

If one can call a dog a decorative object, then one ought to include the Oddstaðir skeletal remains of a small-sized individual found in context 108 (Phase V, late 13th - late 14th c.), which was likely lap dog. The fact that there was only one example found at this site does not allow any suggestion on the farmers' or estate owners' attitudes towards this small individual.

Figure 2.31. Oddstaðir canine maxilla from context [108] on top, compared to polar fox maxilla from Hrísheimar in Mývatnssveit.

Similar to the specimens found at Gásir, this dog suggests a connection to an idea of dogs as pets rather than working animals, maybe after a fashion from Europe as indicated in the 15th c. picture by Jan van Eyck above?

2.5.3.2. Tools and utilitarian objects

The copper alloy artifacts are indeterminate thin copper sheets, possibly vessel fragments. Some of them are riveted together. One find (finds number 007) is a sheet with textile attached to it that remains unanalyzed, and one piece (find 050), a dome headed mount with broken iron fastening, typical for centuries in Iceland, from the Viking Age onwards (Gísladóttir 2010:62).

2.5.3.3. Craft Work

Small amounts of metal working waste and distorted nails, roves, a hook, one complete awl and objects of indeterminable function make iron the largest material group or finds category represented in trench 1 at Oddstadir. The shape of the iron awl is suggested to be typical for leatherworking (Gísladóttir 2010:63). The Oddstaðir artifacts are not indicative of site status.

2.5.4. *The Skuggi artifacts*

The 2008-09 Skuggi midden excavations produced artifacts that were not diagnostic beyond signifying general Viking Age and early medieval finds. The contexts containing them could be dated through Radiocarbon and Tephrochonology dating methods.

2.5.4.1. Decorative objects

Two imported Viking-Age style glass beads (contexts [038, 051], one badly eroded glass bead [038], and one bead made from likely local sandstone were of decorative nature (Hreiðarsdóttir 2010:43), and can be dated to ca. AD 950-1050 or earlier.

Figure 2.32. Glass bead, find number 062, context [051], Skuggi midden Phase II (Hreiðarsdóttir in Harrison et al 2010, © Hreiðardsdóttir/FSI).

2.5.4.2. Tools and utilitarian objects

Other finds retrieved from that site so far were every day necessities: tools and iron smelting debris. Slag and then iron artifact fragments (knives, nails, and possible fittings) make up the largest number of finds from the Skuggi Midden Trench. One unidentified coppe-alloy piece, manuports, whetstones, two pins from bone and a few other artifacts largely complete the array of finds materials from Skuggi. A few leather and textile fragments were likely clothing and are to be analyzed.

The three well preserved whetstones recovered from the trench are all from the Norwegian region of Telemark (Hansen 2010:56-57). Their contexts date them to the mid-10th - mid-11th c. (Phases II and III).

2.5.4.3. Craft Work

One artifact, a possible crucible fragment was found in context (018), Phase III, and dated to ca. AD1050. This ceramic crucible fragment may have been used for fine metal working and is a quite rare find in Iceland. There was a large quantity of charcoal found in the lower midden layers; together with the crucible fragment, these materials could be viewed as indicators for on-site metal working (Harrison 2010, Church 2006).

2.6. Conclusion

The goal of this chapter was to present the general socio-economic conditions in Iceland in the 13th and 14th c. and to introduce the sites discussed in this dissertation. Especially Gásir and its international aspects were discussed with reference to the Norwegian Kingdom or North Atlantic power realm and also the period of the Age of Sturlungs, leading up to Icelandic submission to Norway in 1264. While it was relevant to stress how Gásir could be understood as a site frequented by foreign merchants, goods, and information, it was equally important to explain how the monastic estate at Möðruvellir with its enormous landholdings in the Gásir Hinterlands Region may have been one of the instrumental actors in the organization of this international exchange. Möðruvellir likely had enough social and political power to regulate the surplus production of the Hörgárdalur farms that would then be used for export bulk items, i.e. sheep wool in exchange for imported grains, and whetstones, as well as baking plates from Norway. The luxury exports of Gyrfalcons aimed at the European courts could have been equated with the import of lap dogs for the Eyjafjörður elite families. Since one of those individuals was found at the non-elite site at Oddstaðir, it will be important to investigate whether these dogs were also brought to Öxnhóll, or whether they signify a more commonly available imported "good". Sulphur, as well as woolen products in such typical form as vaðmál at Möðruvellir and the Gásir Church Area was likely part of the local and international exchange. Vaðmál fragments found at the Gásir Church Site were of distinctly less uniform quality than those recovered from the Möðruvellir midden excavation. Textiles recovered from the Gásir Trading Area were much more abundant in unwoven forms of twisted strands, called roving, and potentially in use as measuring units (Hayeur Smith 2011). The still 'invisible' stockfish is yet to be detected in Eyjafjörður, but all the above could have been some of the reasons why foreign merchants were interested in coming back to this remote part of the North Atlantic Territories. These goods, including the more exclusive export items such as the gyrfalcons and possibly walrus ivory products could be among the reasons why the Norwegian King wanted Iceland as part of his 13th c. North Atlantic Territory.

As the zooarchaeological data from the above mentioned sites will show, Möðruvellir may have not only controlled the concentration of the more invisible sheep wool at Gásir, but also potentially the food supply with prime age beef and mutton. It could have at least partially fed its guests, the foreign merchants overwintering and negotiating large-scale trade at the monastic estate, from its own farm, but surely the subsidiary farms (as Oddstaðir might have been) needed to contribute meat cuts to the Gásir visitors during the summer, when Gásir may have been quite busy at times, and some trade was happening on site. The cattle and sheep/goat prime age and quality meat cuts, together with the pottery vessels discussed above, could serve as indication for the treatment the merchants were given when their ships landed at Gásir, even if only for one day of the year. Alternatively, these pottery vessels could have been the merchants' private property and might have been used for attracting and entertaining prospective customers (O. Vésteinsson, personal communication October 2012).

Chapter 3. **Environmental Background**

3.1. Introduction

One major aspect of the study of human eco-dynamics is the relationship between landscape change and demographic changes; another question is the response of humans to changing climatic conditions (i.e. Streeter & Dugmore 2013, Dugmore et al 2012, Walker and Salt 2006, Crumley 1994).

This chapter will move from a general background on Iceland's natural history, environment and environmental change to a more specific focus on the research area, Eyjafjörður, North Iceland (see map below). General and more specific issues concerning the environment and climate of the research area will be discussed. Topics introduced are part of on-going research and therefore the author does not claim to provide complete information on all components discussed here. Rather, this chapter aims to better explain the issues and concerns involved in this research on human ecodynamics in the (sub) arctic north of Iceland. It is very important to convey the idea that for North Atlantic, and particularly northern Icelandic sedentary pastoralists, securing sufficient fodder resources for their livestock for the winter season was the main objective of the farmer´s concern (i.e. Amorosi et al 1998). The issue of available feed for livestock was a main preoccupation, and was certainly influenced by climatic changes resulting in highly varied weather patterns, especially the occasionally extreme cold snap as occurred in the mid- 13^{th} c. following a volcanic explosion in the southern hemisphere in 1258/59 (Mann et al 2012, see also temperature data and climate multi-proxy reconstructions by Mann et al 2009, and Streeter & Dugmore 2013).

This doctoral research project is aimed at a better understanding of the human impact on the local environment (and vice versa) combined with the decision making strategy involved with trans-Atlantic influences and a regional trading economy in medieval Iceland. Some aspects of environmental dynamics draw on current knowledge of Icelandic data available, but also on information gathered so far from the research area. The data will eventually be supplemented by soil Micromorphology, Tephrochronology, charcoal analysis, and potentially snow cover models, similar to those applied in Greenland (Lamplugh Comeau 2013).

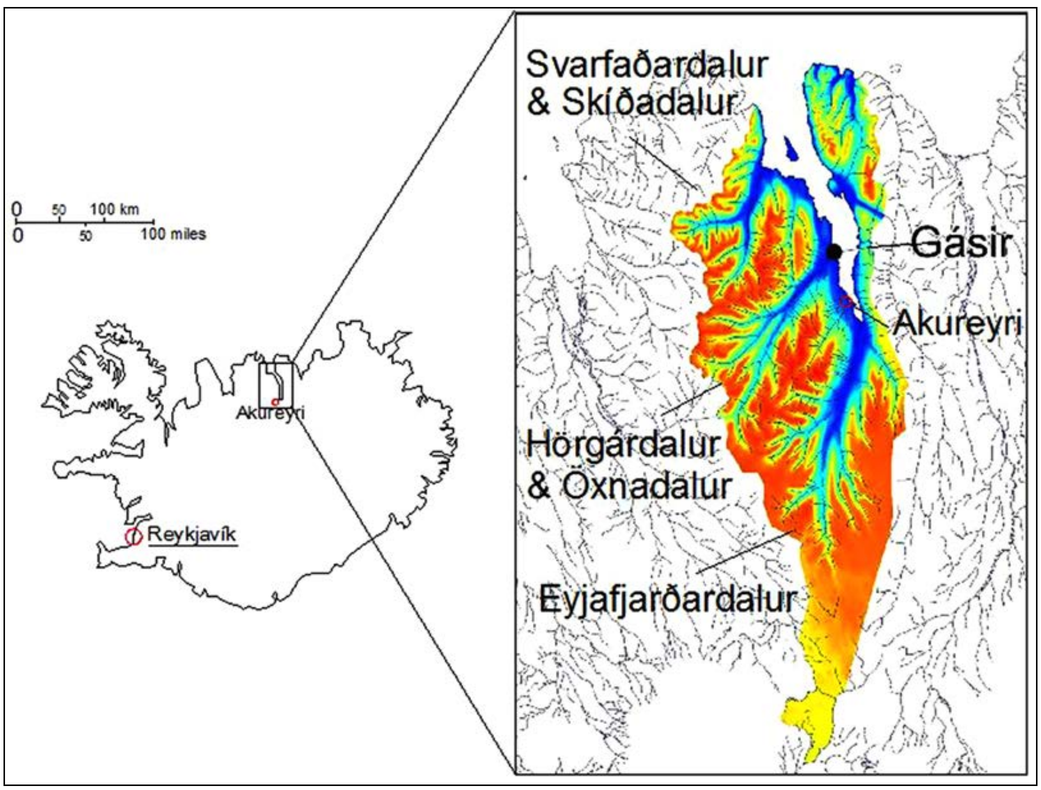


Figure 3.1. Map of Iceland with zoomed-in research region Eyjafjörður in the northeast. (Original Map on right: FSI ©; adapted by author).

3.2. General Overview of Icelandic Climate, Geology and Vegetation

This part briefly introduces Iceland's general geological, climatic, and vegetation conditions to provide an understanding for the particular research region described thereafter. The geology section further discusses soil formation and erosion processes, a topic revisited when describing the Eyjafjörður/Hörgárdalur landscapes in particular.

3.2.1. *Climate*

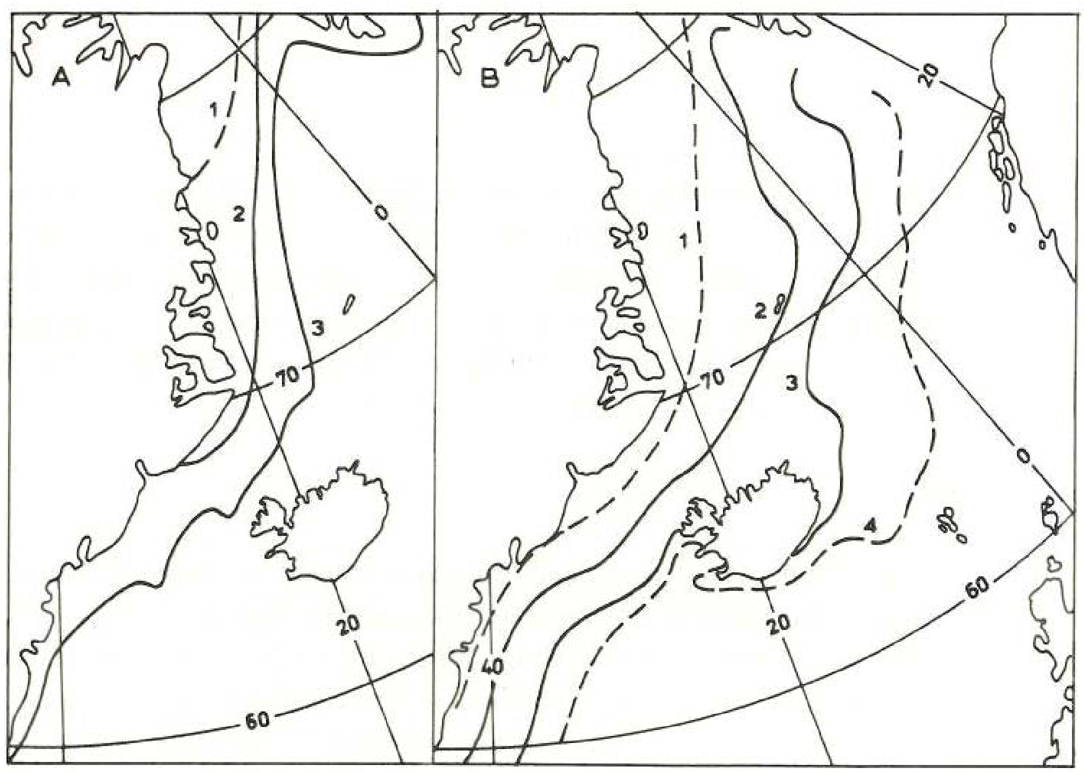


Fig. 2. A. Recent limits of sea ice in early October: *1* = minimum; *2* = normal; *3* = maximum. B. Limits of sea ice in March–May: *1* = recent minimum; *2* = recent normal; *3* = recent maximum; *4* = estimated maximum in historical times. (EYTHÓRSSON and SIGTRYGGSSON, 1971.)

Figure 3.2. Modern sea ice limits in October (left) and March (right) modelled by severity of sea ice. Map and legend from Einarsson M.Á., the Icelandic Meteorological Office. (Einarsson 1984:675).

Iceland lies close to the marine and atmospheric polar fronts: the relatively mild North Atlantic Drift flows north past the south coast of the island. The warm Irminger Current, branches off the North Atlantic Drift, and circles around the south, west, and north coasts (Einarsson 1984:675). The cold East Iceland Current is a branch of the East Greenland Current that can bring drift ice to the north and east coasts. Atmospheric circulation across the island is dominated by westerly winds and the passage of cyclones (Einarsson 1984:675). The interaction of contrasting polar and temperate ocean currents and air masses create a major climate divide between the north and south of Iceland. The latter region is a more maritime boreal environment with limited low elevation winter snow cover. The north of Iceland is characterized by more continental low arctic conditions that are markedly cooler than the south, with relatively warm summers and cold winters that include substantial, long lasting snow covers (Einarsson 1984:678). Winter drift ice brought by the East Greenland Current can occur along the coasts of northwest, north, and east Iceland during severe ice years (Einarsson 1984:675).

Coastal drift ice is related to very cold conditions at settlements such as Svalbarð in the northeast (Amorosi 1992, Woollett 2008) of Iceland. Contrasts between the north and south of Iceland are illustrated by the following data: Reykjavík, located in the country's SW, experienced a total of 115 annual mean frost days measured between 1951-1960; there were as many as 151 observed in the town of Akureyri, the capital of North Iceland (Einarsson 1984:683). A marked difference between Reykjavík and Akureyri minimum and maximum temperature means can be observed from the 1931-1960 temperature records: Reykjavík's highest maximum was 23.4°C, and its lowest minimum -17.1°C. The highest maximum for Akureyri was 28.6°C, the lowest minimum -22.1°C (Einarsson 1984:683). Restricted precipitation in the north of Iceland means that there are semi-arid areas (i.e. Mývatnssveit, east of Eyjafjörður) and highlands between Skagafjörður and Eyjafjörður are affected by limited corrie glaciation, rather than the ice caps observed in the south. Many areas are affected by extensive soil erosion (McGovern et al 2007:4-5). Despite the arctic affinities of the climate of northern Iceland, grain cultivation is possible in favored areas today, and proxy records indicate similar possibilities during medieval times (Mann et al 2009 and 2012 multi-proxy climate reconstructions below).

3.2.2. *Geology (and Soil Formation / Erosion Processes)*

Iceland lies just south of the Arctic Circle and covers an area of 103,100. About 10% of that area is currently glaciated and 23 % or 23,805 km^2 inhabited. Large areas of the island are uplands, unsuitable for cultivation due to unfavorable climate and limited soils (http://www.lmi.is/en/island-i-tolum).

Iceland is located on the Mid-Atlantic Ridge and experiences frequent volcanic activity that heavily influences soil formation (Ó. Arnalds 2005:310). The island is covered with about 23,000 km^2 of wetlands, but only 1.30 km^2 are peats (Arnalds 2005:309). Andosols are the most common soils of Iceland and because of their lack of cohesion they are vulnerable to Aeolian erosion (A. Dugmore, personal communication May 2013, see also http://www.rala.is/desert). Over the past 2000 years, soil erosion driven by a combination of natural and anthropogenic processes has caused marked losses in soil (Arnalds 2005:310).

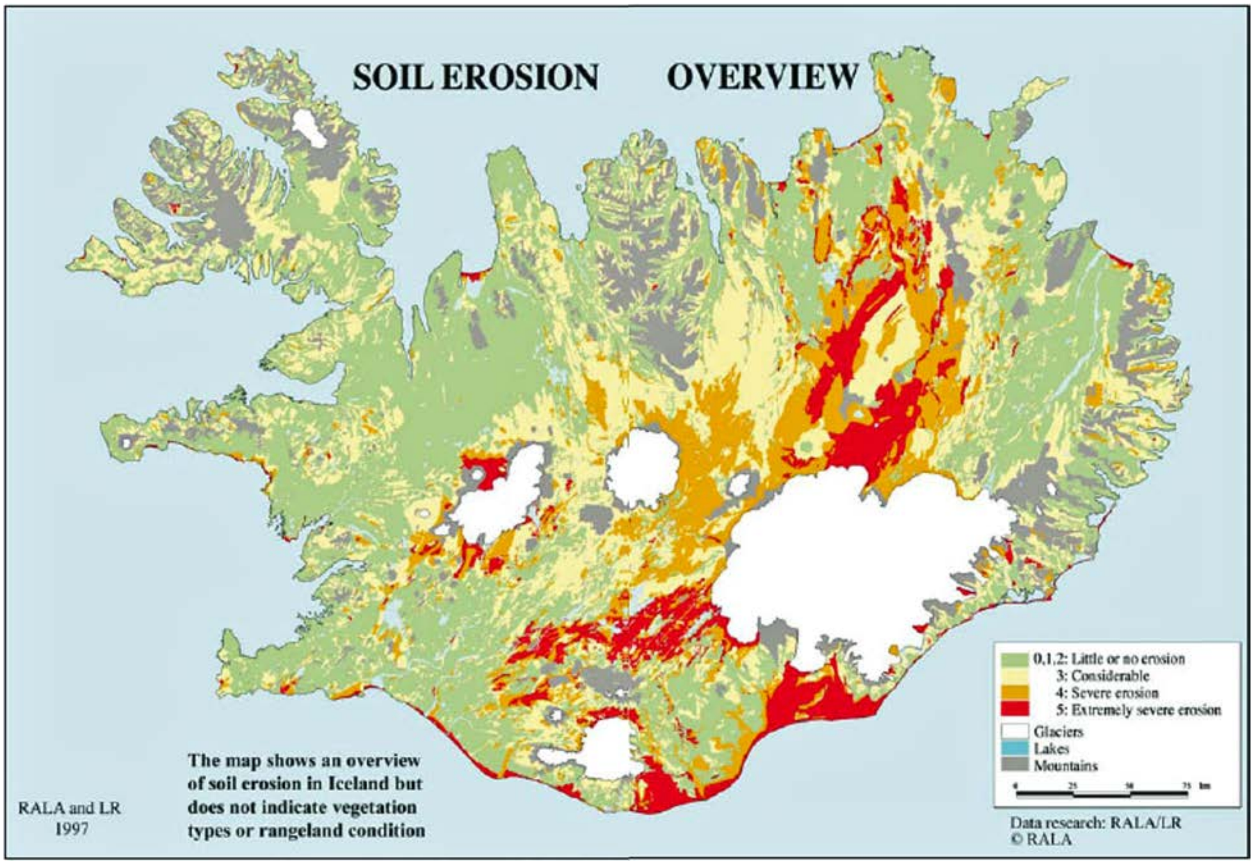


Figure 3.3. Soil erosion map by Arnalds et al 2001:50-51 (English Edition; Icelandic edition in 1997).
Legend: green: no or slight erosion; yellow: considerable erosion; orange: severe erosion; red: extremely severe erosion; white: glaciers; blue: lakes; grey: mountains. (map halves assembled by author)

The effects of cryoturbation, or freeze-thaw related processes, are visible both on the surface and in soil profiles. (Arnalds 2005:310, Kirkbride & Dugmore 2005).

Figure 3.4. Þorvaldsdalur, a ca. 20 km long valley located between Hörgárdalur and Dalvíkurbyggð , Eyjafjörður; effects of solifluction visible on plateau at foot of mountain slope.

The effects of cryoturbation result both in prominent lobes on slopes and hummocks (*Isl. Þúfur*) on more even surfaces. Soil profiles indicated that these hummocks, when encountered in the lowlands, may have developed as late as the middle ages, and in these instances are likely to be the result of both colder climate (i.e. Mann et al 2009, 2012, Dugmore et al 2000 and change in land cover (Arnalds 2005:314-15, also Lawson et al 2005). Aeolian sedimentation rates which are a good proxy indication of soil erosion, increase 4-10 times following Icelandic Settlement, and also bear testament to the effects of human land use combined with climate change (Dugmore et al 2009, Arnalds 2005:217).

3.2.3. *Vegetation*

Hallsdóttir and Caseldine (2005) blame land use by humans in Iceland over the past 1100 years for the great reduction of indigenous birch woodland that is now quite rare. Lands below 300 m asl lie within the sub-alpine vegetation zone. Above this limit and in the outermost coastal districts in the north, vegetation dominated by sub-arctic heath can be found. Today, only about 1.2 % of Iceland is woodland, some semi-natural, some plantation (Hallsdóttir and Caseldine 2005:321). Palynological research suggests that changes in vegetation (principally a marked decline in woodlands) began soon after human settlement. Woodlands seem to have disappeared from farm vicinities within one generation of initial settlement. Other species such as grass heath, dwarf-shrub heaths, and mires occupied the landscape in its place (Hallsdóttir and Caseldine 2005:329). Pollen diagrams also indicate grain cultivation up until the 16th century, including barley, oats, and also flax (Hallsdóttir and Caseldine 2005:329, Lawson et al 2005, 2007).

Bog iron extraction before the 15th and 16th c required charcoal as fuel, and this was produced from birch wood in charcoal pits (e.g. Church et al 2006). As the climate cooled, more fuel was required, driving the utilization of birch woodland, and also turf and peat (Hallsdóttir and Caseldine 2005:329, Church et al 2006). Although not very well researched, it seems the eventual result of a now more or less deforested landscape took effect more slowly in the highlands than in more densely populated areas, such as the valley floors. Recent work on geomorphology in the Mývatnssveit region in the northeast of Iceland (Casely 2006, Brown et al 2012, Simpson et al 2003, 2004, Adderley et al 2008, Lawson et al 2005, 2007, 2006) has advanced understanding of landscape change but more research is needed to create a more detailed, regional specific (eg Hörgárdalur) records of past human stewardship of the birch forests. Some parts of northern Iceland (such as the districts south of Mývatn) have experienced extensive soil erosion; in other areas patterns of soil erosion are very different. In Hörgárdalur for example the high plateau surfaces have not changed much since settlement because they are so high. Much soil has survived in the bottom lands, and even though the vegetation has changed, soil erosion locally has probably been minimal compared with Mývatn (A. Dugmore, personal communication, May 2012).

3.3. General Information on Resource and Landscape Utilization by the Settlers

When Iceland was settled in the late 800s and early 900s (Vésteinsson 1998), the lowlands were covered with birch-willow woods and lacked of land mammals, except for the arctic fox. Ducks and geese were the only indigenous grazing animals and they were migratory.

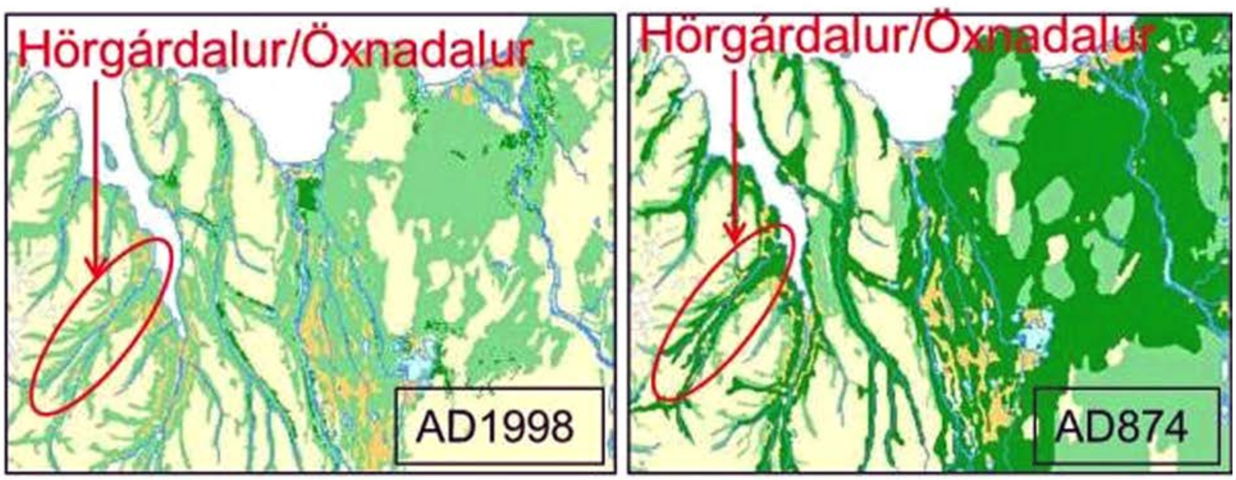


Figure 3.5. Vegetation maps of Northern Iceland, Eyjafjörður region from 1998 on the left (© Guðjónsson & Gíslason; published by the Icelandic Institute of Natural History, 1998) and 874 on the right (Einarsson & Gíslason 2001, unpublished). http://arcticportal.org/uploads/Gr/Jp/GrJpVLM_1-g4rvnk8MyDRw/KRISTINSSON-Vegetation-Maps-of-Iceland.pdf. Additions in red and dates in black by author.

The Medieval Climate Anomaly may have briefly created more favorable conditions for settlers to undertake (Mann et al 2009, 2012, Dugmore et al 2012), but by the later medieval times, only the south and west of Iceland had remained environmentally favorable for cereal cultivation. People living in the northern parts of Iceland changed from agriculture practiced in the Norse homelands of Scandinavia and the British Isles to settled pastoralism, making it important to have access to imported grains (Guðmundsson et al, Guðmundsson 1997, Trigg et al 2009, Simpson et al 2002, 2004 2005 2009). Another important consequence of this change in later medieval temperatures (i.e. Mann et al 2009, 2012) was that grass as main fodder crop became an even more important good.

As Amorosi and others suggest, fodder production in the West North Atlantic Islands was the most important element in Norse Settlement and Subsistence (Amorosi et al 1998:45). Grass and hay comprising quite varied plant species were not the sole animal fodder resources available. Vegetarian animal fodder in form of edible parts of willow trees, sedges, green grains were used as well (Amorosi et al 1998:47). Still, the crops from pasturelands in the homefield, outfield, and upland commons constituted the most the main fodder source and also the most important aspects contributing to a farmer's assessment on how many animals to keep per certain amount of available property and pastureland productivity. Utilizing a landscape optimally, allowing for the greatest number of livestock possible to survive winters in Iceland required planning and developed into a system of utilizing various parts of the farm and communally available landscape for different purposes (Hastrup 1990:61-63, Vésteinsson 1998, Vésteinsson et al 2002, Thomson 2003, Thomson & Simpson 2006, Simpson et al 2001, 2004, 2009, Brown et al 2012).

Generally, summer grazing was associated with shielings (*sel*) which were specialized animal herding structures and operations separate from the farms, utilized for milk ewes and cows, and areas closer to the farm but outside the homefield allotted for grazing cattle. Shielings were frequently within walking distance of the farm (Hastrup 1990:62) while the interior upland and highland summer pastures used by the entire community (*afréttir*) were usually more distant from the homestead. These common pastures were regulated and the arrangements regarding summer grazing varied throughout Iceland (Simpson et al 2001, 2009, Thomson and Simpson 2006). Common lands were generally used to graze lambs and castrate male sheep (wethers) managed for wool and meat until round-up in late August or early September (Hastrup 1990:63). As climate in the later 13th-14th c. cooled and inter-annual variability increased, upland farms may have come under increasing pressure as soil erosion began to become widespread in the highland interior (Streeter & Dugmore 2013, Brown et al 2012, Dugmore et al 2007, Ólafsdóttir et al 2001, Ogilvie 1984,1991,1997, Ogilvie & Jónsson 2001)

If smaller farms were independent, later on they were likely to become subsidiaries or clients of the larger (and ecologically more favored) chieftains' farms in the lowlands (McGovern et al 1988, Vésteinsson 1998, Vésteinsson et al 2002). When allowed, freshwater trout and charr were taken from streams and lakes. Marine fish, sea birds, and marine mammal bones found on inland farms could possibly indicate the existence of interregional exchange networks potentially dating back to the Viking Age (Edvardsson 2005, Edvardsson & McGovern 2005, Amundsen et al 2005, Lawson et al 2005, McGovern et al 2006, Perdikaris & McGovern 2006, 2007, Perdikaris et al 2007, Hastrup 1990).

One reason for utilizing outfield and upland pasture lands was to keep a large part of the domestic stock as far away from the homefield and immediate farm surroundings for as long as possible. The often improved, or manured, homefield surrounding the farmstead was strictly preserved for growing winter fodder and hay making during the summer and where possible, utilized for grazing cattle and sheep during the winter During the summer, the homefield or *tún* was fenced in to keep out cattle grazed in close proximity to the farm (Hastrup 1990:62, Vésteinsson 1998:6, Thomson & Simpson 2007, Simpson et al 2009, 2001). Such enclosures seem to have fallen into disrepair in the later middle ages (O. Vésteinsson, personal communication May 2013).

3.4. The Eyjafjörður Environment

Iceland has very diverse landscapes and environments ranging from valley systems, coastal regions, and highland plateaus (i.e. Vésteinsson 1998, 2000, McGovern et al 2007). These regionally varied geological formations required specific land management and regulations. While for example in the Mývatnssveit region a great area of available pastureland existed, the valley/steep slope systems in Eyjafjörður presented an alternate situation:

3.5. Major Geographic Features

The focus study area called Hörgárdalur (figure 3.1) is situated in Eyjafjörður, northeastern Iceland. Its main water course is the Hörgá river valley (naming Hörgárdalur) which drains into Eyjafjörður about 150 km south of the Arctic Circle. The closest and larges modern town is the region´s capital called Akureyri, located circa 10 km to the SE of the outermost part Hörgárdalur, very close to the site of Gásir. Geologically, the tip of Eyjafjörður is among the oldest parts of Iceland and was created by volcanic activity more than 15 million years ago. The area containing Gásir, Hörgárdalur and Öxnadalur is between 10 and 15 million years old, and the mouth of Eyjafjörður is slightly younger at 8.5 to 10 million years of age (Ólafsson 2000). This is significant because the bedrock was created under non-glacial conditions and therefore forms a lava pile that originally had a gently rolling surface. As it is old and located towards the edge of the growing island, the land rose as the valleys were calved out. With glaciation, troughs formed and the process of uplift accelerated, creating the landscapes of dissected highland plateaus and broad, steep-sided, flat-bottomed valleys encountered by people: (Bentley & Dugmore 1998:11-15).

3.5.1. *Eyjafjörður/Hörgárdalur Geography*

This section will present a series of maps and pictures to highlight the steeply sloped valley systems encountered in this region. Much research is still necessary, and some of it has to do with map making and GIS modelling, some of which is planned for the near future. This will allow for more accurate assessment of where soil erosion, cryoturbation, solifluction, gully erosion, fan development, landslides, rock falls and climatic change have impacted the pastureland. The maps currently available can still offer a broad outlines of the relationship between the sites discussed key landscape and vegetation zones and how navigation through the valley systems was likely the most easily accomplished. The later discussions in this section will include some of the information also found in the modelling exercise appended to this Chapter for an enhanced understanding of local climate change and grazing potentials.

3.5.1.1. Relief and Steepness of Slopes

Hörgárdalur, as well the entirety of Eyjafjörður, can be described as "[…] a landscape characterized by high levels of local relief, deep u-shaped glaciated Valley [due to its old age - see above] within a high plateau region (Streeter and Dugmore 2009:2)." Much of the Eyjafjörður landscape consists of valleys that are deep, have steep slopes, and are divided by high inter-valley areas (Streeter and Dugmore 2009). These valley systems allow for limited and linear settlement patterns as land is also available in very restricted ways (Vésteinsson 2001, Streeter and Dugmore2009:2, Harrison 2010 (Skuggi)). The contour map of Eyjafjörður below indicates the quite rapid ascent of slopes once the coastal areas are left behind and the inner valleys are reached. Gásir, located at the coast, as well as Möðruvellir, whose land is situated in the coastal or estuarine zone (Vésteinsson 2001), are at sea level and therefore experience a different landscape and environment than do the upland sites Skuggi and Oddstaðir, located between 150 and 200 m asl. For alternative visualization on what altitudes sites mentioned in this doctoral thesis mentioned are located, refer to the Eyjafjörður maps below, figure 3.6 and figure 3.7.

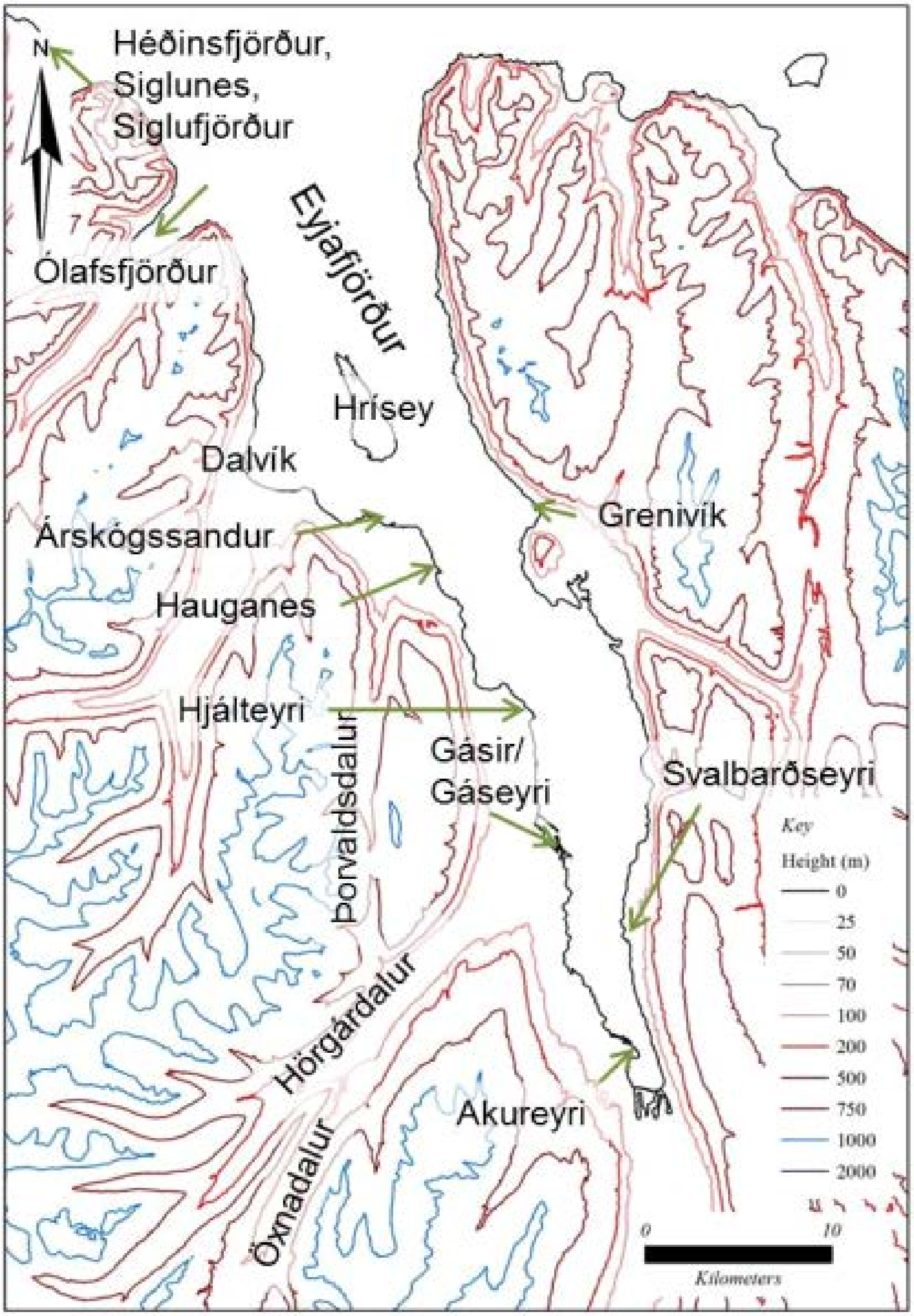


Figure 3.6. Contour map of Eyjafjörður, situating the fjord and eastern and western valley systems; not showing the outer fjords in the northwest: Héðinsfjörður and Siglufjörður at the border to Skagafjörður (source: Icelandic Archaeological Institute, Reykjavík; prepared by Oscar Aldred, 2012, © FSI; valley and place names and arrows added by the author).

3.5.1.2. Vertical Zonation

An issue closely related to the landscape elevation is landscape cover, or vertical zonation. The location of the sites in relation with the elevation above sea level and situation in a specific vegetation zone helps better understand a site's environmental conditions and also identifies potential erosion factors. As mentioned earlier in this chapter, lowland areas to about 300 m asl lie within the sub-alpine vegetation zone, and thus within the tree-line zone of ca. AD 1100 (Hallsdóttir and Caseldine 2005:321).

The Hörgárdalur contour map below indicates elevation zones and locates Skuggi and Oddstaðir well within the climatically-controlled birch tree zone, while Gásir and Möðruvellir again are located in coastal zones, the latter also in the lowland Hörgárdalur Valley bottom zone.

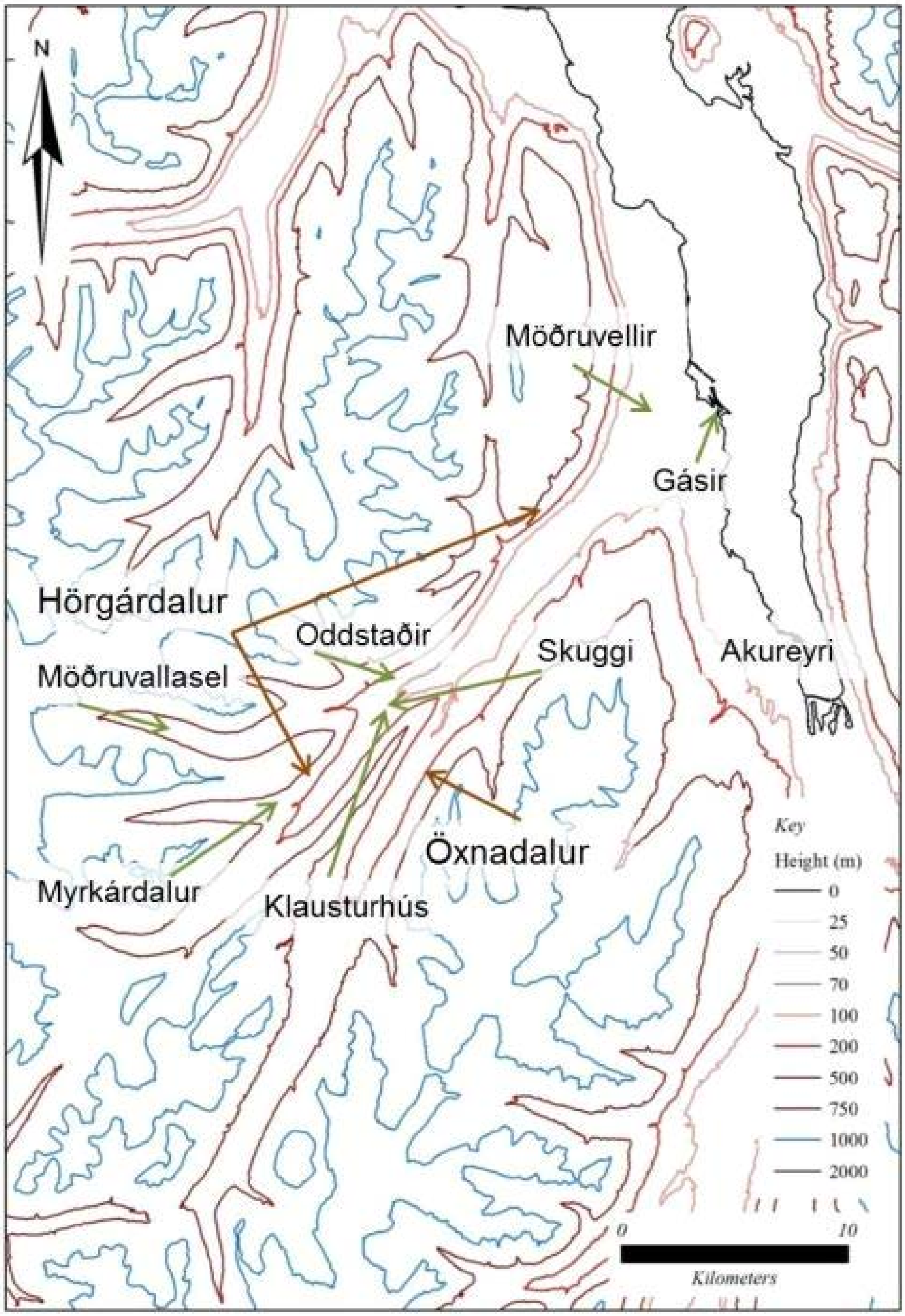


Figure 3.7. Hörgárdalur/Öxnadalur contour map (source: Icelandic Archaeological Institute, Reykjavík; prepared by Oscar Aldred, 2012, © FSI; valley and place names and arrows added by the author).

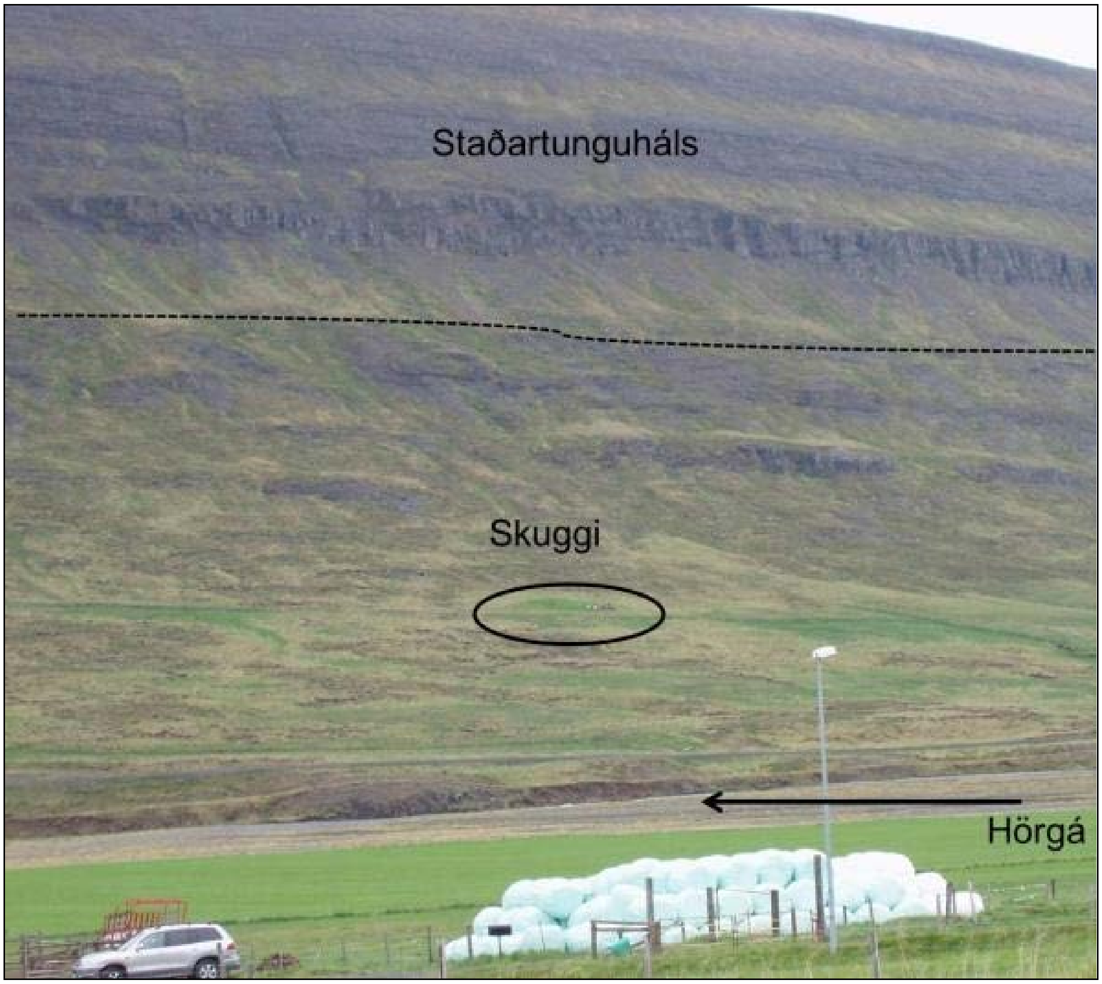


Figure 3.8. View to Skuggi from Barká, the farm neighboring Öxnhóll land and Oddstaðaá, located just west of the Oddstaðir ruins. The dotted line shows the putative tree line at the time of Settlement.

The picture above shows three different zones: the Valley bottom, where the Hörgá River makes its course through the Valley, the Barká homefield area has preserved very well, no undoubtedly manured at least during modern times; the upland area with Skuggi on it, and the highland area above it. Skuggi, located at an elevation of ca. 158 m asl, lies at the lower part of the northern Staðartunguháls slope. The other side of this mountain marks the northern slope of Öxnadalur Valley (see discussion on route ways below). There is some rich grazing land in this area below the Skuggi site, marked with an oval here; above that elevation, the sloping becomes more severe, and the grazing areas seem very sparse. According to the survey report, Skuggi (*shadow*) once was located in forested area, at least until the 18th c. (Hreiðarsdóttir et al 2008:233, Hreiðarsdóttir, personal communication, September 2010). It is likely that the tree line reached the dotted line on Fig 3.8 (added by the author), situating Skuggi well within the original birch-woodland limits. In this area, the Staðartunguháls ridge lies ca. 400 m asl.

Figure 3.9. NW and SE facing Hörgárdalur slopes. Red circle on the left indicates Oddstaðir location; red circle on the right indicates Skuggi location. According to Google.Earth (www.google.earth.com), both sites are at an elevation of 150-160 m asl, with Oddstaðir lying on a very gradually rising plateau compared to the steep slopes leading up to the top of the mountain.

Figure 3.9 shows the NW and SE facing slopes of Hörgárdalur, with the river Hörgá in the center, and camera view to ENE. The mountain visible to the left of the picture is relatively steeply sloped Lönguhlíðarfjall on the northern side of the valley, and the grey lines are indications for landslides. The Oddstaðir and Skuggi sites are marked by circles. The slope on the right side of the picture represents the southern side of the valley bounded by the mountain Staðartunguháls which divides Hörgárdalur on its northern slope from Öxnadalur on its southern slope.

3.5.1.3. Proximity to Eyjafjörður and Marine Resources

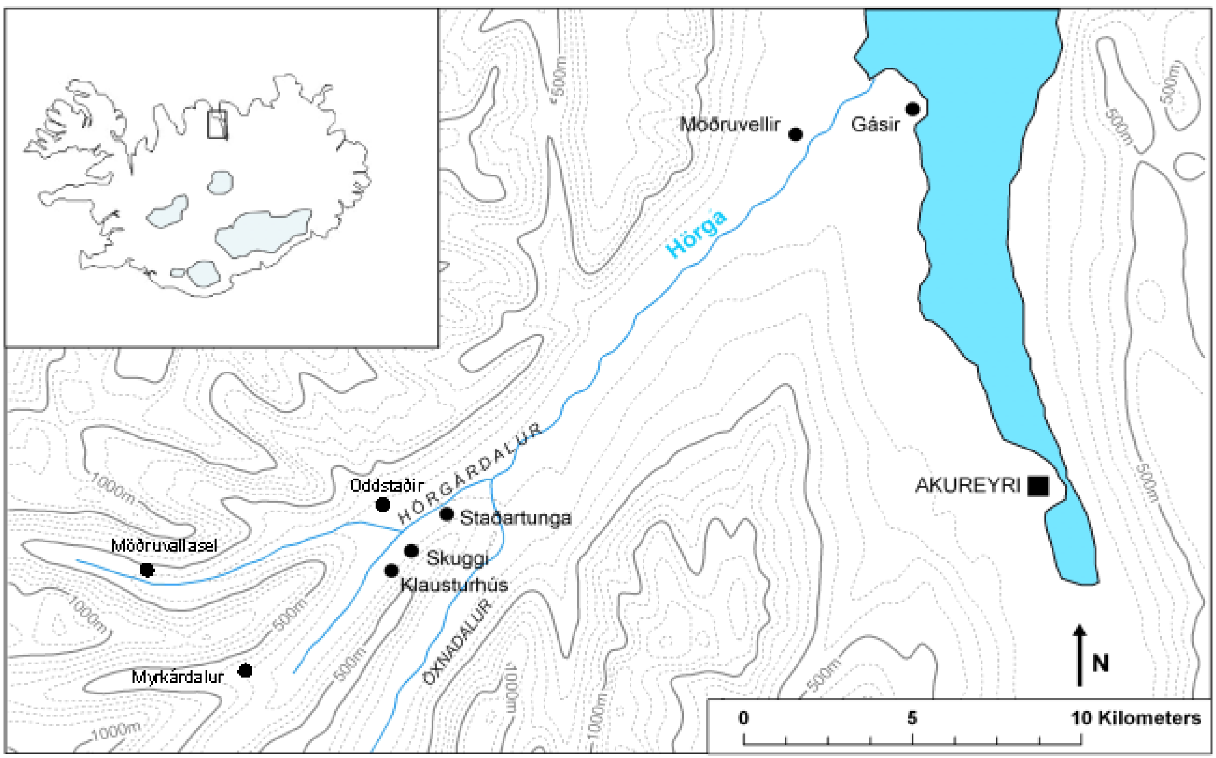


Figure 3.10. The Hörgárdalur research area. Map indicating sites investigated in Hörgárdalur and their respective proximity to the coast and the Gásir and Möðruvellir major centers (Map after Streeter in Dugmore et al 2008; sites added by author).

The Gásir trading site is located at the coast of the fjord, and is therefore a coastal site, whose archaeofauna reflects this quite clearly, although the site was famously supplied also with terrestrial food rations (see Gásir Zooarchaeology Chapter 4 for detailed discussions). Möðruvellir in Hörgárdalur also was situated very close to the sea, again mirrored in the archaeofauna, although the proportionally high amount of domesticate elements among the medieval archaeofauna, partially due to poor preservation (but see discussion in Möðruvellir Zooarchaeology Chapter 5), but also likely due to the food preferences of the medieval manor´s inhabitants.

Skuggi and Oddstaðir on the other hand are considered inland sites, situated circa 20 km removed from the fjord. This relative close proximity to the coastal areas does explain a certain amount of marine food sources on both sites (see Skuggi and Oddstaðir Zooarchaeology Chapters 6 and 7, respectively), with proportions of wild and especially marine resources found early on in Oddstaðir to decrease towards the later medieval occupation phases there. At Skuggi, the amount of wild resources including marine species increased over time. While presence of these marine species at the inland site could have been due to hunting and fishing by the Skuggi farmers themselves, it could have also been due to a local exchange of prepared cod fish filets for possibly labor or in kind that may have taken place between at least these inland valley sites and the coastal areas. The archaeofauna does not suggest at this time that whole fish filets made to either of these sites in the majority of instances.

3.5.1.4. Proximity to Open Sea/ Deep Water Resources

As mentioned above, the Hörgárdalur sites Oddstaðir and Skuggi are within 25 km distance from the fjord, from Möðruvellir, and from Gásir, and thus had easy access to fish products from the coast. The two fish species present in low numbers from these two inland sites' archaeofaunal remains were Cod (Gadus morhua) and Haddock (Melanogrammus aeglefinus). The first is a deep water whitefish species that is usually found in ocean waters at depths between 100 m and 250 m (*Hreiðar Þór Valtýsson, University of Akureyri,* http://www.fisheries.is/main-species/cod/catch-and-fishing-methods/, accessed June 30, 2012). The latter is a smaller cod relative and can be found at depths between 10 m and 200, and therefore could be caught in Eyjafjörður, especially during the warmer periods when more Haddock are found in the north of Iceland than in the south (Hreiðar Þór Valtýsson, University of Akureyri, http://www.fisheries.is/main-species/codfishes/haddock/, accessed June 30, 2012).

There were no immediate cod fishing grounds around coastal Gásir, where the fjord is relatively narrow and the water quite shallow. In the southern part of the fjord, anywhere between Akureyri and Hrísey Island, the sea is at most between 50 and 80 m deep[3], with the deepest areas east of Hrísey. Once north of Hrísey, the water becomes deeper, and the fjord eventually opens into the open ocean.

[3] *All water depth measurements from Google.Earth (accessed June 30, 2012*

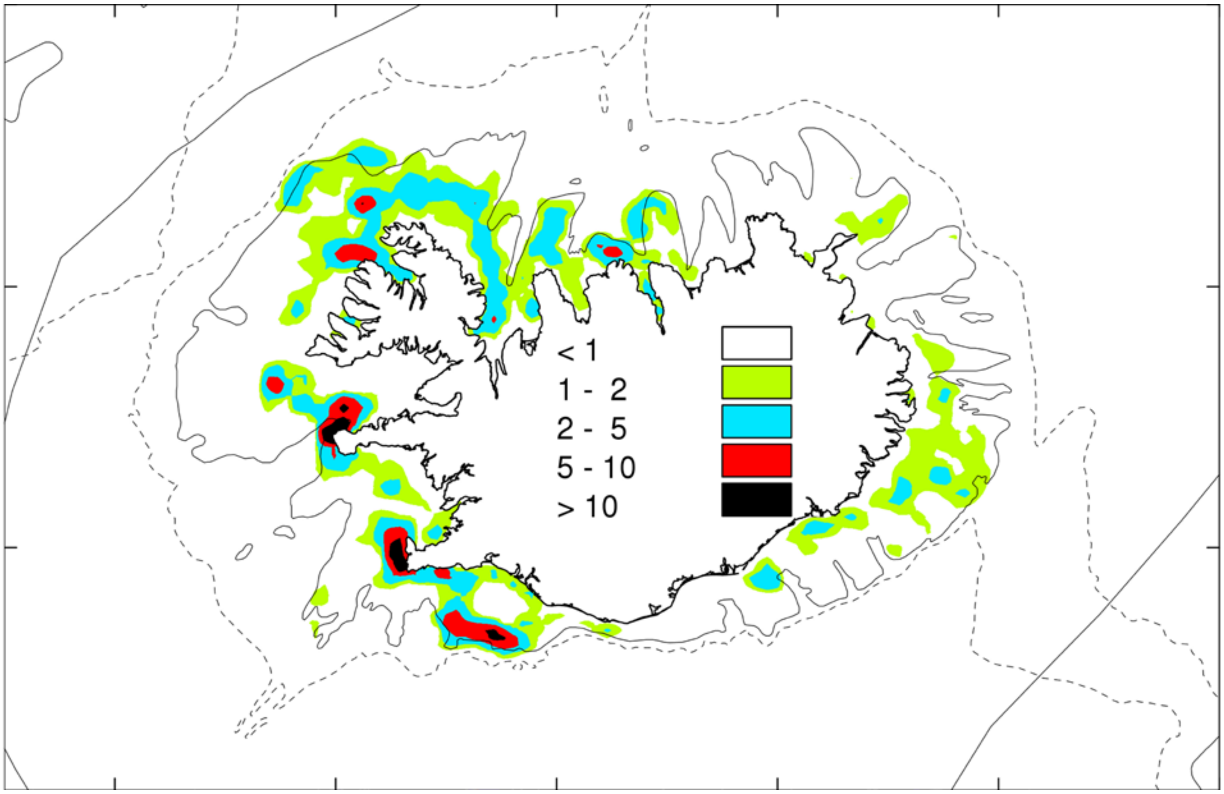


Figure 3.11. Map of Modern Haddock fishing grounds (2011). The darker colors indicate higher catches. State of marine stocks in Icelandic waters 2011/2012 and prospects for the quota year 2012/2013. Marine Research in Iceland 163. 186 pp. Available online at: http://www.hafro.is/Bokasafn/Timarit/fjolrit-163.pdf. © Marine Research Institute, Iceland.

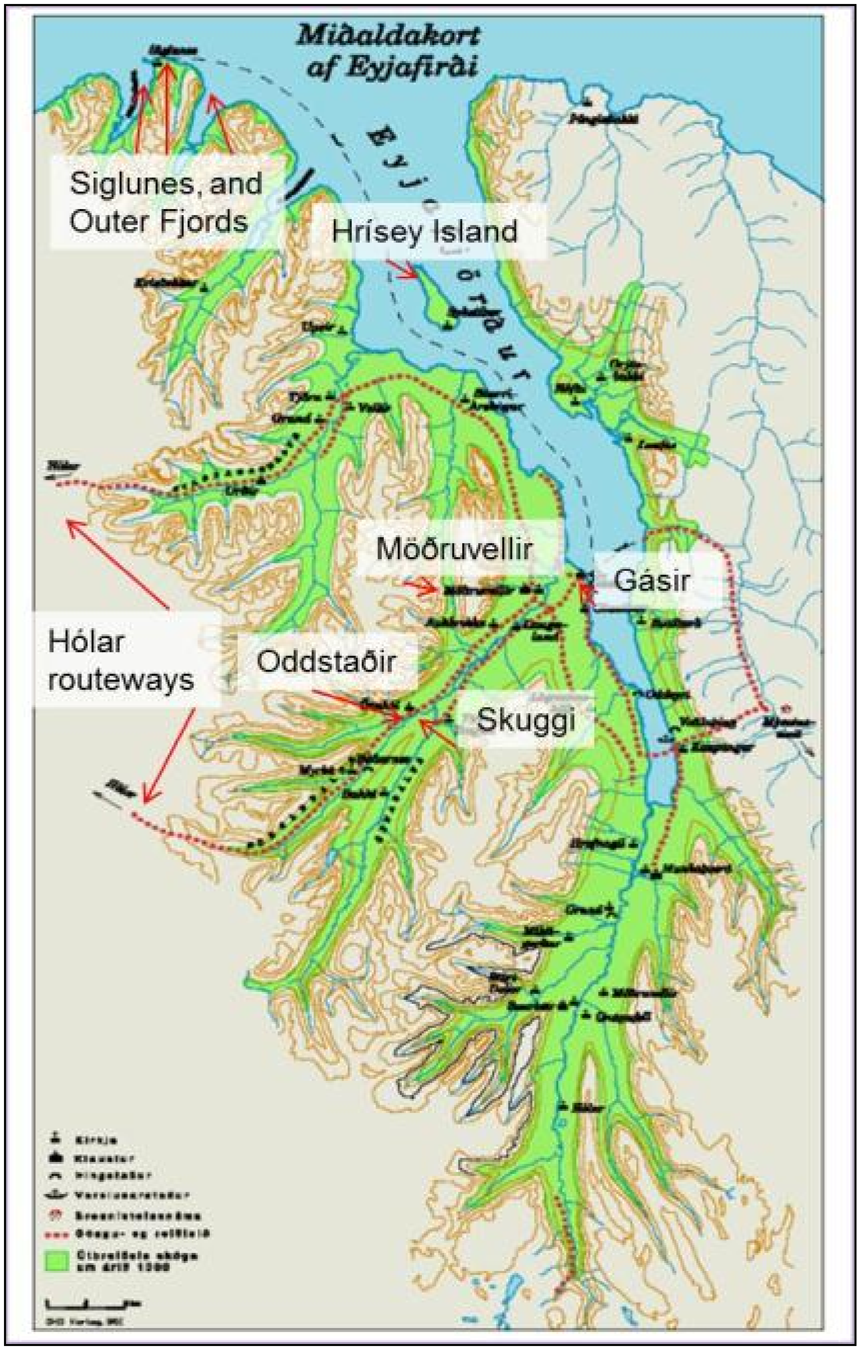


Figure 3.12. Medieval map of Eyjafjörður, locating the coastal sites Gásir and Möðruvellir (situated in several ecological zones) and the inland sites Oddstaðir and Skuggi. The outer fjords, Siglufjörður and Héðinsfjörður are indicated, with Siglunes at the northern most tip of Eyjafjörður (© Museum of Akureyri/Minjasafnið á Akureyri 2002).

At the mouth of the fjord, the water depth fluctuates between ca. 100 and 200 m, as it does at the outer fjords, Héðinsfjörður and Siglufjörður, where the water reaches a depth of 100 m and beyond within ca. 10 km of the coast. Deep water fish like the Cod (Gadus morhua) can be caught there at highest volumes in this area, although cod certainly occurs further south in the fjord.

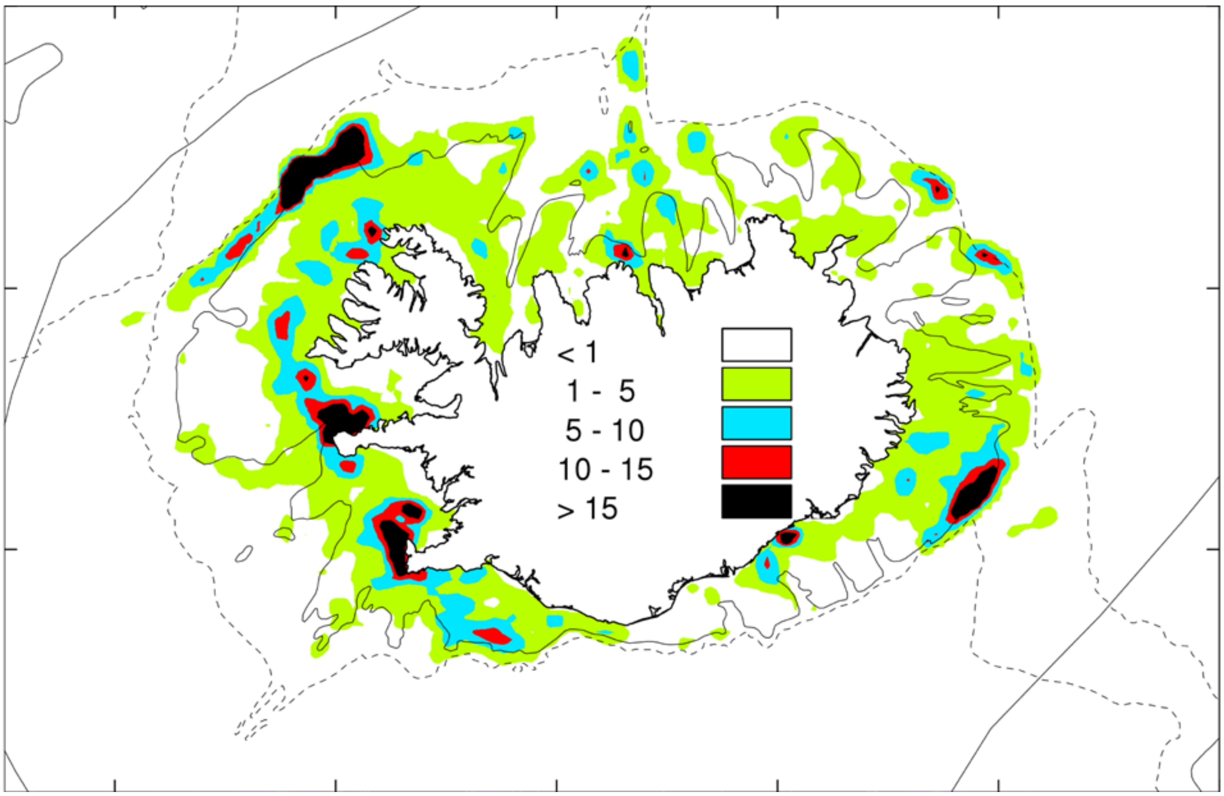


Figure 3.13. Modern Cod fishing grounds (2011). The darker colours indicate higher catches State of marine stocks in Icelandic waters 2011/2012 and prospects for the quota year 2012/2013. Marine Research in Iceland 163. 186 pp. Available online at: http://www.hafro.is/Bokasafn/Timarit/fjolrit-163.pdf. © Marine Research Institute, Iceland.

If the Oddstaðir and Skuggi farmers went fishing themselves, it is unlikely that they would have rowed on their own boats (O. Vésteinsson, personal communication, October 2012; see also Amorosi et al 1998).

Skeletal remains of seals are another marine resource found at the inland sites, at relatively high proportions at the Skuggi site (see Skuggi Zooarchaeology Chapter 6). Seals are a wild resource indigenous to Eyjafjörður; the closest access to seals could be found in the fjord where 'seal beaches' were controlled for access to these species (Kristjánsson 1989:447).

The complete absence of fresh water fish and ptarmigan in the Skuggi archaeofauna and only few ptarmigan elements but none from fresh water fish found at Oddstaðir may hint to the rank these farmers held within the local society. Likely, they were not the only potential subsidiary farmers controlled by a larger institution functioning as immediate holder such as either Staðartunga or Öxnhóll, or another larger farm close-by (Harrison 2010). The monastic estate at Möðruvellir controlled even those holder farms (if Oddstaðir was indeed a subsidiary farm) through collection of rent from these properties or potentially even run them directly as parts of the estate (O. Vésteinsson, personal communication, October 2012). The landowners who may have resided at Öxnhóll may have reserved access to Ptarmigan and fresh water fish for their own household(s), or even used received these natural resources as part of tithe payments.

3.5.1.5. Routeways

The pictures and map below (Figures 3.14 and 3.15) depict the valley and slope systems characteristic for the region: relatively high mountains are creating boundaries to narrow valley systems, and in turn create channel valley systems, where route ways are very restricted and create almost mandatory passage ways. One example is the mountain Staðartunguháls (named after Staðartunga farm), dividing Hörgárdalur and Öxnadalur. Figure 3.10 above locates Staðartunga farm, at the foot of the mountain. Skuggi is situated on the uphill slope of that same mountain, and Klausturhús at the bottom of that slope.

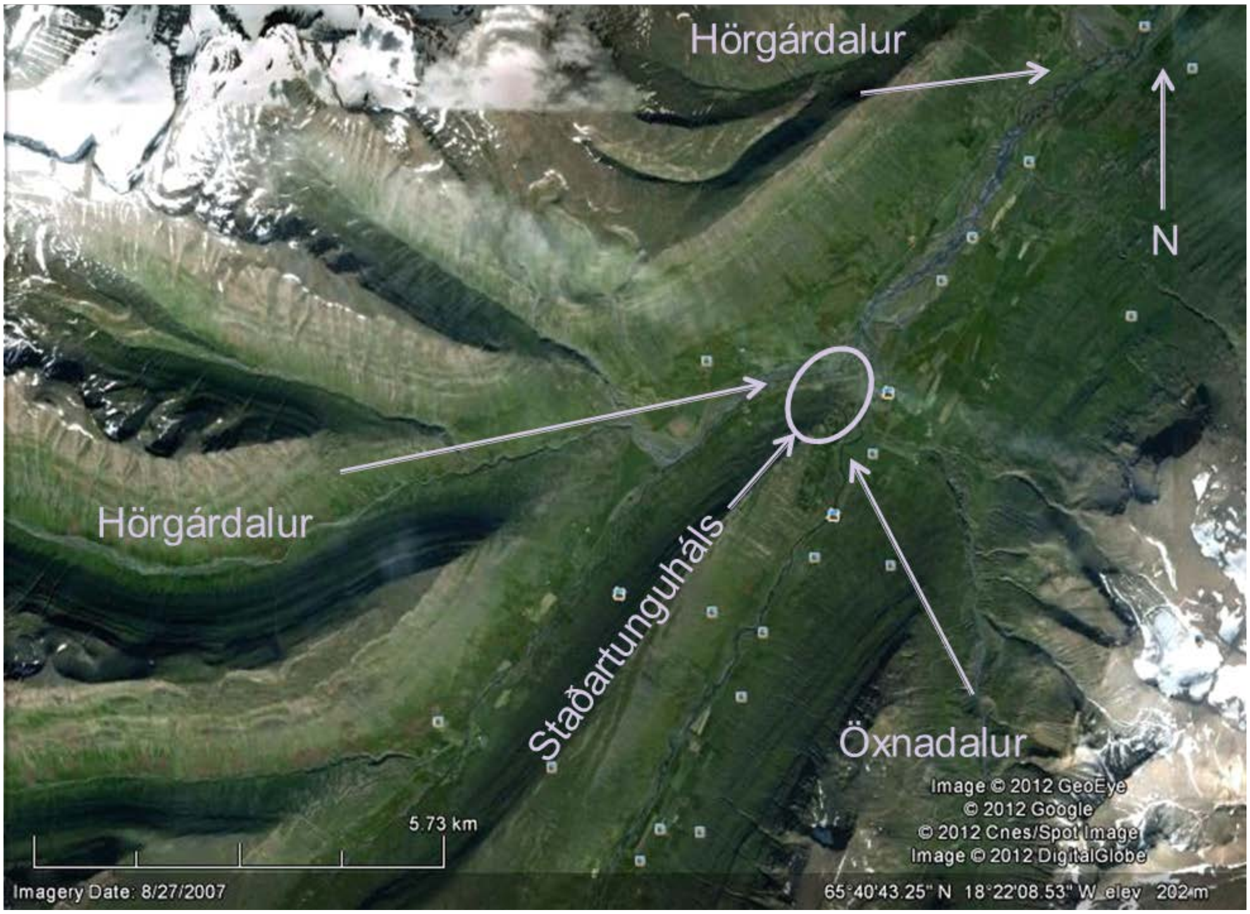


Figure 3.14. View of Hörgárdalur and part of Öxnadalur to the SW. The mountain range indicated originates in the Staðartunguháls Mountain, dividing Hörgárdalur from Öxnadalur, creating a clear passage way. Google Earth Image (© googleEarth.com, accessed 6/28/12).

3.5.1.6. Proximity to the Major Sites at Gásir, Möðruvellir and Hólar

The medieval trading site at Gásir is located at the mouth of the Hörgá, and the monastic manor at Möðruvellir is situated ca. 5 km from the coast at the juncture of the steep-sided Hörgá valley (running NE-SW) and the Eyjafjörður valley (N-S). The fact that the fjord is 60 km (37 miles) long is important, as this allowed for ocean going merchant vessels to reach an area located relatively deep in the island's otherwise hard to access interior. The Hörgá drainage forms both a natural catchment zone and many of the valley's farms were owned or controlled by the monastery (and earlier chieftain's farm) at Möðruvellir during the later middle ages, as indicated by a 1447 inventory of the Möðruvellir holdings indicates (DI IV:710). The Möðruvellir monastery was one of the largest landholders in Eyjafjörður, but did not have the extensive control over its region as for example the Hólar bishopric did over the neighboring Skagafjörður to the west. Other large farming estates, for example Skriða which is mentioned later in this chapter, were owned by chieftains or nobles during later medieval times (Á.D. Júlíusson personal communication, March 2013). Both Skuggi and Oddstaðir are within a day´s walk from Möðruvellir and the very outer edge of the Hörgá Valley and also Gásir, located where the Hörgá River drains into the fjord. There could have easily been regular social, economic, and religious exchanges between all these sites. Further, the Northern bishopric at Hólar is located just across the mountain range bordering the inner valley sites (i.e. Myrkárdalur). One way of passing through the valley was by using the path passing Oddstaðir as Staðartunguháls was creating a major natural barrier, directing travelers either along the Hörgárdalur route, or the one passing through Öxnadalur just to the south.

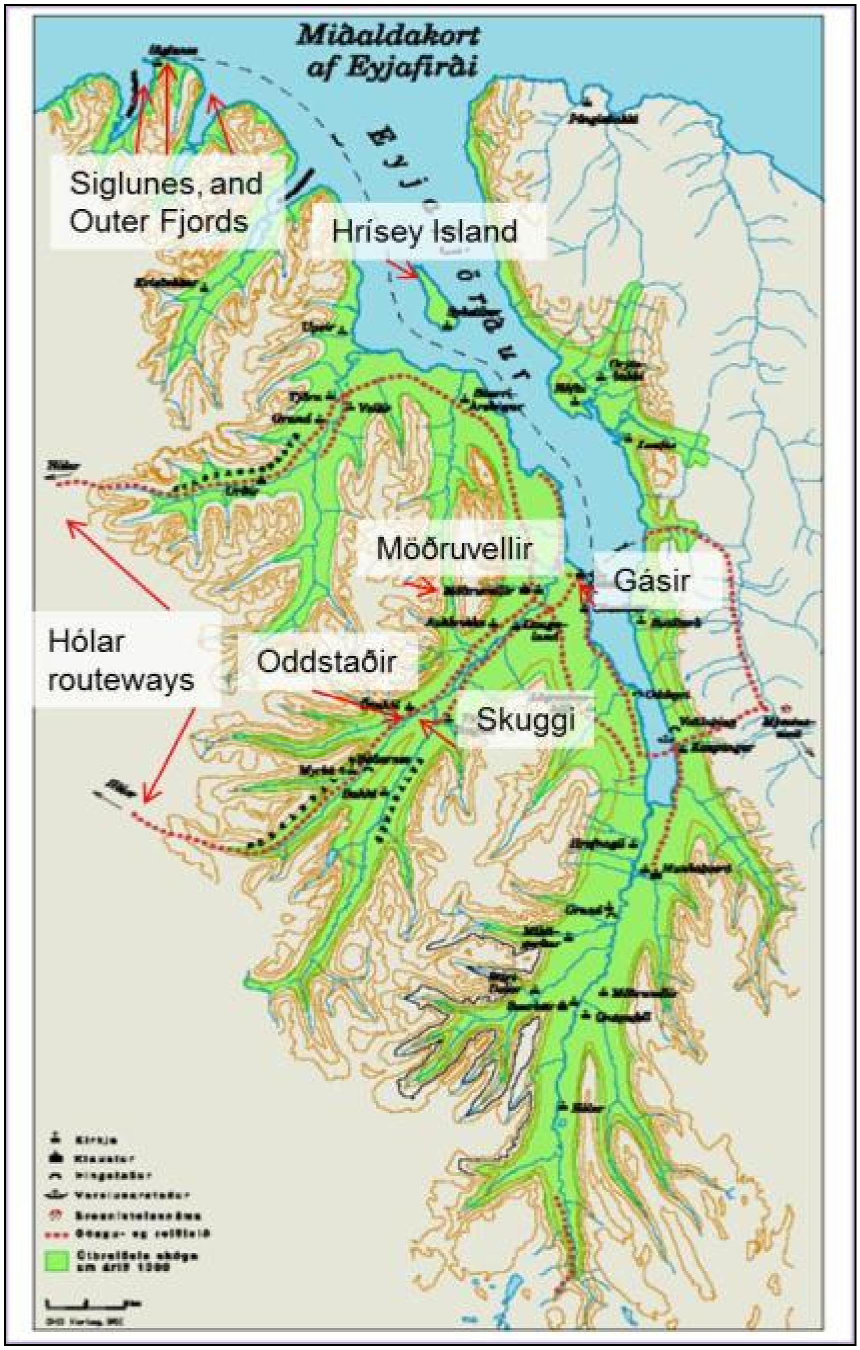


Figure 3.15. Medieval map of Eyjafjörður. The dotted lines indicate prominent/important passage (walking and riding) ways, indicating a possible pass from Hörgárdalur to Hólar in Skagafjörður. (© Museum of Akureyri/Minjasafnið á Akureyri, 2003),

The map above shows quite clearly how close the hinterlands area was to both Möðruvellir and Gásir (within c. 25 km distance to the northeast) but also to the northern bishopric at Hólar (c. 30 km to the northwest, across the mountain range from Hörgárdalur, and Hörgárdalsheiði)

3.5.2. *Vulnerabilities to Climate Change*

This section considers, some of the potential environmental vulnerabilities faced by the Hörgárdalur region as a result of land use, landscape change, and climate change manifested in fluctuating temperature patterns and severity of weather (Mann et al 2009, 2012).

The figure below (Dugmore et al. 2007) displays cumulative storminess proxy indicators derived from Meeker and Mayewski (2002). As described in the figure caption, the year 1425 represents a key change in the trajectory of cumulative annual deviations from the mean, indicating a change in the long term pattern of climate: Mean conditions shift as a new circulation pattern takes hold in the North Atlantic. This is likely to be related to a disruption in TEK or Traditional Ecological Knowledge (A. Dugmore personal communication, May 2013).

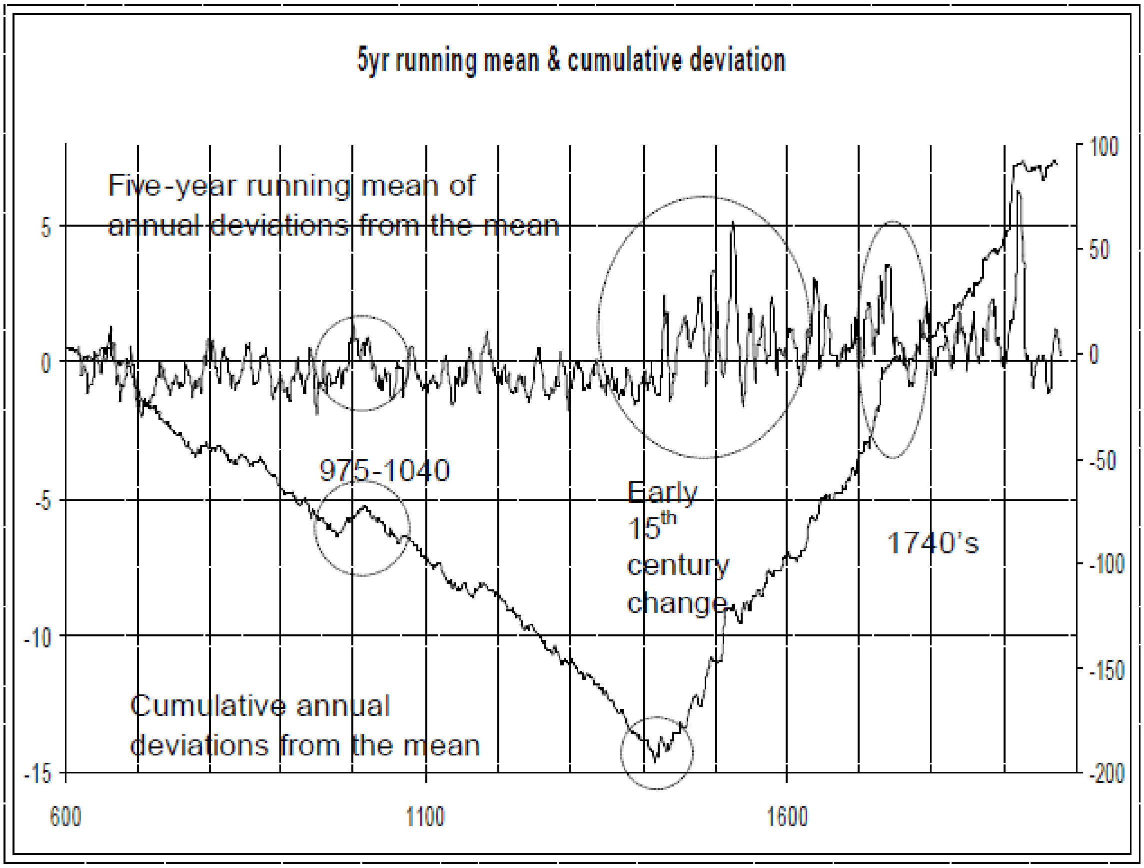


Figure 3.16. Graph showing GISP-2 proxy storminess data (Dugmore et al 2007:126, ©Springer).

As the GISP-2 proxy storminess data graph above suggests, the period before 1425 is generally more predictable and stable when it comes to storminess levels. It does however include some cold periods and inter-annual variability, especially demonstrated by the in Figure 3.17, (data by Richard Streeter; based on Mann et al 2009). Similar but less sustained circulation changes occurred between 975 and 1040; later and more extreme events occurred in the early 18th c. (Dugmore et al 2007*)*. Generally, the pre-1425 storminess levels suggest higher predictability than those after (A. Dugmore personal communication, October 2012).

Type of Event	Extreme Period Began	Extreme Period Ended	Duration	Magnitude (cum-mulative deficit)^2	Intensity (Magnitude / Duration)^2
Warm	1005	1014	10	5.6	0.56
Warm	1024	1029	6	1.6	0.26
Warm	1040	1044	5	4.6	0.93
Warm	1052	1059	8	8.6	1.07
Warm	1067	1101	35	21.6	0.62
Cool	1118	1127	10	4.43	0.44
Warm	1134	1150	17	9.7	0.57
Cool	1176	1181	6	3.91	0.65
Warm	1184	1190	7	4.7	0.67
Cool	1193	1199	7	2.95	0.42
Warm	1202	1217	16	4.3	0.27
Cool	1229	1239	11	5.92	0.54
Cool	1250	1262	13	11.97	0.92
Warm	1264	1274	11	5.6	0.51
Warm	1313	1325	13	4.9	0.38
Cool	1334	1355	22	11.17	0.51
Cool	1366	1376	11	9.25	0.84
Cool	1384	1390	7	3.05	0.44
Warm	1398	1401	4	0.4	0.11
Cool	1407	1428	22	13.34	0.61
Warm	1435	1442	8	2.6	0.33
Stormy	1451	1481	31	24.2	1.73
Cool	1456	1469	14	11.09	0.79
Cool	1475	1478	4	0.49	0.12
Cool	1488	1493	6	2.77	0.46
Stormy	1491	1504	14	23.9	2.66
Stormy	1516	1534	19	22.6	2.26
Stormy	1555	1562	8	3.9	0.78
Stormy	1575	1585	11	10.8	1.35
Stormy	1632	1659	28	27.6	1.53
Stormy	1691	1750	60	62.3	1.83
Stormy	1786	1796	11	11.0	1.84
Stormy	1835	1858	24	15.4	1.19
Stormy	1875	1890	16	16.1	1.79
Stormy	1910	1932	23	41.2	3.17

Table 3.1. Table depicting periods of temperature or storminess extremes, with lowest numbers indicating highest severity. (Ingram 2012, unpublished data table; data based on

Mann et al 2009, data supplied by A. Dugmore and R. Streeter). Blue highlights added by author, indicating level of intensity for cool events higher than 0.40. Grey highlights by Ingram: coincident with Greenlandic Norse decline.

With these temperature and storminess indicators presented above, and the potential effect of a generally unpredictable series of farming seasons in mind, potential vulnerabilities of the Hörgárdalur/Eyjafjörður landscape will be briefly discussed below. The areas on the table highlighted in blue are time periods of relatively intense cooling of temperatures, with an intensity level of 0.4 and higher. This intensity level is a calculation based on the length of the cooling period (or warming period) times the magnitude, or sum of departures from the mean (Ingram 2012, unpublished graph). The sites discussed in this doctoral dissertation were occupied during those times and therefore the farms and the whole region affected by these extreme weather and temperature events.

3.5.2.1. Soil Erosion and Loss of Soil Fertility

In Fall of 2009, as part of the GHP, a series of soil profiles were dug in Hörgárdalur and consequently examined by Streeter and Dugmore (Streeter and Dugmore 2009, in press) to investigate the rate of local Sediment Accumulation (SAR) as a way of establishing the degrees of erosion in relationship with land use (see Dugmore 2000, Dugmore et al 2009, Streeter & Dugmore 2013). Soil profiles showed frequent slope wash episodes. Another observation was that dormant alluvial fans were well vegetated, often providing the only good grazing areas outside the home fields, indicating either a general loss of soil fertility in other areas, or enhanced fertility on the fans.

Figure 3.17. Stripped hill slopes above Oddstaðir showing thin sediment cover and active solifluction lobes likely contributing to the loss of soil fertility on the slope through leaching minerals from the soil. However, this slope activity could provide a supply of nutrients to the slopes below (Dugmore, personal communication October 2012). Picture courtesy of Andrew Dugmore (Streeter and Dugmore 2009:14, in press).

Streeter and Dugmore question whether climate change was the only reason for changes in the Hörgárdalur landscape, as it does not account for all the significant changes taking place after time of settlement. The very highest slopes are unlikely to have supported deep soils and therefore there would have not been much change with human impacts and climate change (Streeter & Dugmore 2009). The bottom lands are dominated by fluvial activity and not that much change would be expected there either. The slopes, however, likely have experienced the greatest vegetation change with the removal of tree cover (A. Dugmore personal communication, October 2012). Deforestation and grazing pressure therefore may have quite heavily contributed to destabilization of the Hörgárdalur valley slopes (Streeter and Dugmore 2009:3). Streeter and Dugmore (2009:3) suggest that their hypothesis of climatic changes initiating the most significant phase in Hörgárdalur landscape instability is the most likely explanation as suggested by litho-stratigraphic analysis. An increase in slope instability, for example activated fan surfaces, debris slides, and rock falls would be results of increased and altered geomorphic activity brought by the climate changes associated with the cooling period of the Little Ice Age (Streeter and Dugmore 2009:3 in press). Another geomorphic process connected with geomorphic changes is cryoturbation, as explained earlier in this chapter (Kirkbride & Dugmore 2005). This phenomenon can also be found in the research area (see landslides section).

3.5.2.2. Landslides

This section discusses the occurances and effects of landslides on the mountain slopes. It seems fitting to give this some attention, as the research area is in a political district called Skriðuhreppur, named after the farm at Skriða where the local assembly was held (O. Vésteinsson personal communication, October 2012); skriða also being the Icelandic term for landslide. This area experienced many episodes of landslides, one example is the one that destoyed the formerly Langahlíð farm, afterwards renamed to Skriða (see below).

Although climate is the major driver of Hörgárdalur landscape instability, deforestation of areas immediately after Settlement may have also had an effect on the stability of the steep valley slopes (Streeter and Dugmore 2009:16 *in press*). Landslides are seemingly much more frequent on the valley´s south facing side, as all the examples provided here are from there. The south facing valley side probably experiences more fluctuations around freezing point during the spring and fall than the north facing slopes which could trigger more landslides (A. Dugmore personal communication, October 2012).

Lönguhlíðarfjall is the mountain where one major landslide occurred in 1390 (Jónsson 1992:306-308), destroying the Langahlíð farm that henceforth was called Skriða.

Figure 3.18. Boulder commemorating the landslide killing several people and destroying the Langahlíð farmhouse in 1390. This is the very eastern end of the Lönguhlíðarfjall Mountain.

Figure 3.19. Oddstaðir ruin complex, visible part indicated by the red arrow. Oddstaðir is situated at the western end of Lönguhlíðarfjall, with the river, Oddstaðaá, creating the western edge of this mountain. The black arrow indicates an area still covered in cobbles that were most likely the result of a landslide. Oddstaðir land, or at least the land owned by Öxnhóll, experienced at least one major landslide (Hreiðarsdóttir et al 2008:94, 97).

Oddstaðir is situated at the western end of Lönguhlíðarfjall, with the river, Oddstaðaá, creating the western edge of this mountain. In this picture, the ruin is clearly visible in the landscape, due to its height, but also the lush green colour in contrast with the surrounding field. There are a lot of hummocks found in the area on top and around the ruin mound, possibly but not necessarily indicating cryoturbation action upon abandonment of this farm site during the cooling period in the late 14th and early 15th c.

Despite climate change playing likely one major role in Hörgárdalur landscape instability, deforestation of areas immediately after Settlement may have also had an effect on the stability of the steep valley slopes (Streeter and Dugmore 2009:16).

Figure 3.20. NW and SE facing Hörgárdalur slopes. Red circle on the left indicates Oddstaðir location, red circle on the right indicates Skuggi location. According to Google.Earth (www.google.earth.com), both sites are at an elevation of 150-160 m asl, with Oddstaðir lying on a very gradually rising plateau compared to the steep slopes leading up to the top of the mountain

Figure 3.20 shows again NW and SE facing slopes of Hörgárdalur, with the river Hörgá in the center, and view to ENE. As mentioned earlier, landscape change in medieval Iceland can be influenced by varied processes such as changing climate, land management by humans, or volcanic activities (Arnalds 2005, Streeter & Dugmore 2009 in press, Streeter & Dugmore 2013, Dugmore 2000. The research by Streeter and Dugmore was aimed at testing the most plausible cause for potential landscape change in Hörgárdalur. The valley slopes /sides support little vegetation well suited for grazing. Their initial conclusion is that this is primarily the result of climate, because the vegetation in the landscape is constrained by temperature and water availability as well as the frequency of disturbance. Changes are likely to have been brought by with the increase in snowfall associated with the cooler conditions of the LIA (Streeter & Dugmore in press:3-4). Other likely drivers for landscape change are the change in vegetation brought by humans mostly in form of deforestation and animal grazing.

Figure 3.21. Landslide from the Early Modern time in Þorvaldsdalur, a valley connecting Hörgárdalur and the coastal area called Árskógssandur, part of Dalvík district further north from Gásir (see contour map of Eyjafjörður for location of Dalvík and Árskógssandur.

The Þorvaldsdalur landslide occurred in early modern times and very clearly impacts the mountain slope – no vegetation could recover here under present land management conditions for a very long period of time. In neighboring locations the shallow soils that exist today have taken thousands of years to form because of generally low sediment flux rates. Vegetation is limited because of grazing. Therefore, under present conditions these recent slope movements are likely to take centuries to millennia to revegetate (A. Dugmore personal communication, October 2012),

Figure 3.22. Klausturhús shieling site, located toward the valley bottom, less than 1 km southwest of Skuggi.

One possibility to relieve the home field and infield pastures from grazing pressure was the utilization of shieling sites, or specialized animal herding sites (Amorosi et al 1998, Simpson et al 2002, 2004, 2007, 2009, Brown et al 2012) for grazing livestock in the summer, or sheltering them during the winter. Klausturhús could have been utilized for keeping a relatively large amount of sheep that were grazing on pasturelands previously managed by Skuggi farmers

(Harrison 2010). The Klausturhús vegetable fodder catchment area overlaps with Skuggi´s and therefore it is likely that these two sites were not in use at the same place, but rather the former was used some time later than Skuggi which was abandoned likely during the 12th century (Harrison 2010).

3.5.2.3. *Pasture yield and grazing*

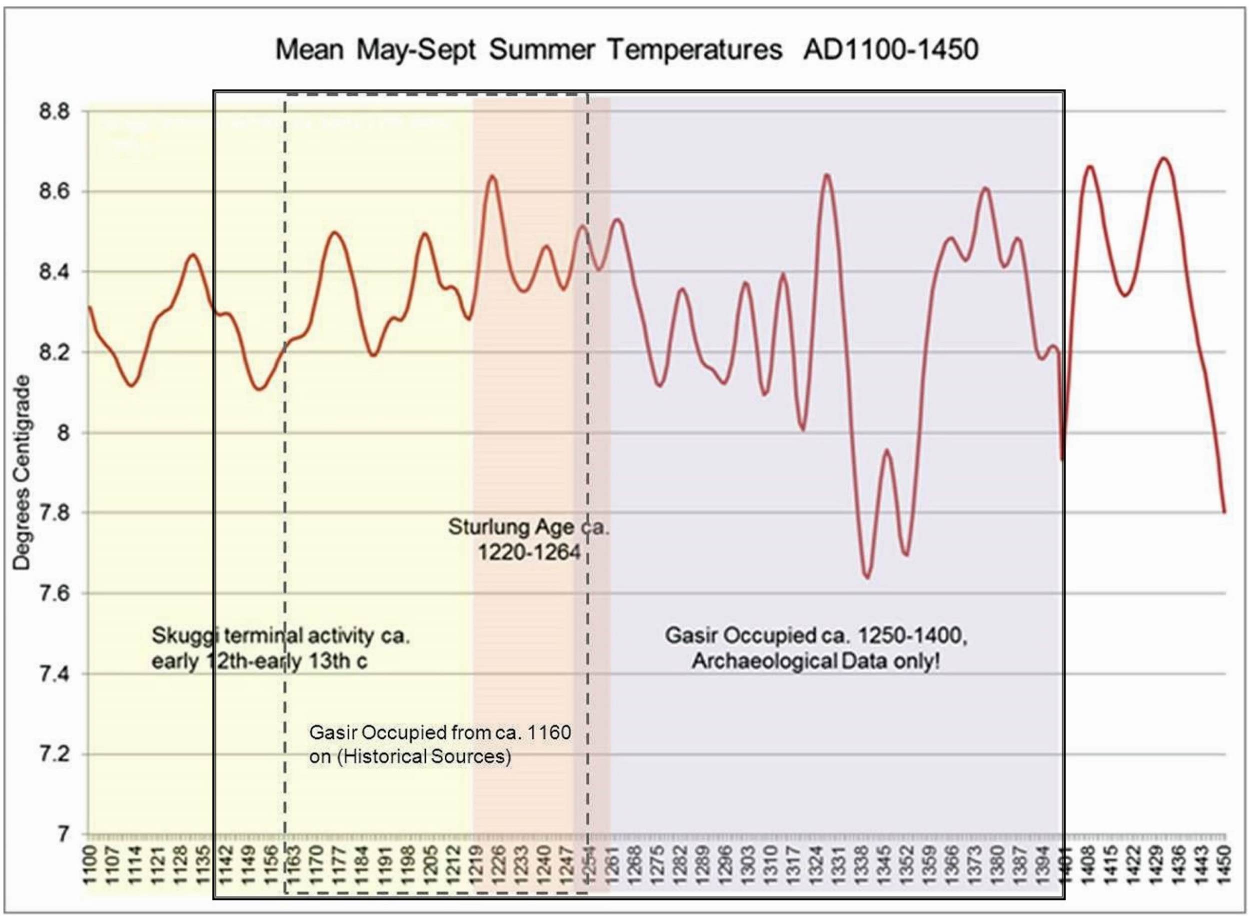


Figure 3.23. Mean May-September Temperatures AD1100-1450. Black rectangle indicates potential span of Gasir activity. Temperature Anomaly Data for Western Iceland provided by Richard Streeter, based on Mann et al 2009. Baseline Mean Annual Temperature (http://en.vedur.is/climatology/data/).

Climate change can influence temperatures, precipitation and snow cover, growing season and feeding periods; these features are all crucial to pastureland productivity and the ability to overwinter as many animals as possible to keep the herds size large enough to sustain the farming activities (see McGovern 2006 for more information on this issue).

The graph in figure 3.23 displays reconstructions of growing season temperatures from AD1100-1450. Based on these data, for the majority of the known Gásir occupation, the Eyjafjörður farmers would have not only been facing overall declines in growing season temperatures compared to the early 13th c., but also considerable inter-annual variability. This is the period of Gásir occupation for which we currently have archaeological materials. The earlier Gásir occupation as documented in historical sources falls into a time period that saw relatively more stable and warmer temperatures, as did summer temperatures for the period of Skuggi abandonment.

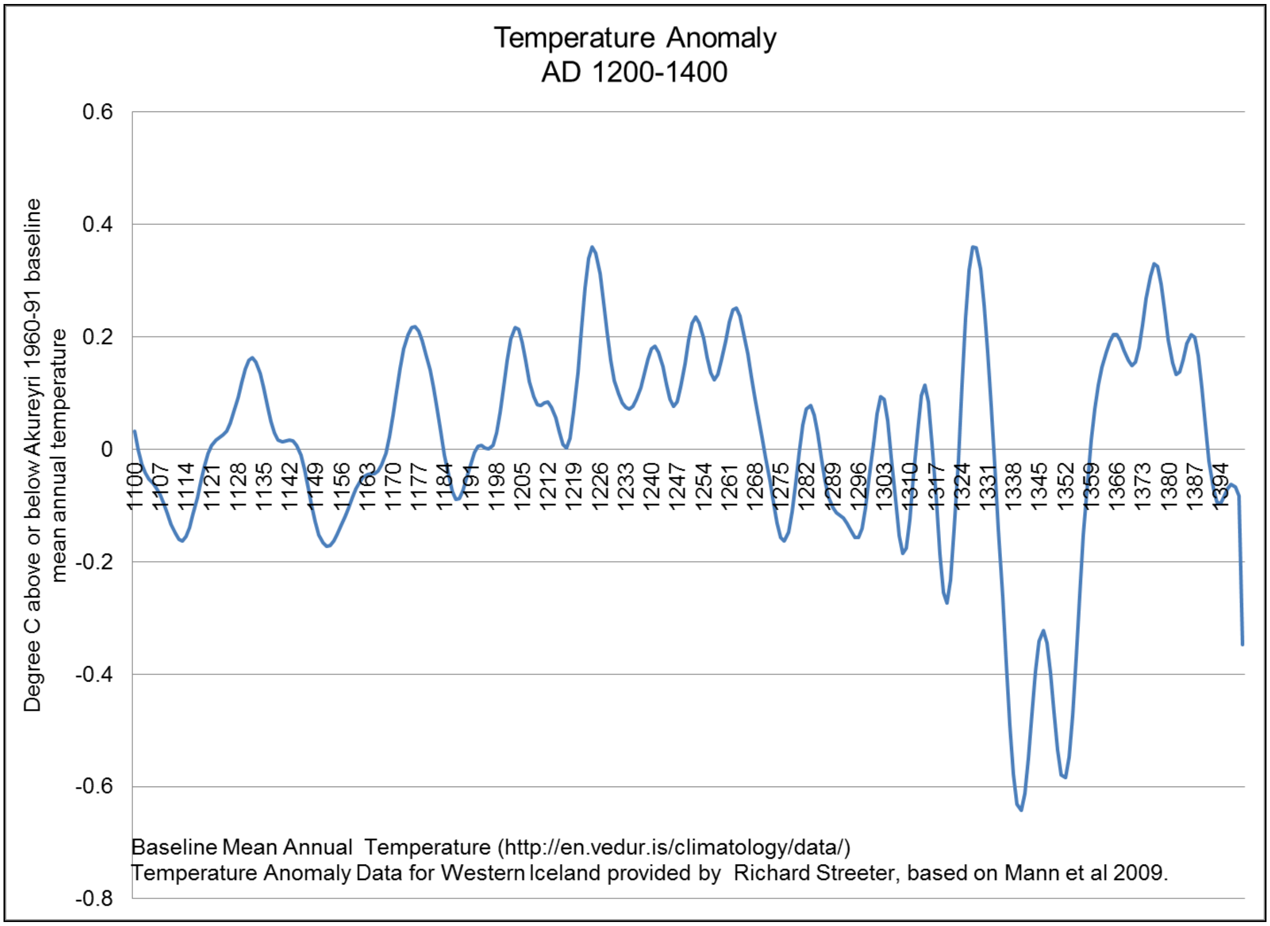


Figure 3.24. Temperature Anomaly from annual mean, AD1200-1400. Temperature Anomaly Data for Western Iceland provided by Richard Streeter, based on Mann et al 2009; Baseline Mean Annual Temperature: http://en.vedur.is/climatology/data/.

The figure above shows annual (rather than just summer) deviations from the annual mean. There, the data available for 12th c. show significant dips in temperatures during the earlier, the middle, and the later parts of this century, indicating somewhat unstable climate during that time that broadly coincides with Skuggi abandonment. In conjunction with a generally less stable climate and a decline in temperatures in the 13th c. and especially the 14th c, it is possible that the crops in the lowlands and especially in the highlands were affected by the change in melt water behavior and ensuing ice encasements of plants previously covered by snow blankets (Guðleifsson 2010:112). Increased snowfall is also associated with increased risk of avalanches.

3.5.2.3.1. Modern Precipitation and Snow Cover in N. Iceland

According to weather data collected throughout the majority of the 20th c., Iceland´s northern and north-eastern regions are the driest parts of the country, and the maximum of precipitation usually occurs in October, as fall and winter are generally the months receiving greatest precipitation (Einarsson 1984:684). While in most parts of Iceland about 50 - 65 % or the annual precipitation falls between October to March, winter precipitation in some areas in north-eastern Iceland is lower at 40 - 50 % (Einarsson 1984:685). Dry periods in the summer, so important for drying hay reserves, are the most likely in the interior regions of northern and north-eastern Iceland. While in southern Iceland, the average percentage for dry days for the period June through August is 47%, the one for the north and east interior areas is much higher at 66 % (Einarsson 1984:686). If these proportions were similar in the middle ages, these numbers suggest that pasture productivity in the inner parts of northern and eastern Iceland could have been higher in Eyjafjörður than in the south and west of Iceland as the more 'continental' climate conditions are better than more 'maritime' ones.

As earlier mentioned, the northern Icelandic climate zone experiences more snowfall during the winters and in fact, 20th c. data suggest that more than half of the winter precipitation falls as now there, with complete snow cover lasting for weeks and months (Einarsson 1984:686). According to Einarsson, the first snow fall usually occurs in September in the northern districts, but in October in southern and western Iceland. An average annual mean from 1951 - 1970 indicates that the first snowfall in Reykjavík occurs on October 14, and the last one on April 30. The first snowfall in Akureyri occurs on September 29, the last snowfall on May 27. In Akureyri, the complete snow cover period lasts from October 23 through April 22; in Reykjavík it lasts from November 4 through April 9 (Einarsson 1984:687).

3.5.3. *Concluding Observations*

Based on the currently available environmental data available for Eyjafjörður and especially Hörgárdalur, the following observations can be made:

- Because of the extremes of relief (high plateau and low valley floors) and relative shelter provided by the steep mountains, spread soil erosion by wind is far less of a factor than in highland upland areas such as Mývatnssveit (TH McGovern, personal communication March 2013). On a local level landslides and slope wash erosion have probably have affected farming and settlement choices, the latter may have actually improved the soils on the valley bottom. Dating of episodes of destabilization of slopes will be important to a longer term investigation of geomorphology here. Overall, human / sheep grazing impacts seem to be less of an issue than in some other parts of Iceland (McGovern et al 2007, 2009).

- The Hörgárdalur valley systems create central route ways that will tend to funnel travel along valley bottoms and make Möðruvellir a central point for travel.

- Current multi-proxy climate indicators suggest a rapid cooling from a warm 11th century. This change in climate may have contributed to the decision to abandon Skuggi and potentially other higher elevation farms. It may have also lowered productivity and increased inter-annual variability in the overall pasture areas, placing some stress on the overall farming system.

Though clearly an issue, the cooling environment was likely only one of multiple factors affecting farming and settlement systems in the area.

- The Oddstadir pattern (stable cattle numbers, no increased investment in climate resistant caprines, and reduction in use of marine resources - see chapter 7 for full discussion of the Oddstaðir archaeofauna) is thus very difficult to explain as a response to cooling and fluctuating terrestrial climate and pasture productivity. The "expected" response would be reduction of cattle, increase of caprines, and increased use of marine food as supplement. However, such a decision seems to not have taken place on this farm, providing an outcome not determined by the environment, but more likely by human decision making.

Chapter 4. **The Gásir Data from Faunal Analysis**

4.1. General Introduction to the Data Chapters

The majority of the following data sets were previously published as NORSEC/HERC Zooarchaeology Reports (Harrison 2005, 2006a, b, 2007, 2008, 2009, 2011a, b, Harrison et al 2004).

Individual topic discussions are included into the various sections throughout the text. A thorough discussion on the regional archaeofaunal materials presented in this dissertation is offered in the Discussion and Conclusion Chapter, 8.

The data chapter series thus reflects the development from the Gásir project to Gásir Hinterlands project, investigating the Eyjafjörður / Hörgárdalur region based on predominantly archaeological analysis coupled with environmental data and limited historic resources and presents a growing number of regional data sets available to refine the current picture on the Eyjafjörður Human Ecodynamics and the question of whether or not Gásir trade activities had an impact on the region.

4.2. The Gásir Faunal Data from Area A

4.2.1. *Chronology*

This initial section provides the available dating evidence for the Gásir archaeofauna and other materials presented in this doctoral dissertation. The chronology of the whole Gásir site has been assessed through radiocarbon, tephrochronology, artifacts, and documentary evidence, with the C14 dates offering the currently most secure dating evidence of Area A site activity during the 13th and 14th c.

4.2.2. *Radiocarbon Dates for Areas A and B*

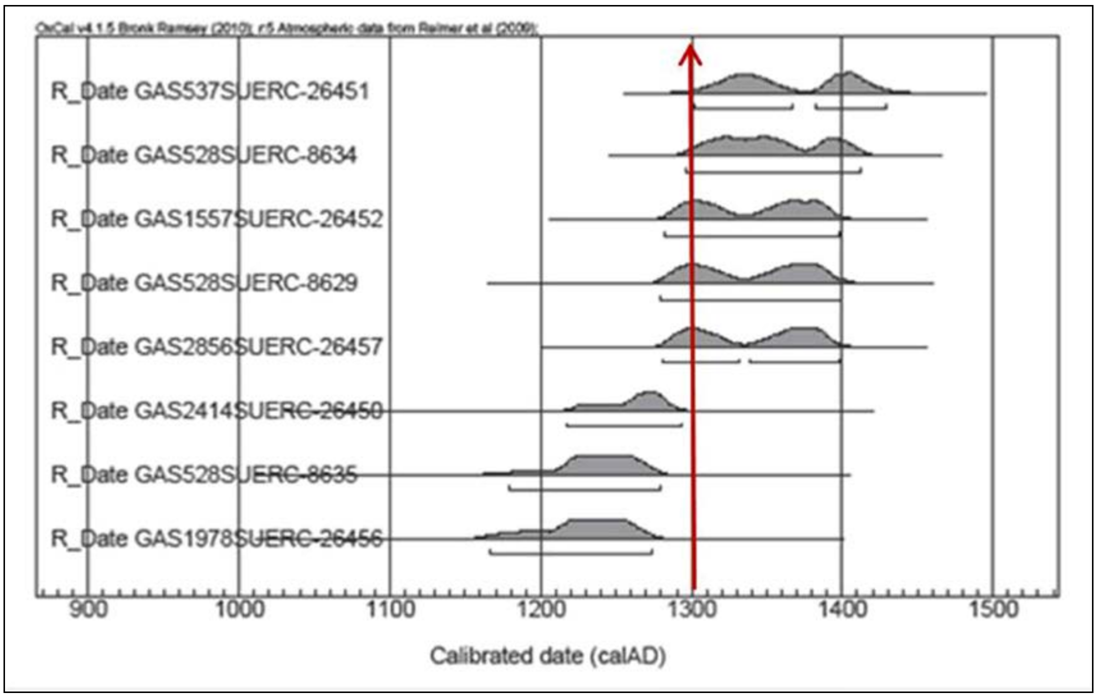


Figure 4.1. Gásir Area A, calibrated Radiocarbon dates (c14.arch.ox.ac.uk/oxcal/OxCal.html, v. 1.6, Bronk Ramsey 2010, Atmospheric data from Reimer et al. 2009).

The calibrated Radiocarbon dates from the area A analysis, all from terrestrial mammals are presented in figure 4.1 above. Five dates (SUERC 26451 [context537], 8634 [context 528], 26452 [context 1557], 8629 [context 528], 26457 [context 2856]) group mostly within the 14th century, which probably accurately reflects the period of deposition of the (528) context analyzed in more detail in figure 4.1 above and agrees with the tephra evidence (AD 1300 tephra indicated by arrow). The outlier in context 528 (SUERC 8635) appears to be a residual bone fragment probably redeposited in later layers from an earlier context. This and other earlier 13th c. dates from what are likely redeposited faunal remains recovered from later cultural layers (SUERC 26450 [context 2414] and 26456 [context 1978]) provide confirmation of an earlier occupation at Gásir below the 1300 tephra horizon, as suggested by some of the documentary sources. Pre-1300 deposits have been observed across the exposed archaeological area but remain un-excavated due to inundation by the sea (Pásldóttir & Roberts 2006).

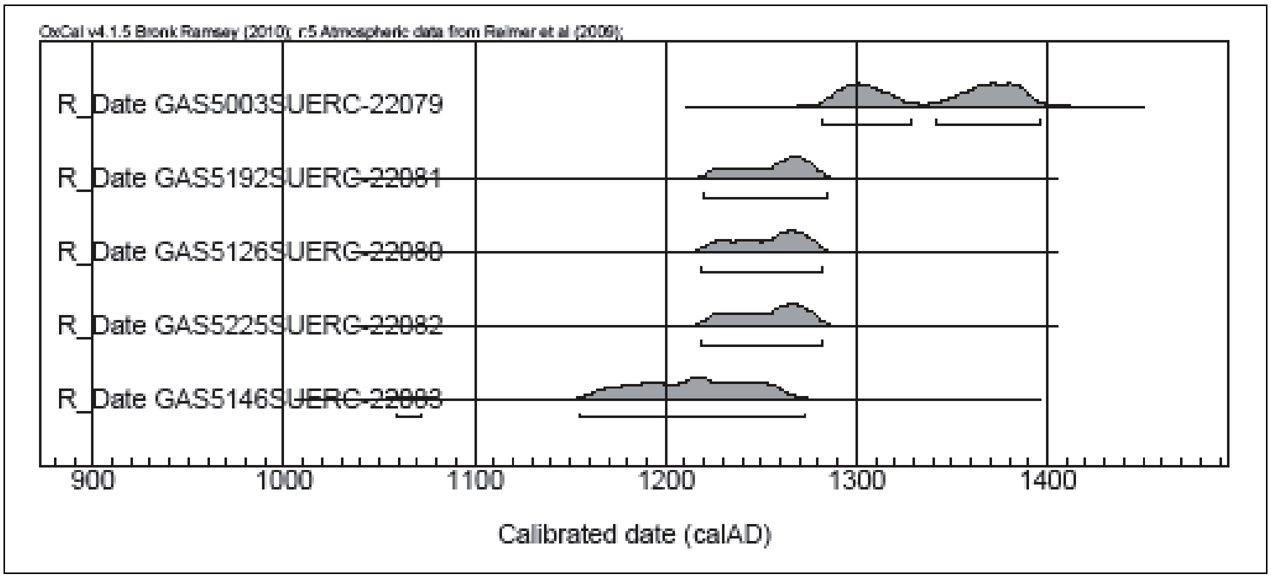


Figure 4.2. Gásir Area B, calibrated Radiocarbon dates (c14.arch.ox.ac.uk/oxcal/OxCal.html, v. 1.6, Bronk Ramsey 2010, Atmospheric data from Reimer et al. 2009).

The recent C14 analysis on area B archaeofauna offers dates from a series of contexts, with one (SUERC 22079 [context 5003]) falling into the 14th century and coinciding with terminal use of the church (Vésteinsson 2009a). SUERC 22080 [context 5126], 22081 [context 5192], and 22082 [context 5225] date the contexts to about AD 1250 – 1300 and coincide with the earlier data from area A. The last date (SUERC 22083 [context 5146]), associated with initial church building activities, gives an earlier 13th c date.

Site/Area	SUERC #	GU #	C-14Radiocarbon age years BP	Age error	2 sigma (95.4%) probability
Gásir/A	8629	13632	645	40	1280 (95.4%) 1399calAD
Gásir/A	8634	13634	595	35	1296 (95.4%) 1412calAD
Gásir/A	8635	13635	795	35	1178 (95.4%) 1279calAD
Gásir/A	26450	20151	745	35	1217 (95.4%) 1294calAD
					1306 (53.9%) 1364calAD
Gásir/A	26451	20152	565	35	1385 (41.5%) 1426calAD
Gásir/A	26452	20153	640	35	1282 (95.4%) 1398calAD
Gásir/A	26456	20154	810	35	1166 (95.4%) 1274calAD
					1280 (42.7%) 1331calAD
Gásir/A	26457	20155	645	35	1338 (52.7%) 1398calAD
					1281 (42.4%) 1329calAD
Gásir/B	22079	18014	645	30	1341 (53.0%) 1396calAD
Gásir/B	22080	18015	765	30	1219 (95.4%) 1282calAD
Gásir/B	22081	18016	760	30	1220 (95.4%) 1284calAD
Gásir/B	22082	18017	765	30	1219 (95.4%) 1282calAD
Gásir/B	22083	18018	830	30	1160 (95.4%) 1265calAD

Figure 4.3. Gásir Area A and B Radiocarbon dates with more detail on calibrated AD probability.

4.2.3. *Tephrochronology*

Tephrochronological dating further refines the chronology presented in the previous section; the majority of the excavated layers from Area A are stratigraphically later than the Hekla volcanic tephra horizon dated circa AD 1300 (Magnus Sigurgeirsson, in Roberts et al. 2002). As the radiocarbon results suggest, some of the faunal materials excavated in 2006 were older remains redeposited in later cultural layers and are dated to the mid- to late 13th c. This is likely a result of repeated cutting into existing features due to the seasonal occupation of the site. Further unexcavated layers clearly continue to some depth below the limits of excavation, which have intentionally focused upon the later phases (Rob Pásldóttir & Roberts 2006). Whilst Gásir may have origins as early as the Viking period, to date there is no unequivocal evidence to support this assumption, and this paper deals with the fairly narrow time range between the circa 1300 tephra fall and the end of the trading site around 1400.

4.2.4. *Dating Evidence from the Material Record*

Few of the artifacts are diagnostic for high-resolution dating, with the pottery assemblage as best relative dating indicator suggesting activity during the 13th –14th c. (Mehler 2003:46; Gísladóttir 2006:21, Brorsson 2009:5).

4.2.5. *Documentary Sources*

The earliest mention of Gásir's involvement in market activities in the year AD 1163 is found in the Prestssaga Guðmundar góða (Jóhannesson et al. 1946:119), while the last time written sources mention the seasonal fair is AD 1391 (Storm 1888:367) (Roberts 2002). The C14 results discussed above loosely correspond with documentary sources (Harrison et al 2008).

4.3. Fragmentation: Assessing the Validity of Gásir Handpicked versus Sieved Contexts

Fragmentation can be caused by trampling and exposure to freeze thaw cycles (see for example Skuggi Chapter, Phases IV and especially V exhibited bone erosion and fragmentation typical for freeze thaw cycles). Other potential causes for fragmentation are burning, the production of bone grease, and butchery in general (Woollett & McGovern 2003). The fragmentation data presented in figure 4.4 are very helpful when comparing the faunal remains that were handpicked versus fully sieved ones. The large midden dump with context number (2076) for example was fully sieved as were all other midden deposits. One of the main issues with (partially) hand-picked collections is the preference for large elements removed from the matrix while smaller ones are lost. As indicated from the entire Gásir archaeofauna however, and demonstrated clearly in the above graph, the Gásir archaeofaunal remains collected from contexts other than 2076 (the fish processing pit) are indeed fully valid for comparison. A large portion of the faunal remains from the hand-picked contexts are associated with consumption behavior in living spaces areas, favoring survival of larger elements than the specialized midden in context 2076. Other contexts however are associated with the Gásir trackway area and are those containing the smallest fragments as well as the highest TNF. The high percentage of bones smaller than 1 cm attests to that. As the Hörgárdalur bone fragmentation comparison presented in the conclusion demonstrates, the Oddstaðir later medieval phases contained proportions of bones larger than 5 cm that were similar to those from Gásir, while those at Skuggi during that site's later occupation periods were quite different, possibly indicating frequent freeze-thaw cycles.

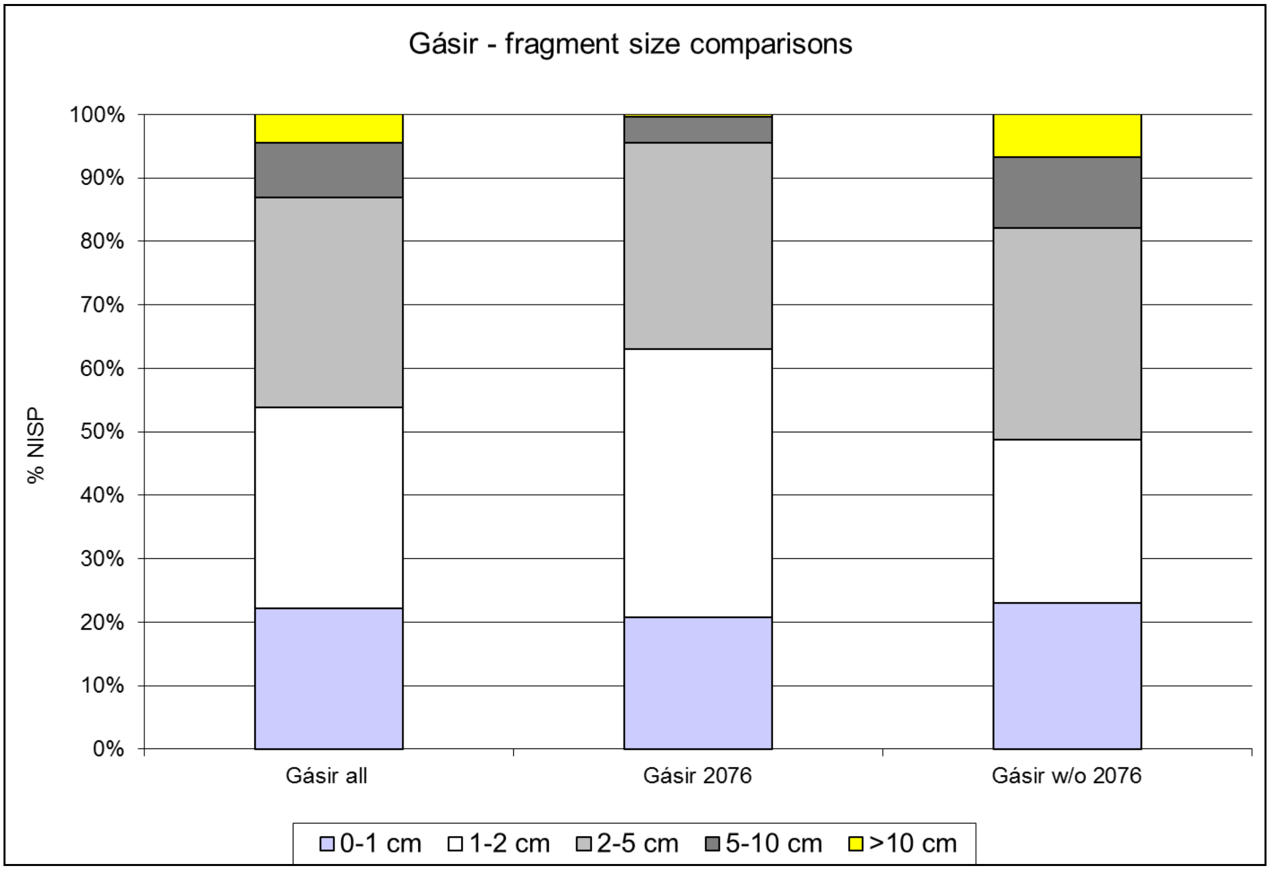


Figure 4.4. Gásir bone fragment comparisons: entire collection, context 2076 only, Gásir collection w/o context 2076.

4.3.1. *Context Association*

Apart from the context 2076 faunal materials which provides a substantial faunal collection, and contexts 1557, 101, 1948 (midden), and 1487 which provide faunal assemblages with a TNF of >500, the Gásir bones generally come in relatively small quantities (<500) per context.

While it is desirable to do a full scale distribution map of the archaeofauna and its taphonomic indicators across the site (i.e. McGovern et al 2009 - Hofstaðir Monograph), the post-excavation work for the site as a whole has not yet been completed to a point where this is possible. (H. M. Roberts, personal communication December 2012).

4.4. Gásir Area A Archaeofaunal Results

Gásir is a coastal site and from its site layout as well as the zooarchaeological analysis it becomes clear that this site did not function as a farm site, but instead was a site of seasonal activity that very likely was connected with trade and exchange (Harrison et al 2008).

Zooarchaeological data from the years 2002 through 2006 from the Gásir Area A[4] excavations are presented here. The faunal analysis resulted in a total NISP (Number of Identified Species) of 15,735 out of a TNF (Total Number of Fragments) of 25,754.

[4] The Gásir Area B Zooarchaeology Report is appended at the end of the dissertation. This collection is too small in number for any discussion beyond species absence and presence.

Gásir Area A – Aggregated bone fragment count.

Aggregated bone fragment count.			
Taxon	NISP total		NISP context 2076
Domestic mammals			
Cow (*Bos taurus* (L.))	756		3
Horse (*Equus caballus* (L.))	15		0
Pig (*Sus scrofa* (L.))	34		0
Dog (*Canis lupus familiaris* (L.))	15		0
Goat (*Capra hircus* (L.))	18		0
Sheep (*Ovis aries* (L.))	261		1
Unidentified caprine	1,283		60
Total caprine	1,562		61
Total domestic	2,382		64
Wild Mammals			
Harp Seal (*Pagophilus groenlandicus* (Erxleben))	5		0
Harbor Seal (*Phoca vitulina* L.)	1		0
Small seal	15		0
Large seal	1		0
Unidentified seal species	39		3
Total seal	61		3
Small cetacean	13		0
Large cetacean	3		0
Unidentified whale species	13		0
Total whale	29		0
Arctic fox (*Vulpes lagopus* L.)	4		1
Walrus (*Odobenus rosmarus* (L.))	1		0
Total wild mammal	95		4

Gásir Area A – Aggregated bone fragment count continued

Birds			
Gyrfalcon (*Falco rusticolus* (L.))	2		0
Mallard (*Anas platyrhynchos* (L.))	1		0
Common eider (*Somateria mollissima* (L.))	35		1
Guillemot family (Uria spp.)	24		0
Atlantic puffin (*Fratercula arctica (*L.))	8		3
Common gull (*Larus canus* L.)	1		1
Gull species (Larus spp.)	4		0
Razorbill (*Alca torda* (L.))	5		0
Mute swan (*Cygnus olor* (Gmelin))	2		0
Red-throated diver (*Gavia stellata* (Pontoppidan))	1		0
Duck species (Anas spp.)	3		1
Sea bird non-speciated	1		0
Unidentified bird species	133		12
Total bird	220		18
Fish			
Cod (*Gadus morhua* (L.))	1,086		980
Haddock (*Melanogrammus aeglefinus* (L.))	602		500
Pollack (*Pollachius pollachius* (L.))	109		99
Ling (*Molva molva* (L.))	3		2
Atlantic Halibut (*Hippoglossus hippoglossus* (L.))	5		2
Gadid species	2,754		2,231
Brown trout (*Salmo trutta* (L.))	20		1
Salmonid species	5		0
Atlantic Wolffish (*Anarhichas lupus* (L.))	1		1
Pleuronectiformes	1		1
Total fish species identified	4,586		3,817
Marine fish non-speciated	5,187		5,037
Unidentified fish species	3,163		0
Total fish	12,936		8,854
Mollusca			
Periwinkle (Littorina spp.)	2		0
Clam (Mya spp.)	55		0
Unidentified mollusc species	47		4
Total Mollusca	104		4
Total number of identified species	15,737		8,944
Large terrestrial mammal	822		9

Gásir Area A – Aggregated bone fragment count continued

Medium terrestrial mammal	2,036		86
Small terrestrial mammal	20		0
Unidentified terrestial mammal fragments	7,139		218
Unidentified marine mammal fragments	2		0
Total number of fragments	25,756		9,257

Table 4.1. Gásir Area A – Aggregated bone fragment count. The left column shows the site's total archaeofauna; the right column shows the archaeofauna from specialized activity context 2076.

The species break-down in Table 4.1 reflects the total Area A faunal elements, and demonstrates the nature of the faunal deposit from context 2076, a specialized activity area, or fish cleaning and butchery refuse area (see Harrison 2009 and below). The faunal collection from the pit/sunken feature excavated in 2005 (Pálsdóttir & Roberts 2007) consists of 99 % fish remains, combined with a few domesticate fragements and occasional other species. This context is very valuable as it offers insight into the site's fish processing and consumption patterns, as discussed in the fish section below. Not the entire fish skeletal assemblage could be analyzed to species or family level but all unidentified remains are beyond any doubt from marine fish and thus indicative of the coastal site's fish procurement: marine fish were much focused upon and salmonids and other fresh water fishes available from nearby rivers, i.e. the Hörgá do not appear in the zooarchaeological record.

The location of the site makes this preference of ocean fishes no great surprise, as the market place was situated in a coastal inlet at the southwestern end of a very long fjord. At the same time, Gásir is situated very close to the Hörgá. This river holds and held salmonids during the middle ages (Á. Ísaksson, Head of Deparmtne of Salmonid Fisheries and Ecosystem Management, Directorate of Fisheries, personal communication August 2012). The lack in these species among the archaeofauna could mean that char were consumed with their vertebrae and also their head bones as those are so fine (Á. Ísaksson, Head of Department of Salmonid Fisheries and Ecosystem Management, Directorate of Fisheries, personal communication August 2012). Another reason for the bare trace amount of fresh water fish recoverd from this site could be that there was trade in marine fish occuring, but not in freshwater fish.

4.5. Major Taxa

In figure 4.5, the Gásir bone assemblage is compared to roughly contemporary collections from the monastery on Viðey in Reykjavík (VID LM) (Amorosi 1996), from the Hörgárdalur farm sites at Möðruvellir (high status) and Oddstaðir (possibly middle-ranking farm), and two phases (Akurvík 24, Akurvík 22; 13th and 15th centuries respectively) of a seasonally occupied fishing station in the Westfjords of Iceland (Amundsen et al 2005, Krivogorskaya et al 2005).

From the major taxa comparison, it is evident that the faunal assemblage from the coastal Svalbarð farm in Svalbarðshreppur, NE Iceland best resembles the one at Gásir´s trading station, Svalbarð has almost double the domesticate proportion than Gásir and a far higher amount of wild species such as birds, seals and whales. The high status farm at the Möðruvellir House of Canons with its high domestic mammal proportion, the Hörgárdalur farm at Oddstaðir belonging to the Öxnhóll parish, and the seasonally occupied fishing station in Akurvík composed of almost entirely fish, present quite clear contrasts to the faunal assemblage found at the Gásir trading site. Möðruvellir and Oddstaðir both actually have significantly lower proportions of fish than observed at other farm sites. This comparison suggests that the Gásir provisioning strategy seems to have been different from all other sites presented here.

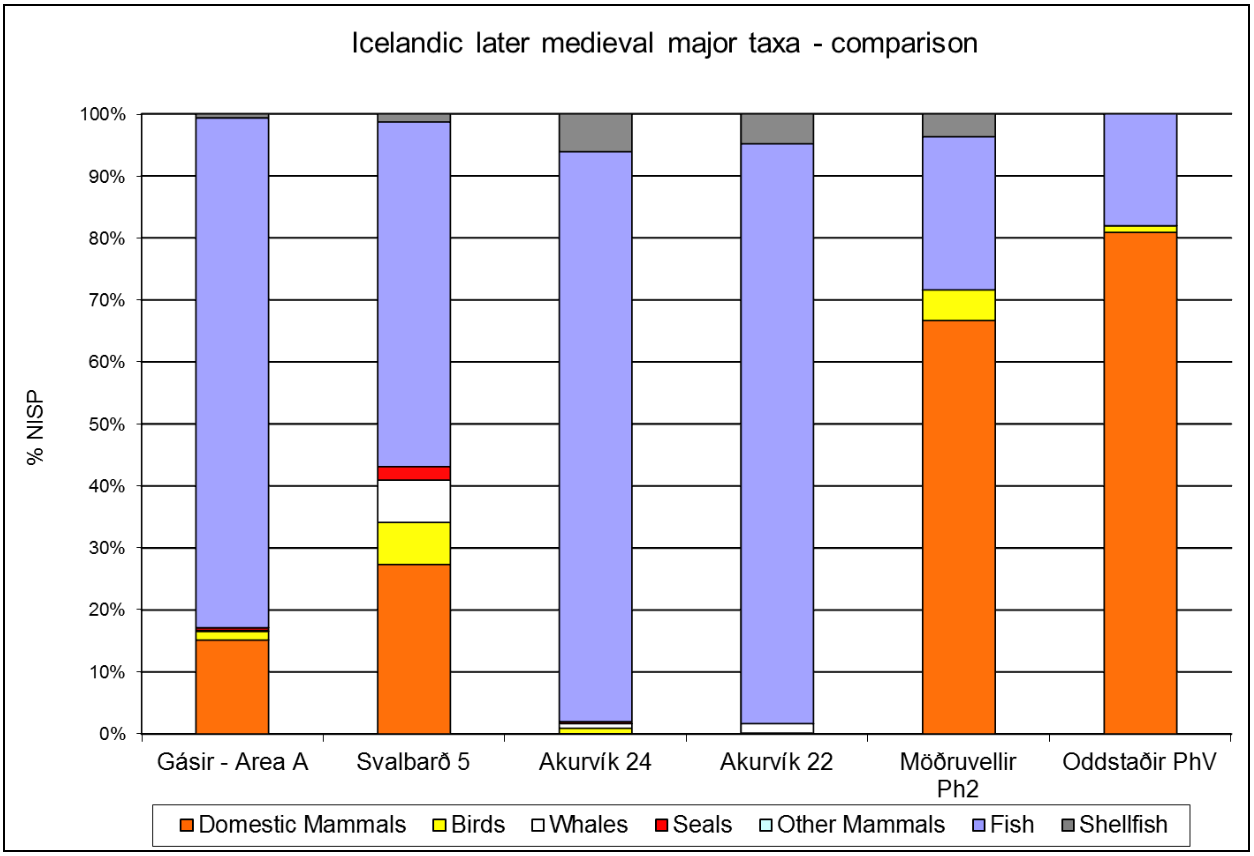


Figure 4.5. The Gásir archaeofauna as compared to other later medieval faunal collections from ca. 12th - 15th c. Sources: Svalbarð (Amorosi 1996), Steinbogi (Brewington et al 2004), Akurvík (Krivogorskaya et al. 2005).

4.6. Domestic Mammals

Table 4.2. presents the relative Percentage of the domestic mammals for the entire Area A contexts excavated at Gásir. The total ratio from the Gásir domesticate faunal analysis is: caprine/cattle = 2.07 which can be reasonably rounded to a ca. 2:1 ratio of caprine to cattle. The goat/sheep ratio is 14.50. Goats thus do not make up a large portion of the collective caprine category.

Gásir Relative % of Domesticates		
	Total NISP	% Total NISP
Taxon		
Bos taurus (L.)	756	31.74
Equus caballus (L.)	15	0.63
Canis familiaris (L.)	15	0.63
Sus scrofa (L.)	34	1.43
Ovis aries (L.)	261	10.96
Capra hircus (L.)	18	0.76
Ovis/Capra sp.	1,283	53.86

Table 4.2. Gásir Area A Domesticate profile.

The data presented in the table above are used for Figure 4.6 below; this time compared to several other domestic mammal patterns from medieval Icelandic sites.

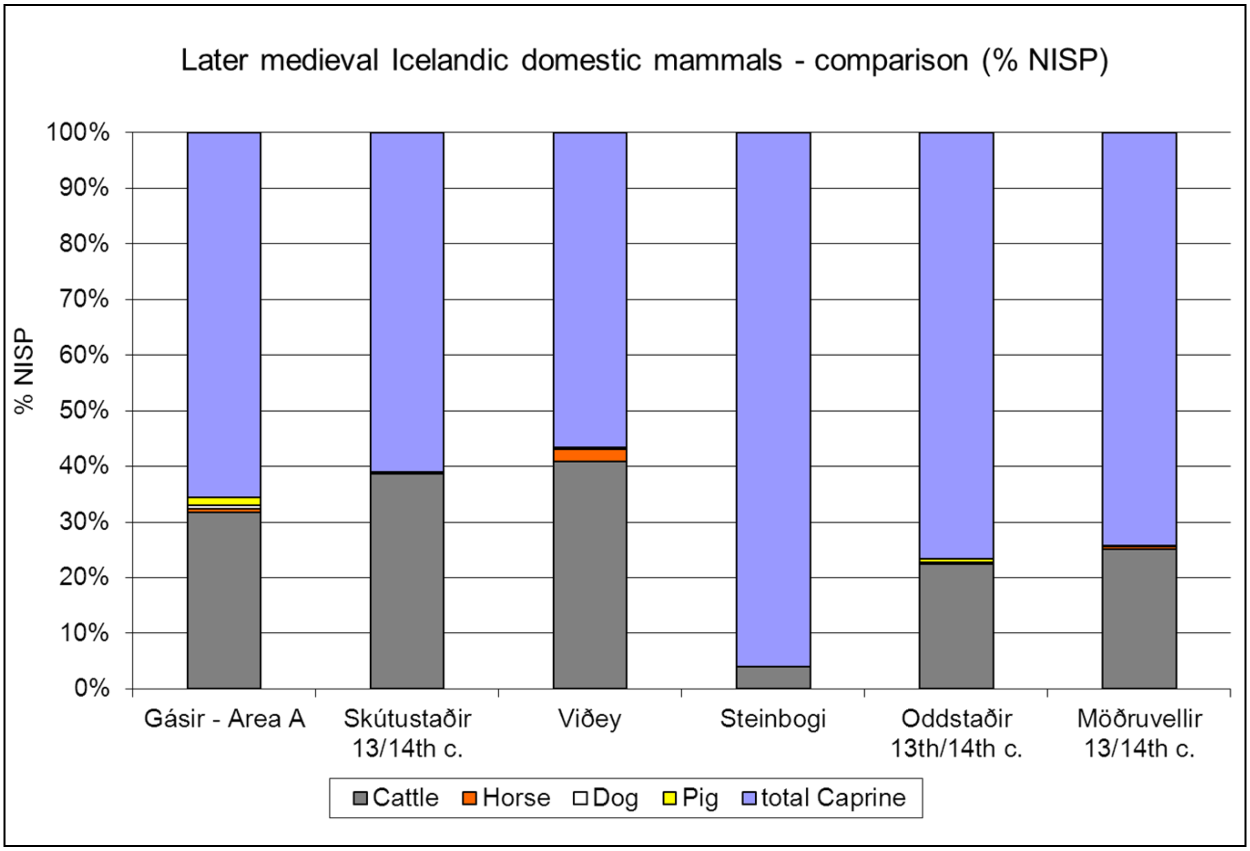


Figure 4.6. Domestic Mammal Proportions from selected high to later medieval Icelandic sites. Sources: Viðey (Amorosi 1996);, Steinbogi (Brewington et al 2004), Skútustaðir (Hicks 2012);

The domestic mammal proportions (figure 4.6) at Gásir most closely resemble the rich monastic center on Viðey outside Reykjavík and the Mývatn district farm of Skútustaðir in the abundance of cattle bone, and contrast with the small and low status Mývatn district farm of Steinbogi (Amorosi 1992, McGovern, 1990). At Gásir the ratio of 2.07 caprine bones for every cattle bone contrasts with a caprine to cattle ratio of close to twenty to one for most rural sites observed in northern Icelandic faunal collections dating after ca. AD 1250 (Vésteinsson & McGovern 2008). Had Gásir been a late medieval Icelandic farm site, its overall domestic mammal proportions would strongly suggest a high status site enjoying prosperous farming conditions (Harrison et al 2010).

4.6.1. *Age at Death Reconstructions – Cattle*

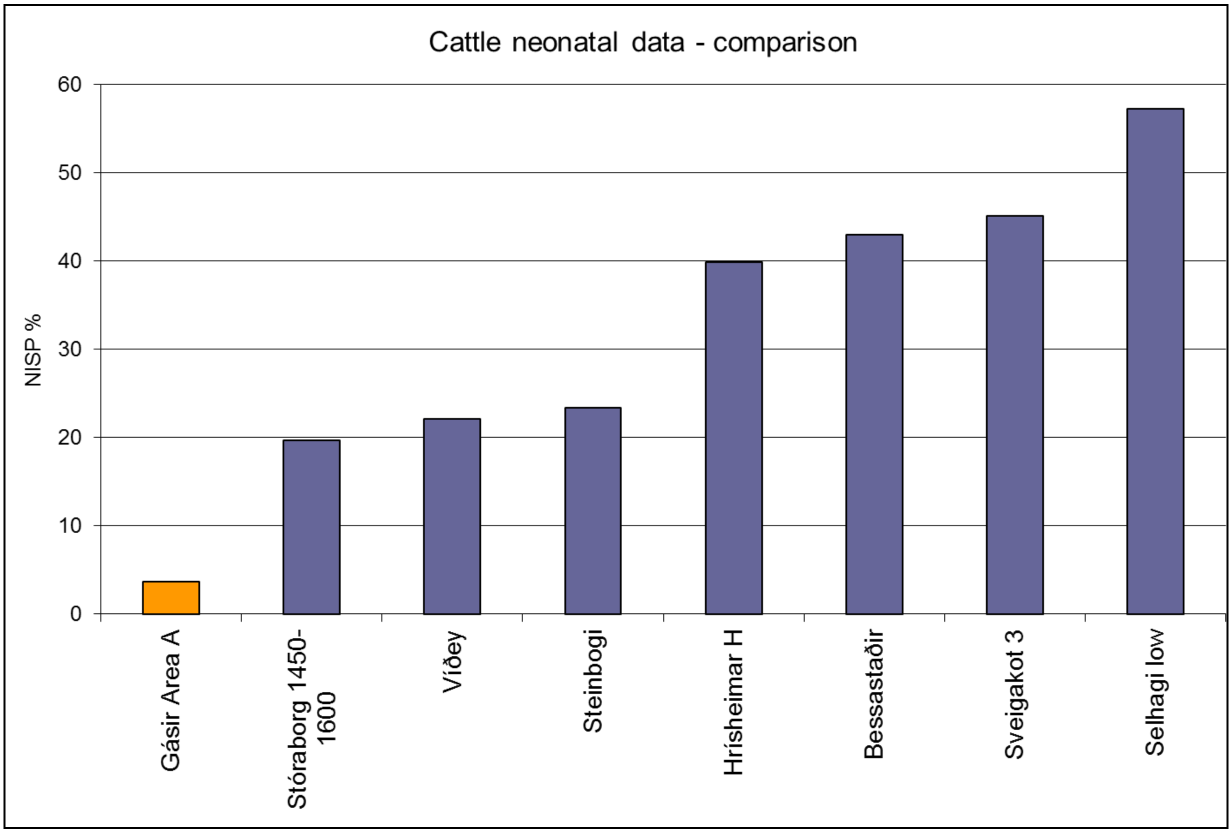


Figure 4.7. Late Medieval Gásir neonatal cattle percentages compared to earlier Medieval medium status farmsteads in Sveigakot (McGovern et al 2004), Hrísheimar (McGovern & Perdikaris 2002), Selhagi (McGovern & Perdikaris 2003, Draft) and Steinbogi (Brewington et al 2004) in Mývatnssveit; the Late Medieval monastic center at Viðey in Reykjavík (Amorosi 1996, 403), the he Late Medieval middle to high status farm at Stóraborg in the Southwest (Amorosi 1996, 373), and the Late Medieval period of the high status mansion at Bessastaðir (Amorosi 1996, 335) close to Reykjavík.

One of the ways of aging animals in Zooarchaeology is by analyzing the **neonatal percentage of the herd**. This is a strong measure as it draws on potentially all bones of the skeleton and even fragments.

Long bone fusion measurements and comparisons are more affected by taphonomy issues and therefore the most comparably dense bones need to collected (NABONE 2010), therefore further limiting the available sample size available.

Tooth row analysis is made difficult as tooth rows are frustratingly rare, and tooth wear (versus tooth eruption) is only partly age dependent.

All these measures together, however, do provide solid information on a herd´s general age at death profile.

Figure 4.7 above illustrates the relative percentage of bones of neonatal (newborn) calves in a range of Viking-Medieval Icelandic sites, illustrating the normal range of variation from ca. 20-50% of the total cattle bone count. The latter is often viewed as typical for dairy herd management, with young cattle culled to preserve milk resources for human consumption (Halstead 1998). The very low percentage of neonatal cattle bones at Gásir (indicated in gold) is thus very uncharacteristic of most Icelandic cattle collections, suggesting a different pattern of management or consumption. The fusion data below may offer a better age-at-death range in this case. What this small proportion of neonatal cattle bone indicates is that at Gásir, veal was likely consumed as well as the young adult animals identified below.

The Gásir cattle long bone fusion proportion comparison (figure 4.8 below) indicates that most of the young cattle survived their 1-1.5 year-old stage in life, indicated by the epiphyseal fusion of the distal humerus.

The data indicate that at Gásir, there was a considerable lack of elements associated with animals between 1-1.5 years and 2.5-3 years as compared to those from Sveigakot and Hofstaðir, suggesting kill off of large but not fully mature juvenile cattle as well as the presence of adults (note the different fall-off of survivorship at Hofstaðir and Sveigakot).

The graph further indicates that less than 40% of adult animals in the Gásir archaeofauna seem to have been between ca. 3.5 – 4 years of age and older.

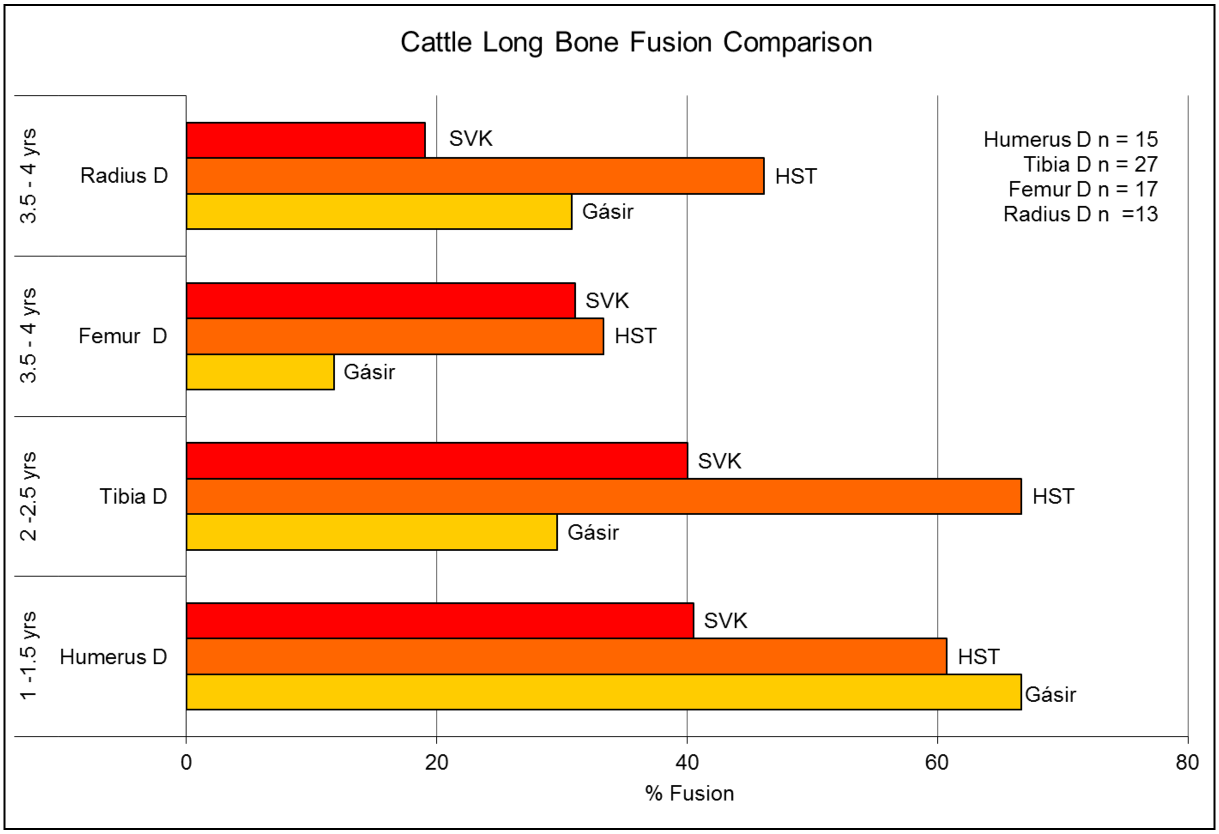


Figure 4.8. Cattle long bone comparison. SVK – Sveigakot, HST – Hofstaðir, both in Mývatnssveit, NE Iceland.

A total of 29 cattle tooth rows were excavated from Area A, and 17 of the lower jaws can offer some insight into the site's food provisioning strategy. The reason for eliminating 8 tooth rows from this eruption analysis is based on mostly post-depositional factors, such as loss of diagnostic teeth that would make this eruption study too speculative. As Figure 4.8 demonstrates, in the majority of the excavated cattle tooth remains, the animals' death occurred either in the second or third year of life or as an adult. The shortage of jaws of usually common newborn or less than 3 month old calves is notable, and supports the impression provided by the overall low percentage of neonatal or very young juvenile cattle bones. If these old juvenile or young adult cattle are males, they have been raised at considerable expense in fodder, especially during the winter.[5] If they are females, they also have lived long enough to consume much fodder, but are only beginning their potential service as dairy cattle. In either case, in the context of a dairy herd, these are very expensive animals to raise and slaughter at this stage in their lives.

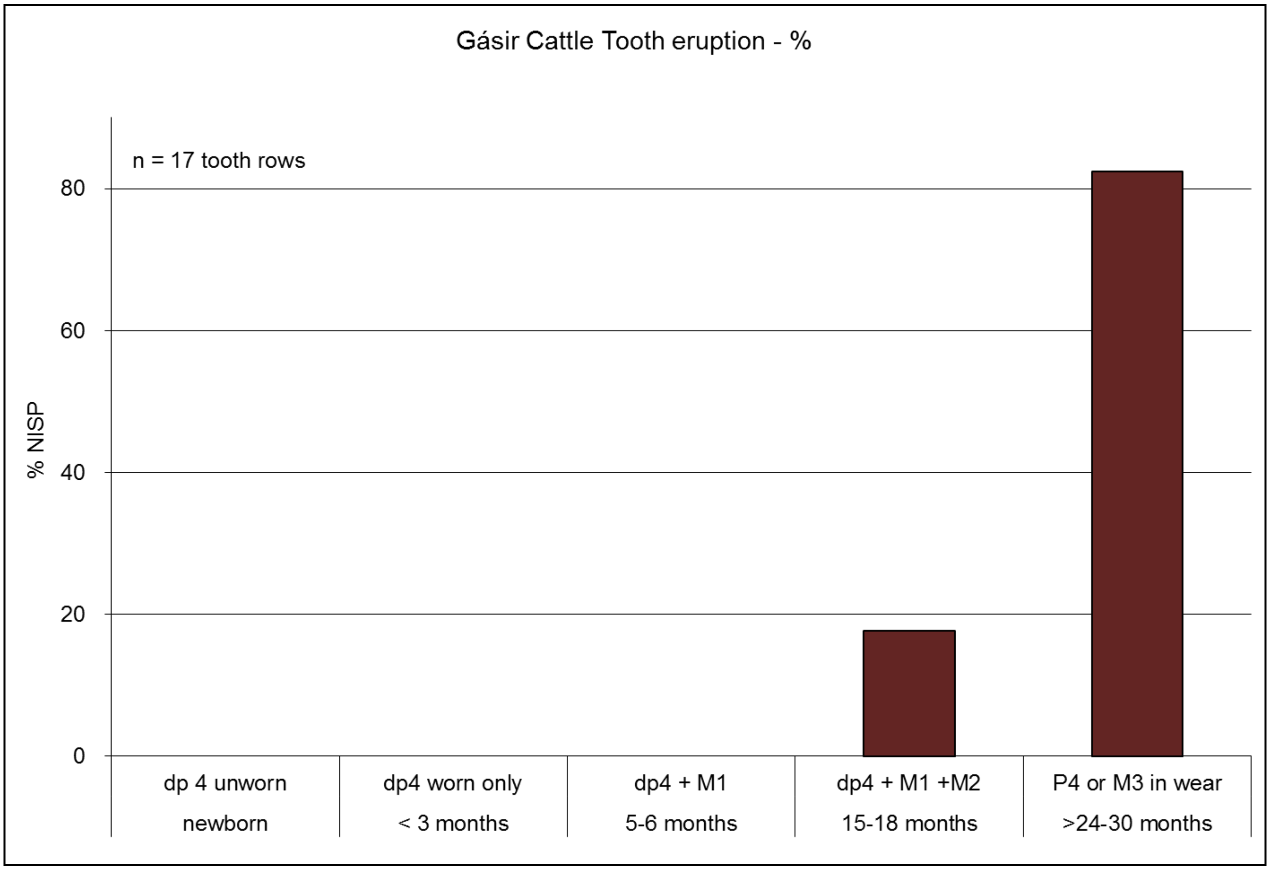


Figure 4.9. Gásir Cattle tooth eruption.

[5] There are ethnographic accounts suggesting that male cattle had to fend for themselves in the winter and were only given hay if the snow was too deep; they were treated more like horses than dairy cows (O. Vésteinsson, personal communication January 2013).

4.6.2. *Cattle Bone Density and Modified General Utility Index (MGUI)*

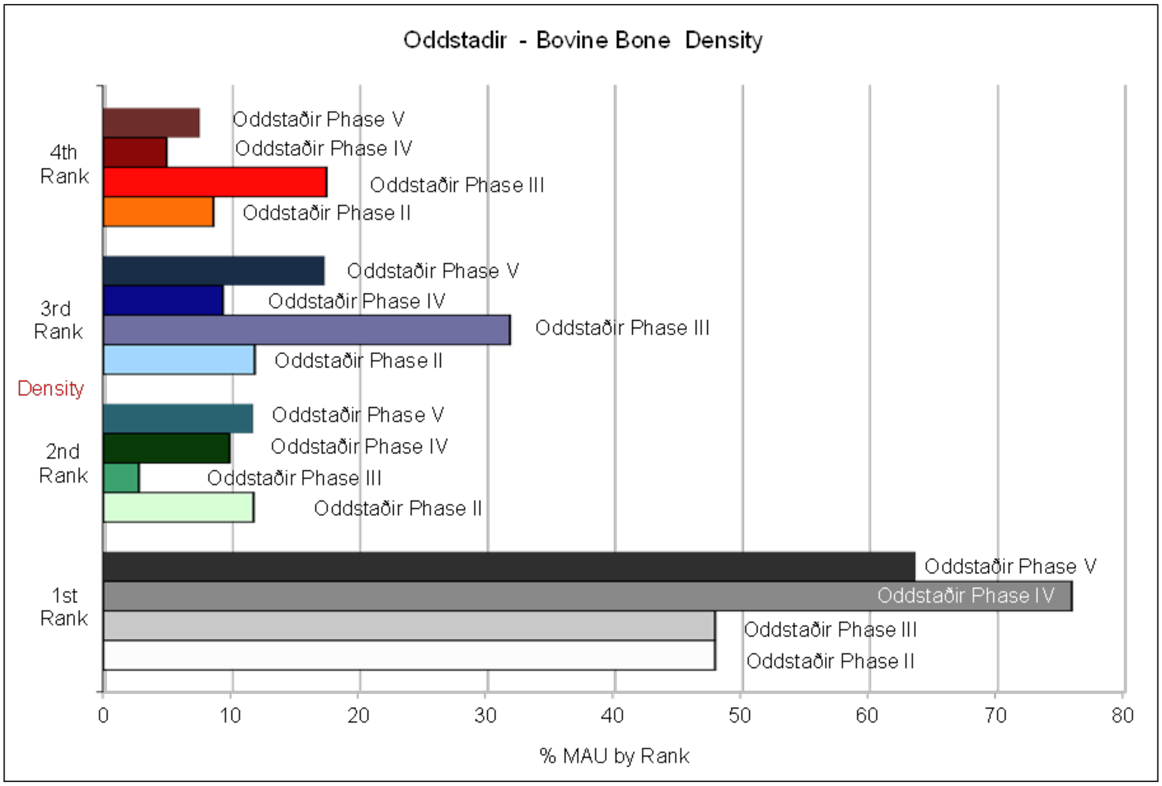
These statistical aids are based originally on Binford's (1978) *Nunamiut Ethnoarchaeology* study of caribou and sheep with more recent expansion to a wider range of mammals (Lyman 1994:231). Under this approach, each bone element is given an MGUI "score" allowing it to be ranked for value in associated meat and marrow (though some scoring includes values for associated sinew and other non-food products). Not surprisingly, there is much variability in the MGUI scoring used by different authors, but as Lyman notes all the scoring approaches end in producing a broadly comparable ranking from "most value" to "least value" for most taxa. In the NABONE zooarchaeology software package used in this thesis (NABONE 9th ed, www.nabohome.org) the cattle and caprine bone element values are grouped into four ranked quartiles (most value to least) in an effort to avoid spurious precision while maintaining a broadly robust indicator of probable meat and marrow value associated with the different parts of the bovid skeleton. The NABONE MGUI presentation is thus aimed at providing a common comparative graphic output for comparison of bone value scores between sites and phases to aid recognition of element distribution patterns that suggest (or refute) culturally patterned differential patterns in animal bone element distributions.

However, element distribution and MGUI scores are only partly the result of past human butchery choices. All archaeofauna are to one degree or another subjected to non-random taphonomic attrition between initial deposit and eventual excavation and analysis. Bone density is widely recognized as a key factor in the differential survival of bones subjected to a wide range of forces of attrition (gnawing, burning, trampling, acid soil). There is thus also a substantial archaeological literature on calculation of bone density for different animal's skeletal elements (summarized and critiqued in Lyman 1994). Again, based originally on Binford's

(1978) early work, approaches to scoring the density of different parts of different skeletons have produced a range of results, but (as Lyman again observes) while these approaches produce different ranked listings, all approaches can be combined in a quartile ranking approach that effectively captures the variability of the individual studies into a more robust if more general quartile scoring approach.

As with the MGUI values ranking the most meat/food-baring elements versus those with the least meat values, the NABONE package follows this approach, again combining elements into four ranked quartiles (most dense to least dense). The graphic output is intended to both flag up collections that are inherently non-comparable (heavily ravaged collections composed mainly of teeth and the most dense bone elements vs. well preserved collections with most elements represented) and to allow investigation of arguments about culturally determined differential transport of bone elements.

Where appropriate, these methods were applied to all sites´ datasets and the above explanation on the motives for ranking bones for their meat value but also their density applies to all faunal collections analyzed in this manner. It seemed important to include a very in-depth discussion on the reasons for doing such in this chapter, as Oddstaðir provides us with the clearest indication for a change in the site´s meat profile over time.



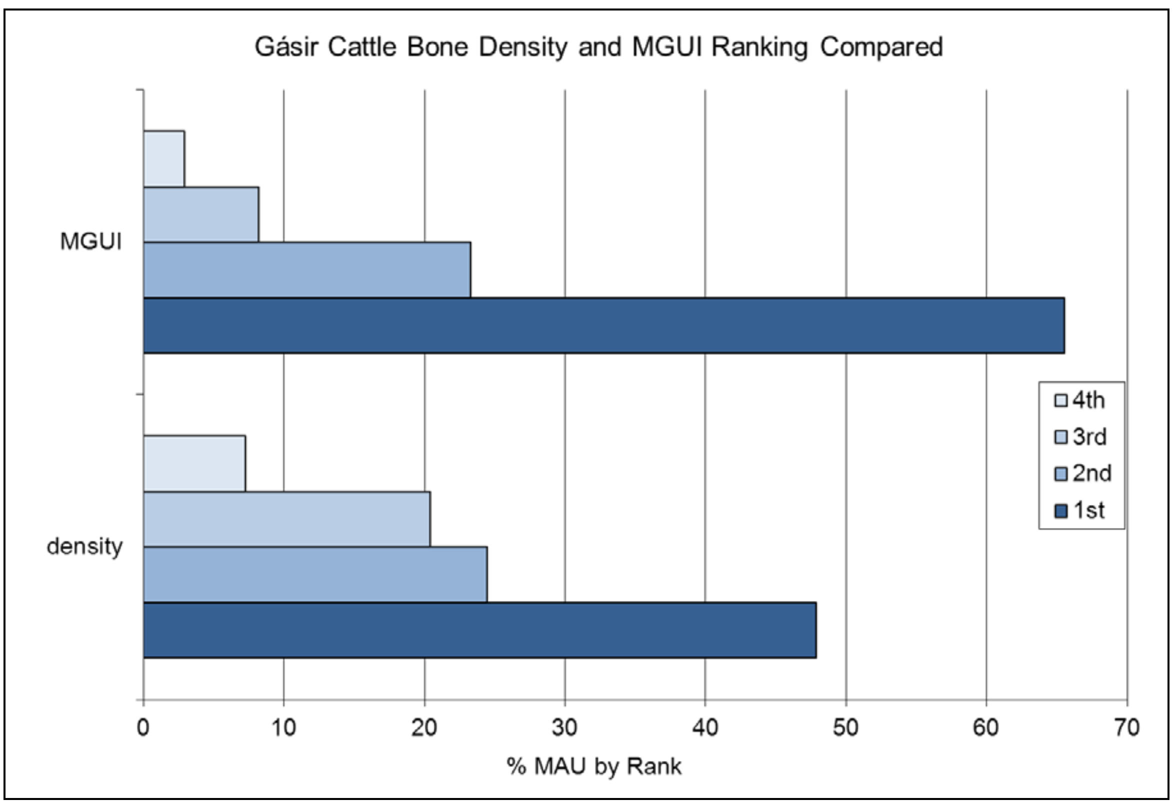


Figure 4.10. Gásir Cattle MGUI (Modified General Utility Index (Lyman 1994:227) and Bone Density Comparison.

The comparative data graph above confirms the interpretation of the cattle skeletal element distribution graph in figure 4.10. **MAU** is '…the minimum number of animal units necessary to account for the specimens observed (Lyman 1994:511).' **MAU** normalizes differences in number of bones in the skeleton, so in a complete and un-fragmented cattle skeleton these bars would be equal length.There is clear distinction between bone density and the meat bearing quality of the cattle skeletal remains in the Gásir collection. Bones associated with the best or at least highest amount of meat were primarily selected for, making up ca. 65 % of the entire assemblage, with those of little meat utility contributing less than five percent. When comparing these meat utility and density profiles to those of other regional sites, the difference of this site's consumption pattern and those of the other sites is very clear: the current Hörgárdalur collections available for faunal comparison suggest that Gásir residents were given the highest quality meat cuts available in the region (see Data Chapters 5, 6, 7 and Discussion/Conclusion Chapter 8). The bone density distribution indicates that it is reasonable to discuss this cattle bone assemblage based on an element distribution analysis.

4.6.3. *Skeletal Element Distribution - Cattle*

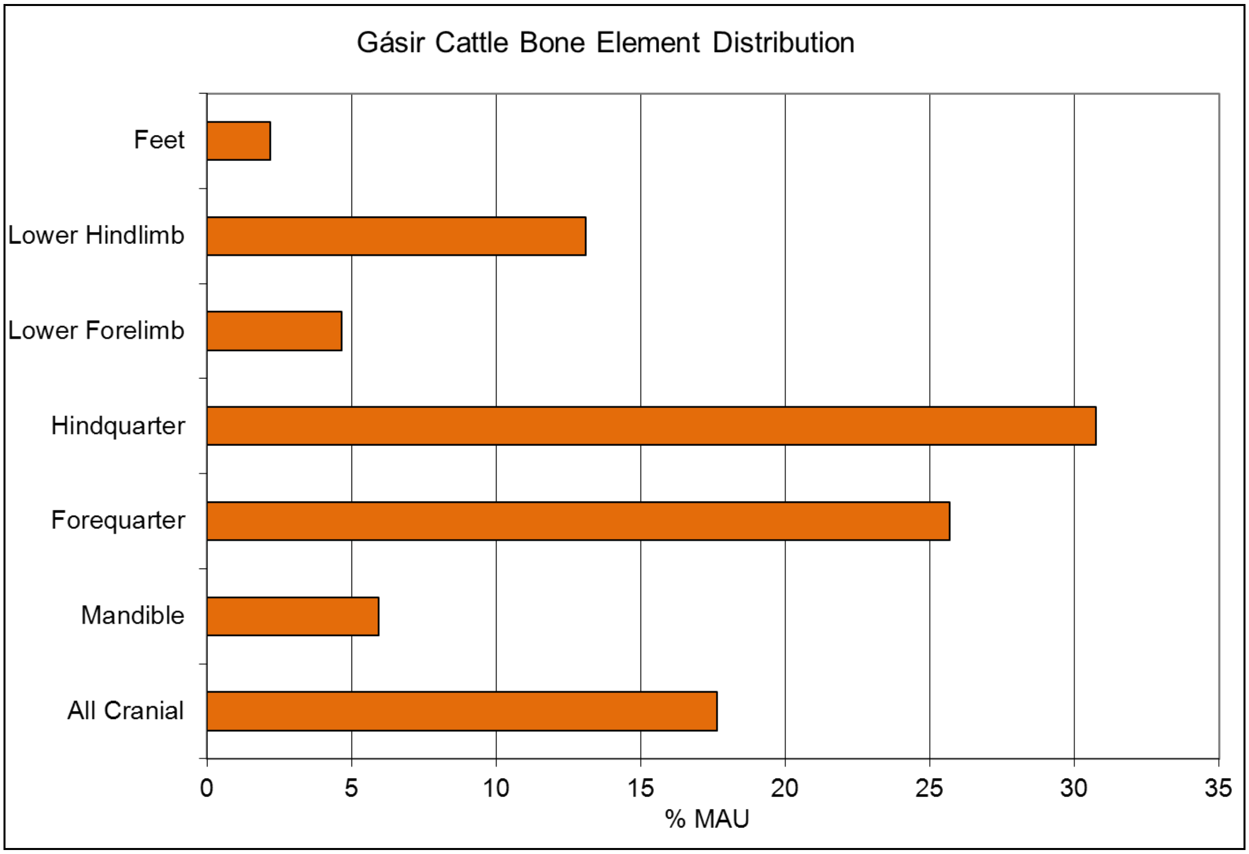


Figure 4.11. Gásir Cattle Skeletal Element Distribution. MAU = '…the minimum number of animal units necessary to account for the specimens observed (Lyman 1994:511).' MAU normalizes differences in number of bones in the skeleton, so in a complete and un-fragmented cattle skeleton these bars would be equal length.

As indicated in figure 4.11, an overabundance of bones from the hindquarter and forequarter, associated with high quality cattle meat can be observed. These include the shoulder bones (scapulae), humeri and radii/ulnae in the front, and the rump, femora, and tibia in the hind part of the animal. The lack in vertebral and rib elements (and therefore sirloin area) is easily explained as a result of the NORSEC protocol of placing non-diagnostic fragments of rib and vertebra into a more general category, in this case indicated as 'LTM' or Large-terrestrial-mammal.

The ca. 17 % of cranial and 6 % of mandibular elements present indicate a small on-site presence of live cattle, but a relatively larger amount of cow elements seems to have been brought to site in form of beef cuts. This is also attested in the low amount of lower fore and hind legs and foot bones. Those are elements that are not heavily meat packed but are often used for marrow extraction.

The graph below uses the information above in form of food utility and bone density comparisons to indicate whether an actual preference for meat bearing bones over a mere taphonomic signature favoring preservation of very dense bones over less dense bones is suggested from the Gásir cattle skeletal remains. Phased cattle (and caprine, below) bone density rankings and the MGUI (Modified General Utility Index (Lyman 1994:227) rankings, or portions of the animal's skeleton bearing the most food utility (i.e. muscle mass, but also marrow and sinews) are presented next. These statistical aids can help identify levels of taphonomic effects versus human choice for certain meat cuts, although their application is somewhat limited because they are based on few examples (Lyman 1994:231).

4.6.4. *Age at Death Reconstructions - Caprines*

Figure 4.12 shows the pattern of tooth eruption in the caprine tooth rows (mandible and maxilla) from the Gásir excavation. The lamb proportion makes up 19% of this assemblage, with very young adult sheep another 19%. This leaves 62% of caprines killed at an age of > 14 months, with full adult dentition in wear. Wear rates on these caprines' third molars suggest that few of these adult sheep were in fact old adults.

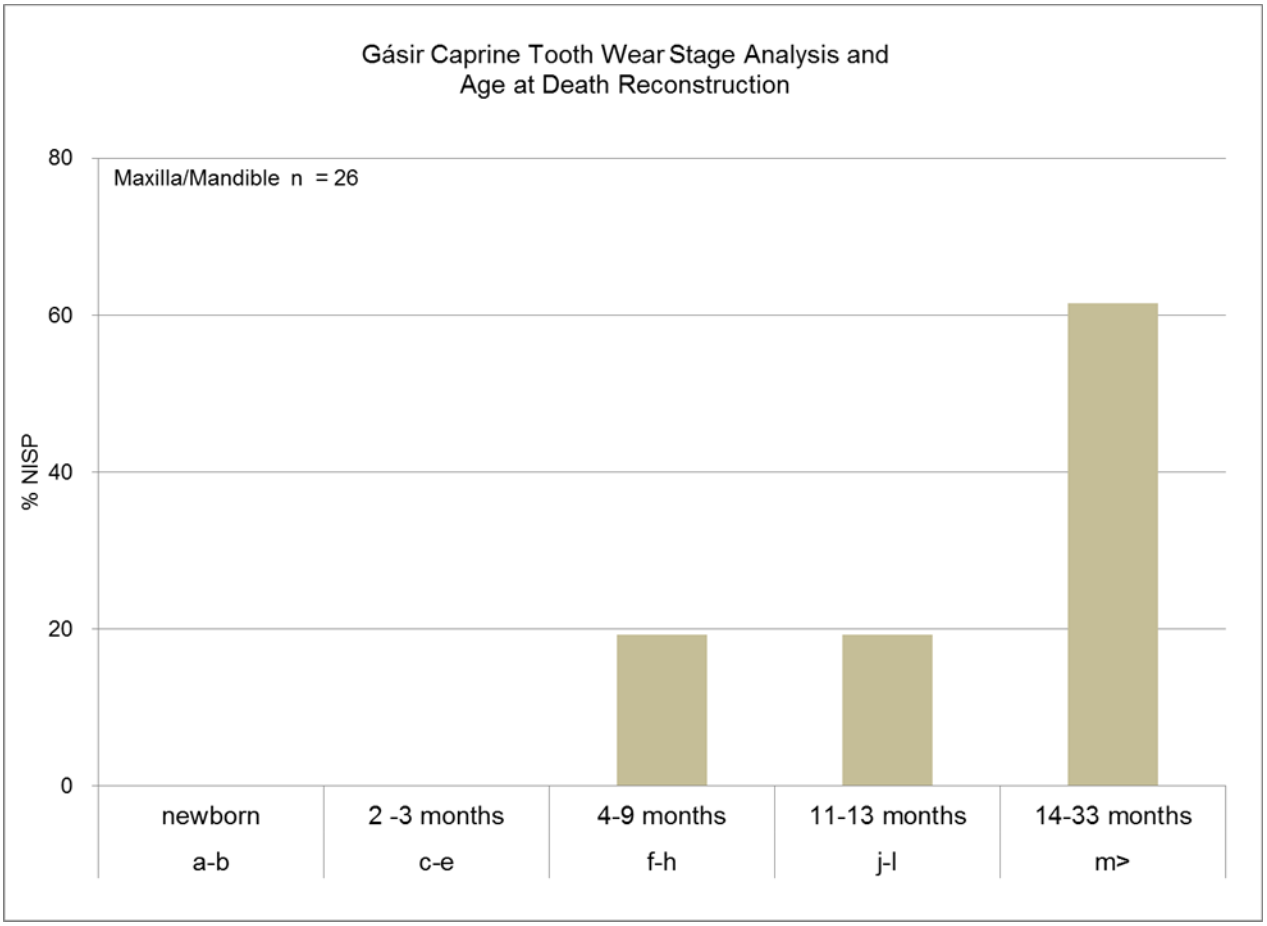


Figure 4.12. Caprine tooth wear stages - estimated age reconstructions (Grant 1982, Enghoff 2003).

Figure 4.13 below displays a comparison of tooth wear stages on caprine mandibles with wear stage scores used from Grant (Grant 1982). As indicated by the graph above, wear rates on caprine third molars (M3) suggest that very few of these animals were killed at an advanced age. Rather, the mandibular wear patterns indicate the presence of substantial numbers of young to middle aged adults, without the higher proportion of highly worn teeth characteristic of old ewes or wethers (probably maintained primarily for wool production) characteristic of most larger Icelandic sheep mandible collections, i.e. HST and SVK used for comparison from the NE Icelandic inland sites mentioned earlier (McGovern 1999, 2002, McGovern et al 2007). There were 17 mandibles available for study.

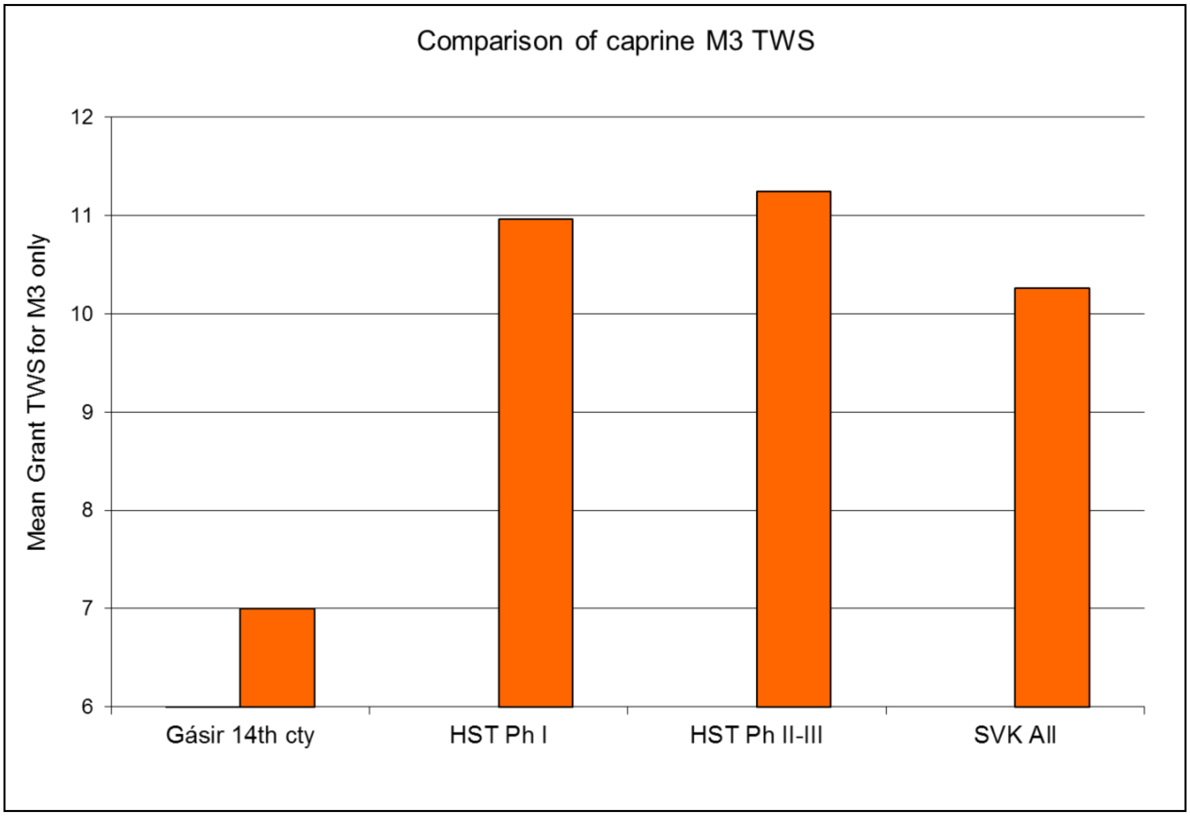


Figure 4.13. Comparison of caprine M3 TWS (tooth wear stages), Gásir n = 17. SVK – Sveigakot, HST – Hofstaðir; both in Mývatnssveit, NE Iceland.

The caprine (sheep/goat) long bone fusion comparison below shows the majority of Gásir caprines killed between 2 and 3.5 years of age, placing them into a young adult and thus high quality meat stage. In comparison, caprines at HST (Hofstaðir) and SVK (Sveigakot) saw a slightly different mortality pattern, with higher culling in the first year and a generally higher proportion of older adults at HST. Tooth wear and long bone fusion patterns suggest that most animals died as younger adults or mature adults.

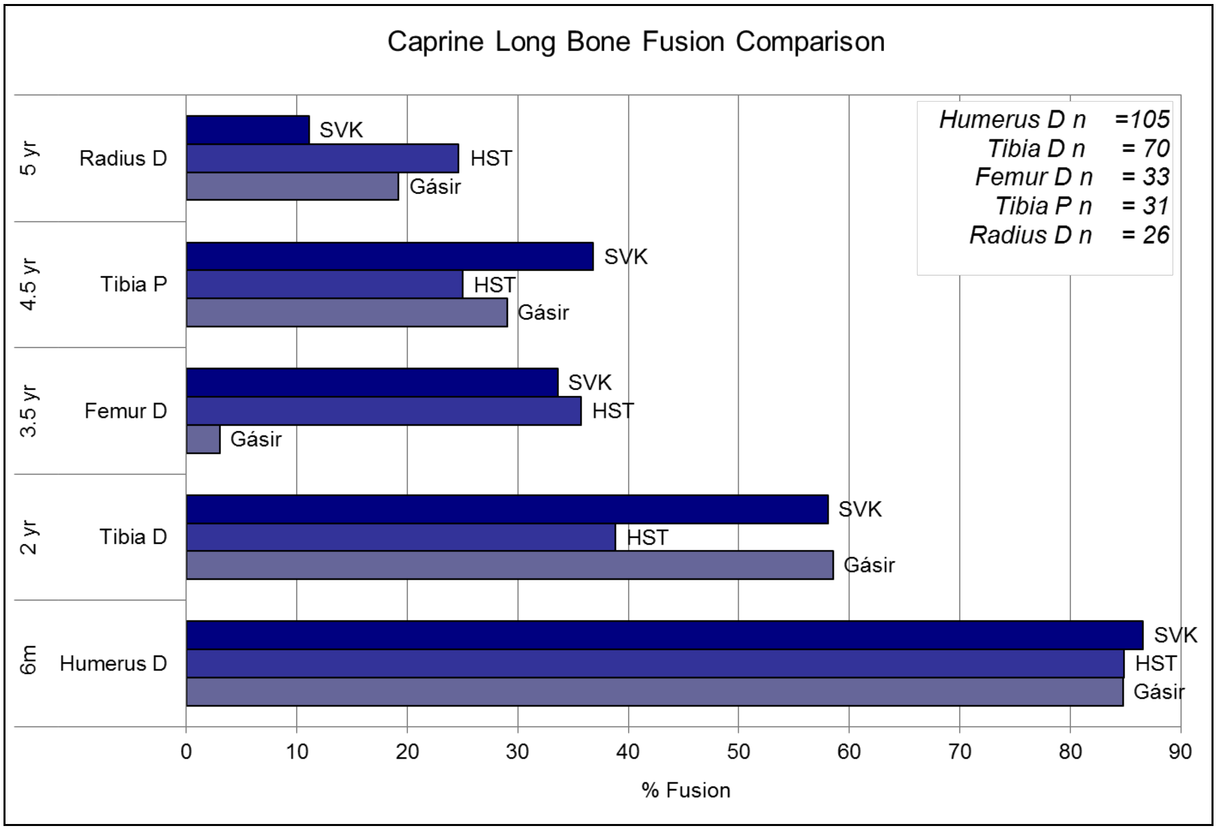


Figure 4.14. Caprine Long Bone Fusion Comparison. SVK – Sveigakot, HST – Hofstaðir; both in Mývatnssveit, NE Iceland.

4.6.5. *Skeletal Element Distribution and Meat Utilization Indices - Caprines*

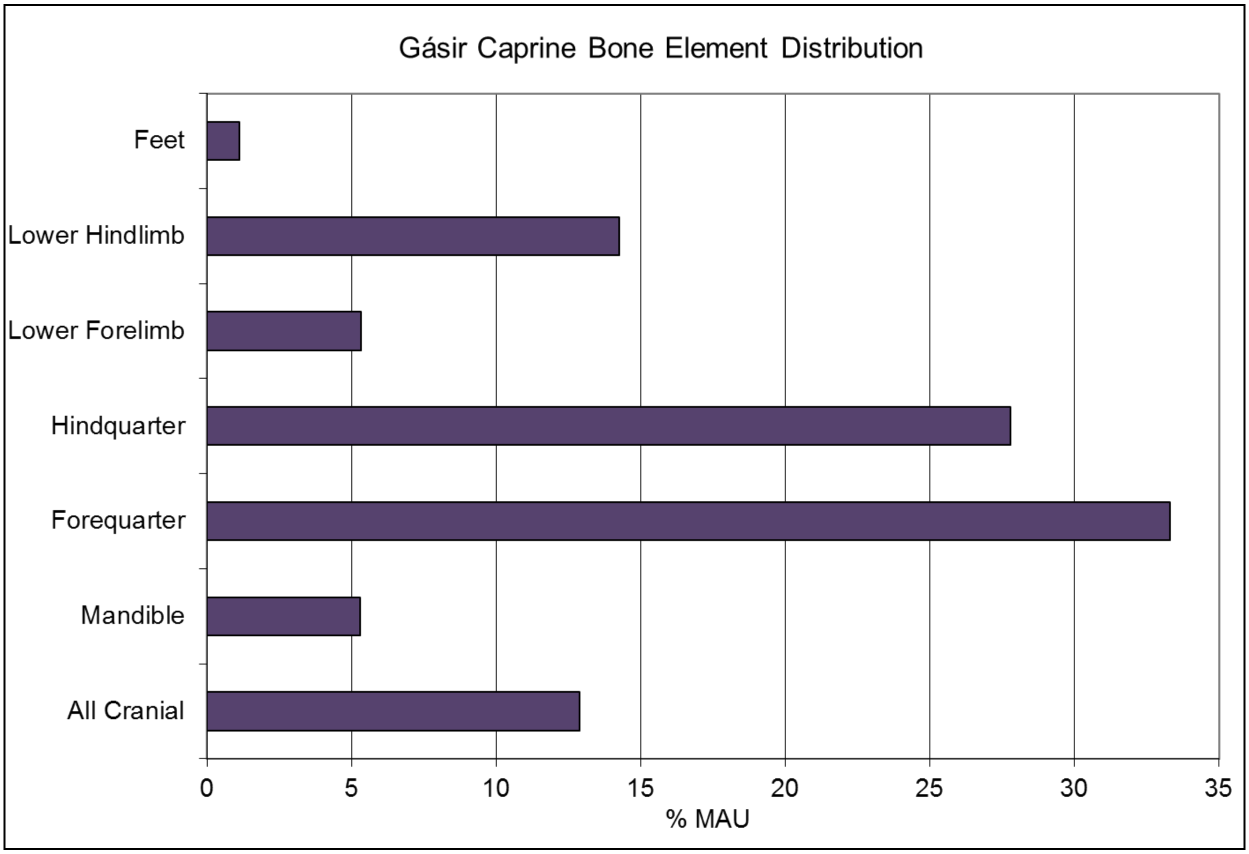


Figure 4.15. Gásir caprine skeletal element distribution. MAU = '…the minimum number of animal units necessary to account for the specimens observed (Lyman 1994:511).'

The caprine skeletal distribution graph suggests higher prevalence of long bones over other body parts whose meat utility is lower than that of the hind and forelimbs. Compared to the caprine skeletal element distributions available from the hinterlands sites (Möðruvellir, see Data Chapter 5; Skuggi, see Data Chapter 6; Oddstaðir, see Data Chapter 7; Discussion and Conclusion Chapter 8), it is clear that the graph above indicates supply of predominantly prepared meat cuts and strongly suggests that while some animals made it to site alive, as indcated by the low amount of cranial, mandibular, and foot bones, there is a disproportionate concentration of meat rich elements suggesting transport of cuts of meat as well as whole animal carcasses present as results from live anmals brought to site. Teeth and mandibular bone as well as some adult cranial bones are very durable and the pattern ovserved in graph 4.15 can therefore not be explained by taphonomic processes alone. Rather, the prevalence of long bone and shoulder/hindquarters suggests a choice made by the providers or consumers. As is usual for NORSEC/NABO protocol, the absence of vertebrae and rib (vert & rib) elements derives from the practice of lumping undiagnostic verterbral and rib fragments into general animal size categories rather than assigning them to species level in an attempt to keep the error level at a minimum. The graph below, displaying meat utility index (MGUI) and bone density comparisons offers a more refined idea about the sort of caprine body elements found at Gásir.

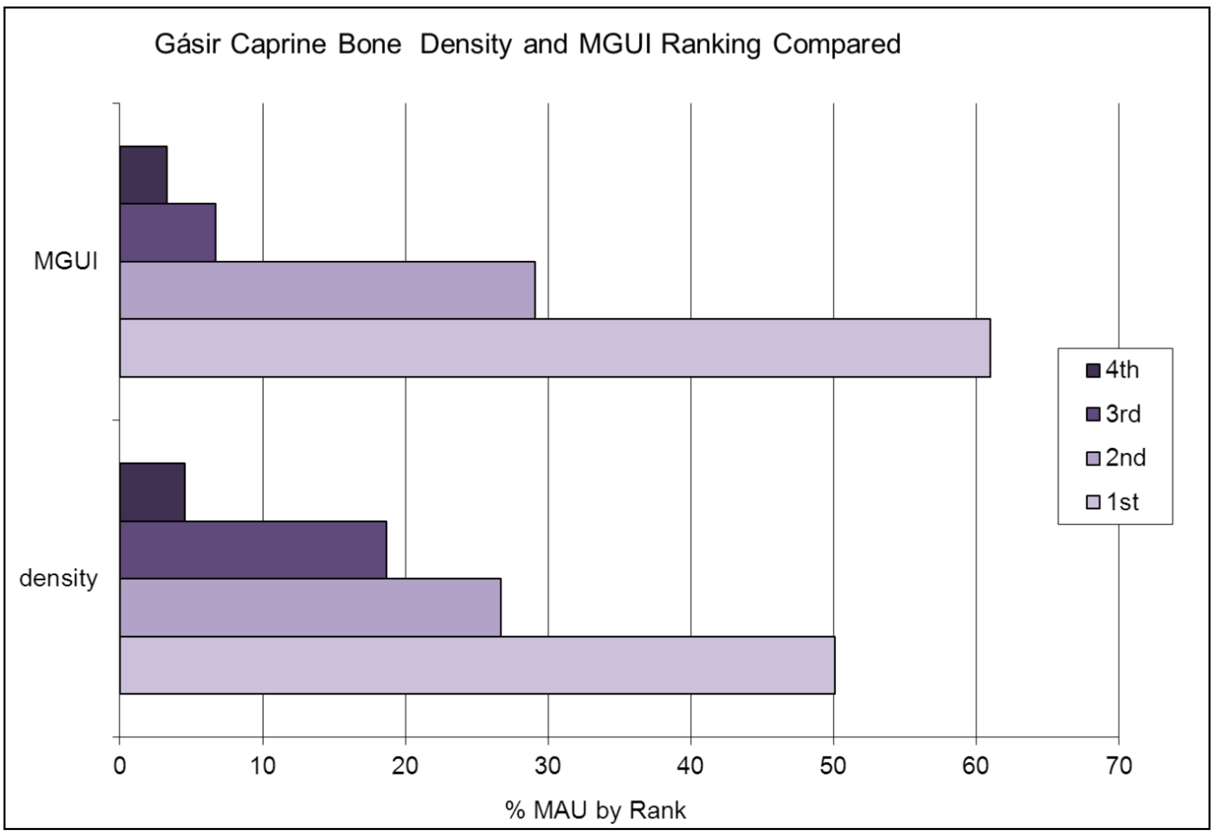


Figure 4.16. Gásir Caprine MGUI vs. Bone Density Graph. MGUI (Modified General Utility Index (Lyman 1994:227) and Bone Density Comparison. MAU= '…the minimum number of animal units necessary to account for the specimens observed (Lyman 1994:511).' MAU normalizes differences in number of bones in the skeleton, so in a complete and un-fragmented cattle skeleton these bars would be equal length.

As was true for the cattle skeletal remains (see above), the bar graph in the MGUI segment clearly indicates that there is a high preference for bones with the highest food utility index. At the same time, the density profile of the Gásir caprine skeletal remains suggests a taphonomic profile, that, while clearly affecting less dense bones, shows less abrupt declines in % bone preservation of less dense bones than at Möðruvellir, where the various stages of bone preservation are clearly reflected in the bone density graphs of the faunal collections from three distinct occupation phases (see Möðruvellir Data Chapter 5 and Discussion and Conclusion Chapter 8). When comparing the Gásir caprine bone density graph with the MGUI graph, a clear preference of bones as proxies for higher meat utilities is suggested.

4.7. Pigs

A considerable number of pig remains are present in the Gásir faunal collection. This is very atypical of late medieval Icelandic and also European (Reichstein 2000) sites. By the 14th Century, the pigs had either disappeared from the Icelandic landscape or become rare (McGovern et al 2006). They actually more or less disappear from faunal collections after the 11th c. and were thus not a part of the average farm´s economy after the Viking Age (but see Oddstaðir chapter for presence of pigs in the 13th and 14th c.). Some of the bone fragments present could have formed portions of smoked or salted pork shoulder or hams (Perdikaris et al 2002), but some cranial fragments suggest that live pigs (native or imported) were present at Gásir.

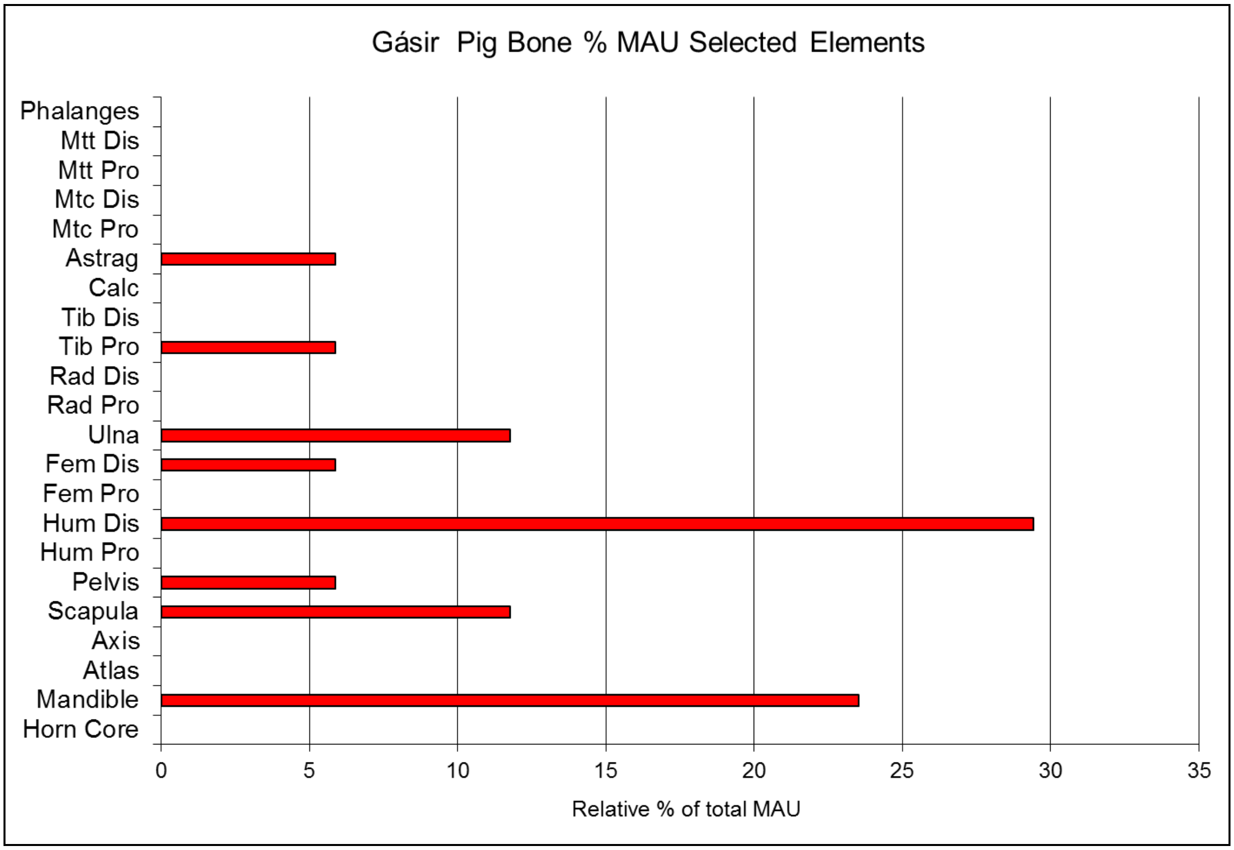


Figure 4.17. Breakdown of Gásir meat-bearing elements (pigs), MAU % (NISP divided by their frequency in skeleton in %).

Figure 4.17 displays the percentage of the various skeletal elements in relation to their frequency in the skeleton. Long bones, and especially femur (80 %) and humerus (>65%) elements were found to have butchery marks on them. The chop marks together with the lack of articulated elements could mean that some pigs were brought to site already proportioned (see Wigh 2001). There were two elements found in contexts 2783 and 637: a chopped femur and the maxilla/calvarium in the first, and a femur shaft element and scapula proximal end in the latter. The pig elements from context 637 do not display any butchery evidence. Those elements could have come to site in form of pork cuts and were not likely the result of live animals brought to site and slaughtered there (for discussion of pig butchery methods see Prilloff 2000). The Gásir pig bone element distribution graph displays more clearly the lack in certain elements associated with the entire animal. There may have been a few animals slaughtered at Gásir, but a disproportionally high percentage of forequarter and hindquarter elements suggest pork cuts were brought to the site, possibly from the local area, or from abroad as provisions for the trip. The few live animals possibly brought to Gásir could have been used for disposal of food offal on board. For example a study analyzing animal bedding have resulted in pig dung on the 13th c. Gedesby shipwreck from Denmark (Robinson and Aaby 1994).

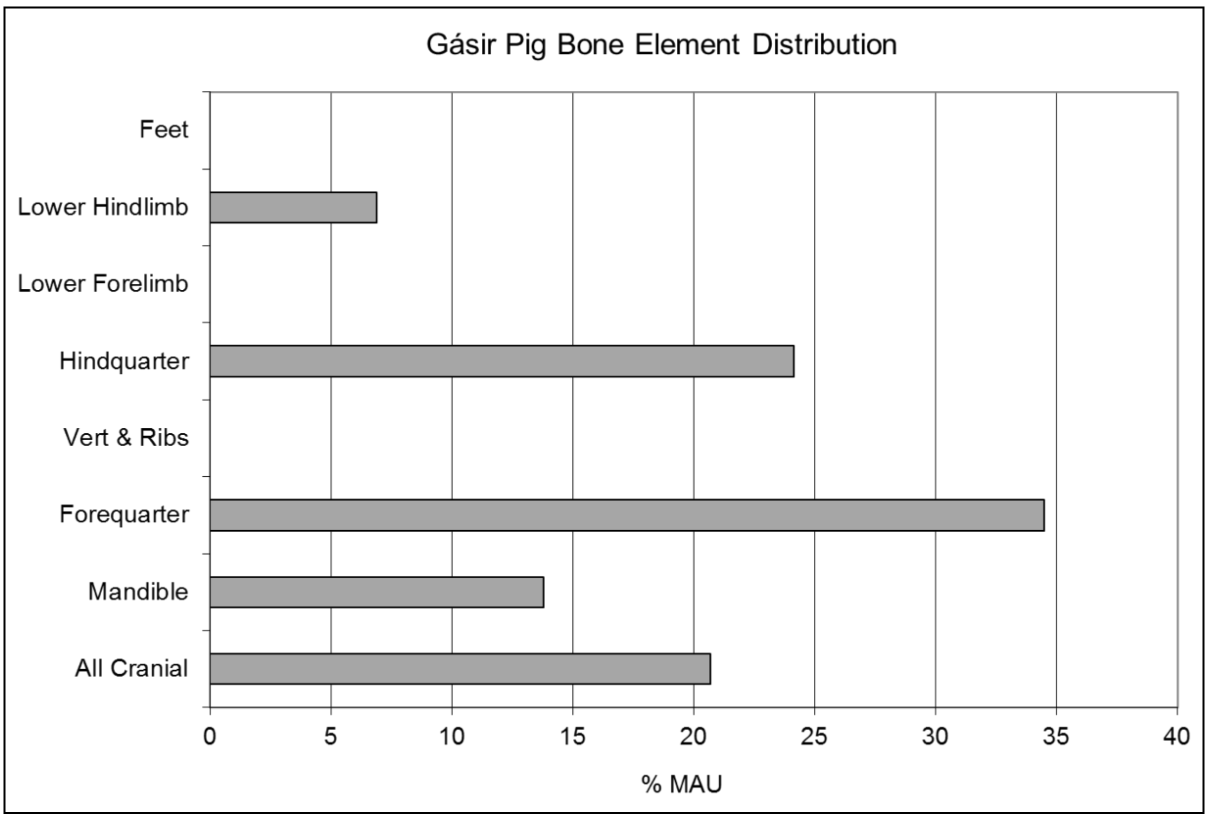


Figure 4.18. Gásir Pig Bone Element Distribution.

4.8. Dogs

In total, 15 dog elements were found in the Gásir faunal remains. These fragments belong to most likely only 11 individuals, as some elements were found in the same context, highly suggestive of articulated skeletons rather than several individuals.

Reconstructed Shoulder Heights of Small Gásir Dogs							
Species	Conte xt	Skeletal Element (bone)	Greatest Length (GL) of bone	Size-reconstructio n factor (von den Driesch & Boessneck 1974)	Recon-structed shoulder height	Size-Reconstructi onMeasurem ent (Harcourt 1974)	Recon-structed shoulder height
Canis f.	1551	tibia	90 mm	2.92	26.3cm	(2.92xtl) +9.41	27.2 cm
Canis f.	2812	humerus	98 mm	3.37	33 cm	(3,43xtl) -26.54	31 cm
Canis f.	2851	humerus	98.55 mm	3.37	33.2cm	(3.43xtl) -26.54	31.2 cm

Table 4.3. Reconstructed shoulder heights of small Gásir dogs.

The discovery of five very small dogs at Gásir is subject to further investigation, but such small "lap" dogs were status items in high medieval Europe (Prilloff 2000) and have been found in late medieval Icelandic archaeofauna from high status sites such as Skriðuklaustur and Hólar (Pálsdóttir & Roberts 2006, Traustadóttir personal communication, 2005). As indicated by table 3, these dogs were of lap dog size, slightly larger than a Pomeranian. The small dog from context 2812 is an articulated individual. Figure 13 demonstrates the small size of the dog's skull as likely representative of the other dog sizes which is compared to a specimen at AMNH. It was not clear to which dog breed that skeleton belonged, but it was smaller than medium-sized.

Figure 4.19. *Canis familiaris*, context 2812 (left), compared to a small AMNH dog specimen (right).

4.9. Birds

The majority of Gásir bird bones were from eider ducks, still common in summer along the shore of Eyjafjörður today. The other larger species assemblage is from Guillemot and Murre (these species cannot be distinguished on most skeletal elements, but have similar habits). These birds' skeletal elements were quite regularly found in the various deposits. Guillemot and Murre may have been consumed quite extensively during seasons of availability, as was the case in medieval Atlantic Europe (Bond and O'Connor 1999:418). Just like guillemots, puffins and razorbills are summer migrants present in breeding colonies near the mouth of Eyjafjörður and offshore islands (Harrison et al 2010). These sea birds belonging to the auk-family were widely consumed in Atlantic Europe, including Iceland (i.e. Bárðarsson 1987: 92). In many parts of Europe (notably in medieval England) swans were "royal" birds and their consumption was restricted to the high nobility. In Iceland, however, migratory swans were occasionally but not commonly taken from first settlement onwards and their bones appear in sites of lower as well as higher status. The consumption of swan meat at Gásir may have carried a different social message to the visiting merchants than their Icelandic customers. Only one specimen of the swan as found in the Gásir archaeofauna, suggesting that consumption of this large bird may be sporadic rather than a frequent occurrence (Harrison et al 2010).

Less ambiguous is the medieval connection between social status and importance of two gyrfalcons (probably from different individuals, contexts 1632 and 756), as these were falconry birds of the highest rank, and were reserved as royal gifts. As early as 1185, Giraldus Cambrensis writes about a noble falcon from Norway that killed King Henry´s hawk, which may have stirred his interest in these birds of prey (Cambrensis in Forester´s translation 2001: 34). Additional discussion on these royal gaming birds is provided in Chapters 2 and 8.

Identified Bird Species	NISP	% NISP
Raptor	2	2.30
Gyrfalcon (Falco rusticolus)		
Migratory Waterfowl		
Mallard Duck (*Anas platyrhynchos*)	1	1.15
Eider Duck (*Somateria mollissima*)	35	40.23
Mute Swan (*Cygnus olor*)	2	2.30
Red throated diver (*Gavia stellata*)	1	1.15
Anas species (Duck family)	3	3.45
Sea birds		
Murre species (Uria species)	24	27.59
Atlantic puffin (Fratercula arctica)	8	9.20
Razorbill (Alca torda)	5	5.75
Common gull (Larus canus)	1	1.15
Gull species (Larus species)	4	4.60
Unidentified sea bird species	1	1.15
Total	87	100

Table 4.4. Identified Gásir Bird Species.

4.10. Wild mammals

4.10.1. *Arctic Fox*

The few Arctic fox (*Alopex lagopus*) elements recovered from various deposits did not offer conclusive evidence of fur production, trading, or whether they were simply killed for being an annoyance as scavengers (Hersteinsson 1989). Clearer evidence for skinning of foxes exists from the 9th-late 12th c. site of Sveigakot (McGovern et al 2004).

4.10.2. *Marine Mammals*

As Gásir is located on the coast of a long fjord opening to the waters of the Atlantic Ocean, the presence of marine mammal fragments among the archaeofauna comes as no surprise as there are several known seal hunting places in Eyjafjörður. (Kristjánsson 1989 I:315), The whale bone fragments at Gásir fall into two overlapping categories: those which have been worked as raw material for artifacts (mainly coming from great whales), and those suggesting whale meat provisioning. The latter category is associated with animals in the small whale/porpoise size range. Late medieval cook-books include many recipes for young porpoise to be served as high-status dishes, but porpoise and small whales have been consumed in many parts of the North Atlantic since prehistory (Szabo 2005). According to Bond and O'Connor, whale and seal meat was sometimes classed with fish in medieval times and was therefore suitable for consumption on meatless fast days, though this practice varied through time and location (Bond & O'Connor 1999, 418, Adamson 2004, 44, see also discussion in Müldner & Richards 2007).

The seal bones found at Gásir include both adults and newborn young and butchery marks suggest that they were eaten. Alternatively, seal skins were also a widespread North Atlantic export. Regularly eaten by coastal people, in later medieval cooking books seals were considered "sailors' food" (Adamson 2004). The seal bones at Gásir thus may either serve as indicator for seafaring people residing at the trading station, or simply as a reflection of normal Icelandic dietary preferences (Harrison et al 2010). Those seal bones that could be analyzed to species level were from the ice-riding harp seal (*Phoca groenlandica*) rather than the local harbor seals (*Phoca vitulina*) still common in Eyjafjörður today (Harrison 2006). Harp seals are common in Icelandic waters only during periods of heavy drift ice and have been associated with later medieval climatic conditions in the North Atlantic, particularly the heavy summer sea ice encountered in Denmark Strait after 1300 (Ogilvie 1991, Ogilvie et al 2008; Amorosi 1992, Woollett 2004).

A brief discussion of a single piece of walrus tusk (*Odobenus rosmarus*) recovered from the Gásir site concludes the wild mammal section. This proximal end of a walrus tusk (figure 4.20) is a part of the apex of the deep tooth root, and has been cut off using a narrow-bladed backed saw (McGovern, personal communication, May 2004). Whole walrus tusks dating to the late 9th c. (before the settlement of Greenland) were recovered from the very early long hall at Aðalstræti in Reykjavik and possibly came from local Icelandic walrus populations (Tinsley & McGovern 2002, Vésteinsson 2006). By the later Middle Ages however, these local populations were certainly extinct. Upon Greenlandic Settlement in the later 10th c., walrus were heavily exploited by the Norse Greenlanders (McGovern 1984) and the frequency of the dense maxillary bone fragments and occasional chips of tusk ivory recovered from midden and floor layers suggests widespread community involvement in the walrus hunt and the final extraction of the tusk ivory on the home farms (McGovern et al 1994, Dugmore et al 2007).

Figure 4.20. Sawn walrus tusk fragment, Gásir.

This sawn tusk root from Gásir is different from any of the Greenlandic walrus processing debris, and may be part of a later stage of ivory working in which the extracted tusk is sub-divided for carving or inlay production. Likely not from a recently killed walrus but from a walrus tusk prepared for high-end craft working, this fragment is thus less likely to represent the remains of an animal killed nearby. It seems more likely that it reflects work done on tusks acquired elsewhere (perhaps Greenland), and thus raises further questions about westwards as well as eastwards connections.

4.11. Fish

4.11.1. *Marine Fish*

Marine fish remains at Gásir account for more than half of the total identified archaeofauna and the great majority of the identifiable 1,745 fish bone fragments belong to the cod family (Gadidae) (Harrison et al 2008).

As indicated by the high number of indeterminate fish bone elements, a large amount of the Gásir fish remains is fragmented beyond speciation. One possible explanation could be the application of stone cod hammers used to tenderize dried fish in medieval times. At least one of these fish/cod hammers was registered as find no. 05-059, from context 2354 (Pálsdóttir & Roberts 2006, finds list, Appendix 2).

4.11.1.1. Brief Overview on Icelandic Fishing Tradition from the Viking Age on

In the early Viking Age pre-commercial period of dried fish production and exchange, there was a wide range of gadid species that were to be dried and exchanged. One signature of the onset of full-scale commercialization and international fish trade however was a specialization on the Atlantic codfish (*Gadus morhua*). After about AD1100, Atlantic codfish bones tend to dominate the midden contents of major fish-producing sites (Perdikaris 1999, Perdikaris & McGovern 2007, Perdikaris et al. 2004). Even after the commercial focus upon a single species (and the standardization of acceptable size ranges for individuals of that single species), fishing communities tended to provision themselves with by-catch of related gadids that were not part of the product processed and destined for commercial trade and export (haddock in

Iceland, saithe in the Northern and Western Isles; Perdikaris and McGovern 2008), as well as cod that proved unsuitable for drying (Perdikaris & McGovern 2006, 2008, Harrison et al 2008).

4.11.1.2. *The Gásir Gadids*

Since the production of round-dried stockfish requires near-freezing temperatures, Icelandic medieval commercial fishery activities (like arctic Norway) took place in winter; the Gásir site occupied in spring and summer could therefore not have been directly involved in stockfish production (Harrison et al 2008).

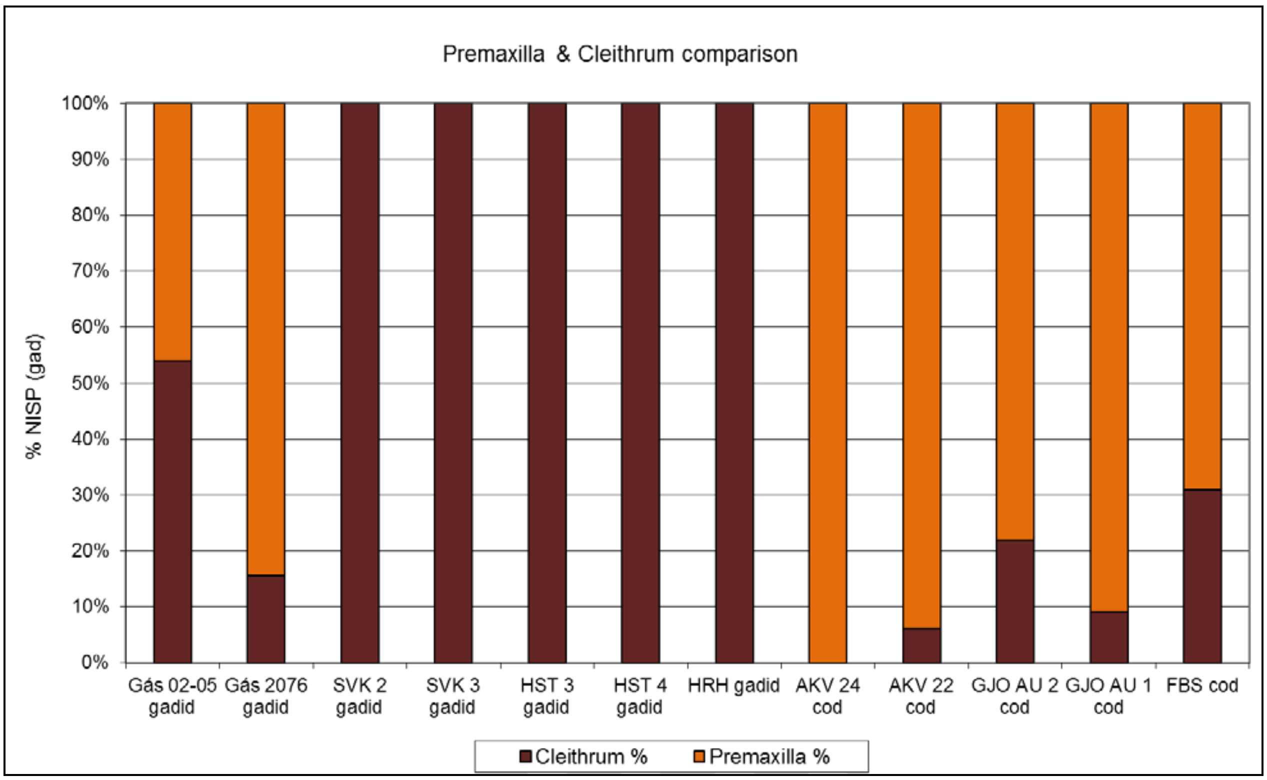


Figure 4.21. Relative proportions of cod family fish bones from inland "consumer" sites (Hofstaðir, Sveigakot and Hrísheimar (McGovern et al 2007, Perdikaris & McGovern 2008) and three coastal medieval fish "producer" sites in northwest Iceland (Akurvík, Gjögur and Finnbogastaðir (Krivogorskaya et al 2005, Amundsen et al 2005, Perdikaris & McGovern 2008) in comparison with Gásir (Harrison et al 2008).

As Figure 4.21 indicates, the proportion of identified gadid fish species present at Gásir do not resemble the cod-dominated signatures of the nearly contemporary fishing sites Gjögur and Akurvík in the West Fjords (Amundsen et al. 2005, Krivogorskaya et al. 2005). Rather, they seem more similar to those from the haddock-rich inland "consumer" sites of Viking Age Mývatn, (Hofstaðir and Sveigakot; McGovern et al. 2006, 2007), although a relatively high proportion of the elements are premaxillary.

The initial analysis of the Gásir distribution of gadid skeletal elements from the 2002-05 excavation suggested a skeletal pattern lacking most head bones and upper vertebrae, a signature normally associated with the consumption of dried (headless) cod (Krivogorskaya et al. 2005). However, expanded open-area excavation later revealed context 2076, a pit fill associated with what is now suspected to be a fish butchery deposit, possibly functioning in a similar fashion as what is in modern times referred to as a 'fish-monger´s' booth (Harrison et al 2008).

Figure 4.22 displays the percentages of premaxilla (one of the jaw bones) vs. cleithrum (large bone found in the pectorial region) bone element ratios for the Gásir gadids. The cleithrum travels with the preserved fish along with varied amounts of the vertebral column, and tends to accumulate in disproportionally higher amounts (than premaxillary fragments) at consumer sites (Perdikaris and McGovern 2007, 2008). The jaw bone called premaxilla is normally discarded at the point of fish cleaning and preparation for drying or consumption, and thus tends to accumulate differentially at dried-fish-producing sites such as Akurvík (Amundsen et al. 2005).

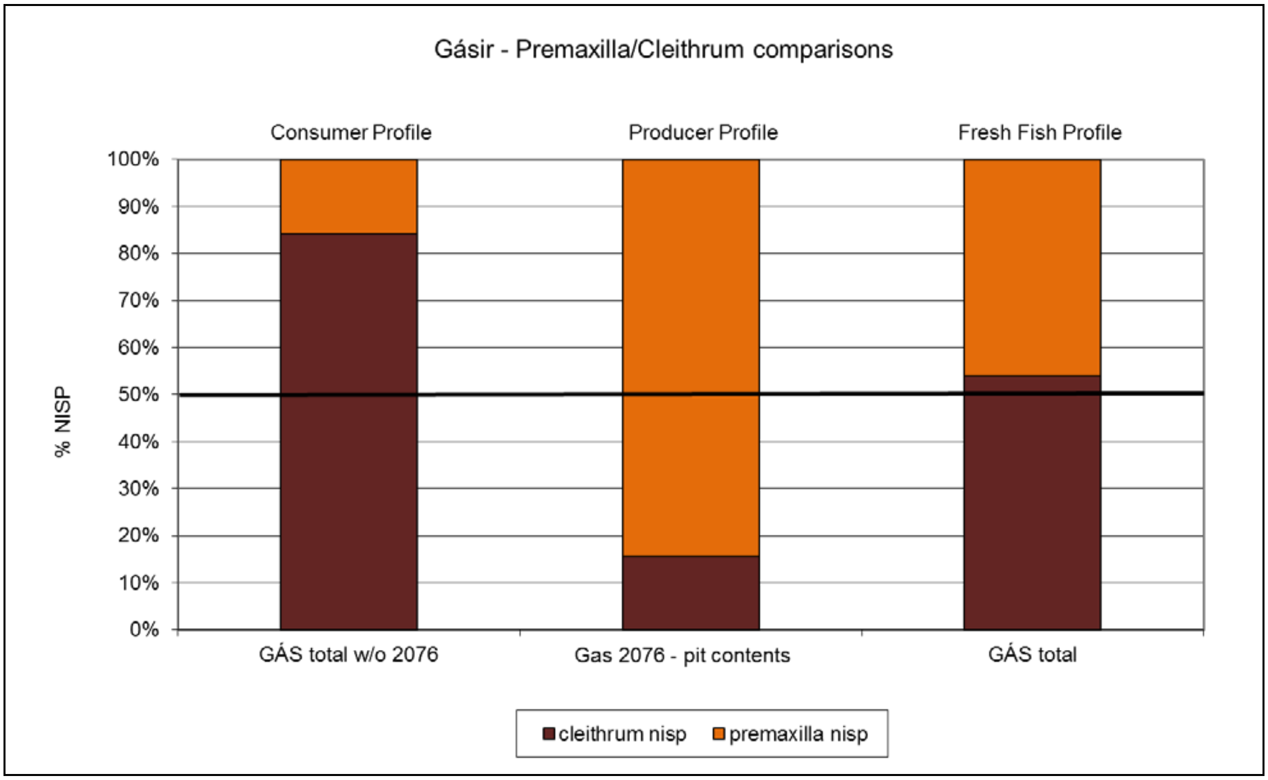


Figure 4.22. Gásir gadid comparison of premaxilla (PMX) vs. cleithrum (CLE) proportions.

Context 2076 pit fill displays just such a fish-processing pattern with substantial amounts of skull and cranial fragments that include the premaxilla, present and thus producing a classic "producer" profile. The rest of the site has produced a surplus of cleithra and vertebral elements that can be interpreted as a consumer profile, apparently not because the visiting merchants were eating hard, dried cod, but because they were getting their mix of fresh-caught cod and haddock freshly butchered from a specific area on site (Harrison et al 2008).

As illustrated in Figure 4.22, when the 2076 pit fill elements are combined with the rest of the site archaeofauna, the proportion of these paired elements matches the 50:50 ratio in a live fish. The "reassembly" of the gadid heads and bodies that were found in the same phase combined with the haddock rich species mix at Gásir suggests provisioning with fresh-caught fish taken from the nearby fjord during the summer trading season (see discussion on Cod vs. Haddock fishing grounds in Eyjafjörður in Chapter 3).

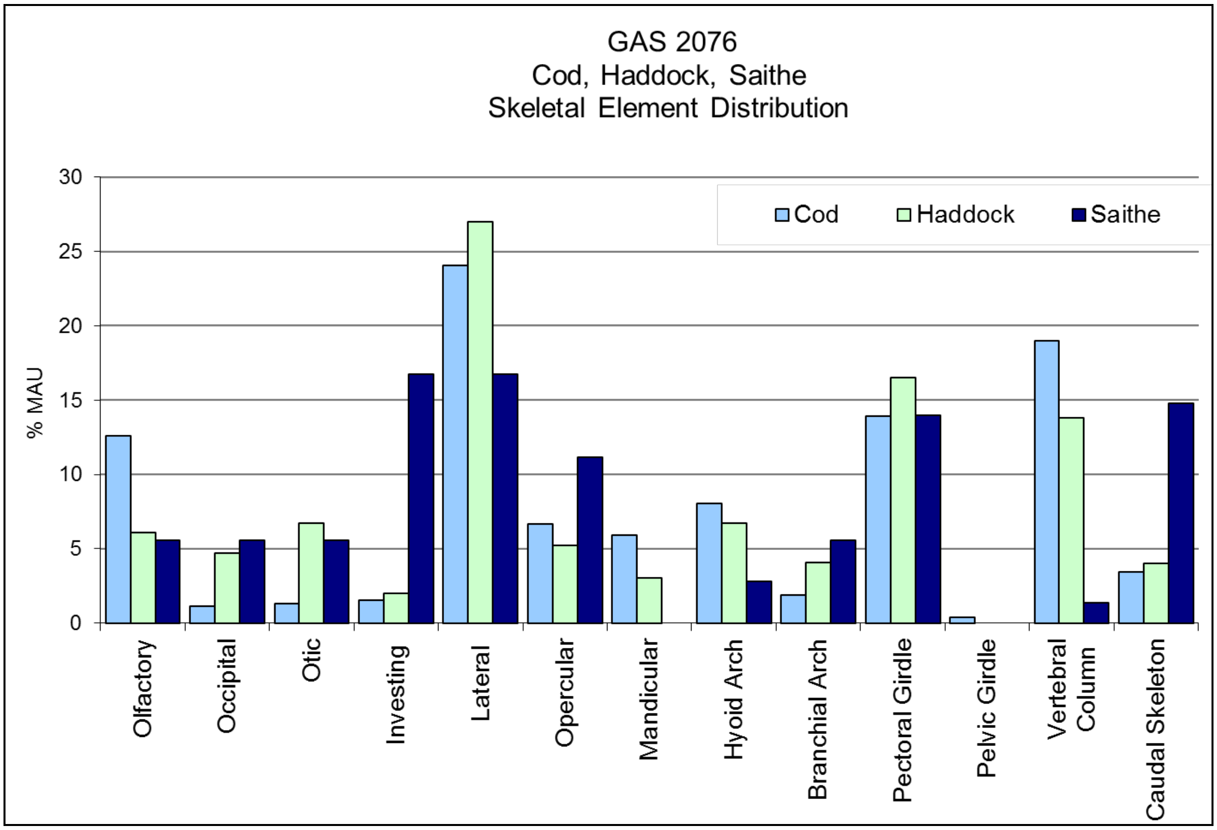


Figure 4.23. Element Distribution comparison from the fish processing pit (context 2076). Cod (*Gadus morhua*), Haddock (*Melanogrammus aeglefinus*), Saithe (*Pollachius virens*).

The cod and haddock skeletal element distribution and size reconstruction from the fish midden (context 2076) (figures 4.23 and 4.25, respectively) point toward a fresh fish processing at Gásir. Since a large amount of the skull elements from the total archaeofauna were found in one specific location, that context can be viewed as a fresh fish processing refuse pit. The cod, haddock, and saithe element distributions from this fish processing pit slightly to the SW of the main trading area indicate that there was not really a preference for one gadid species only and that the fish were most likely used for on-site consumption.

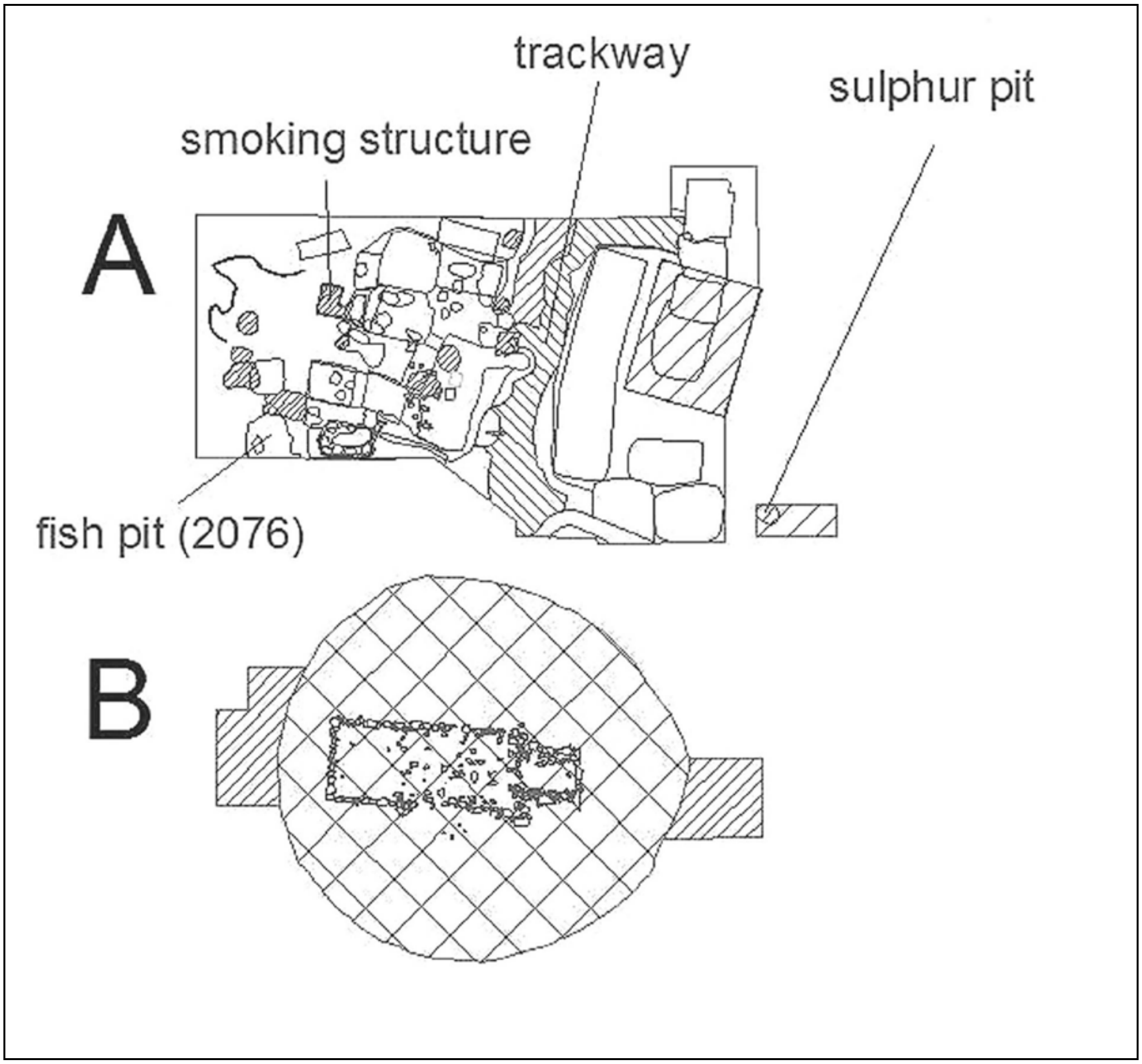


Figure 4.24. Layout of the two main excavation areas: A shows the booth structures and B the churchyard. The fish processing debris from context 2076 was found in the SW part of the excavated area. (Map source: original version: HM Roberts, (c) FSI; edited version: Harrison et al 2008:101).

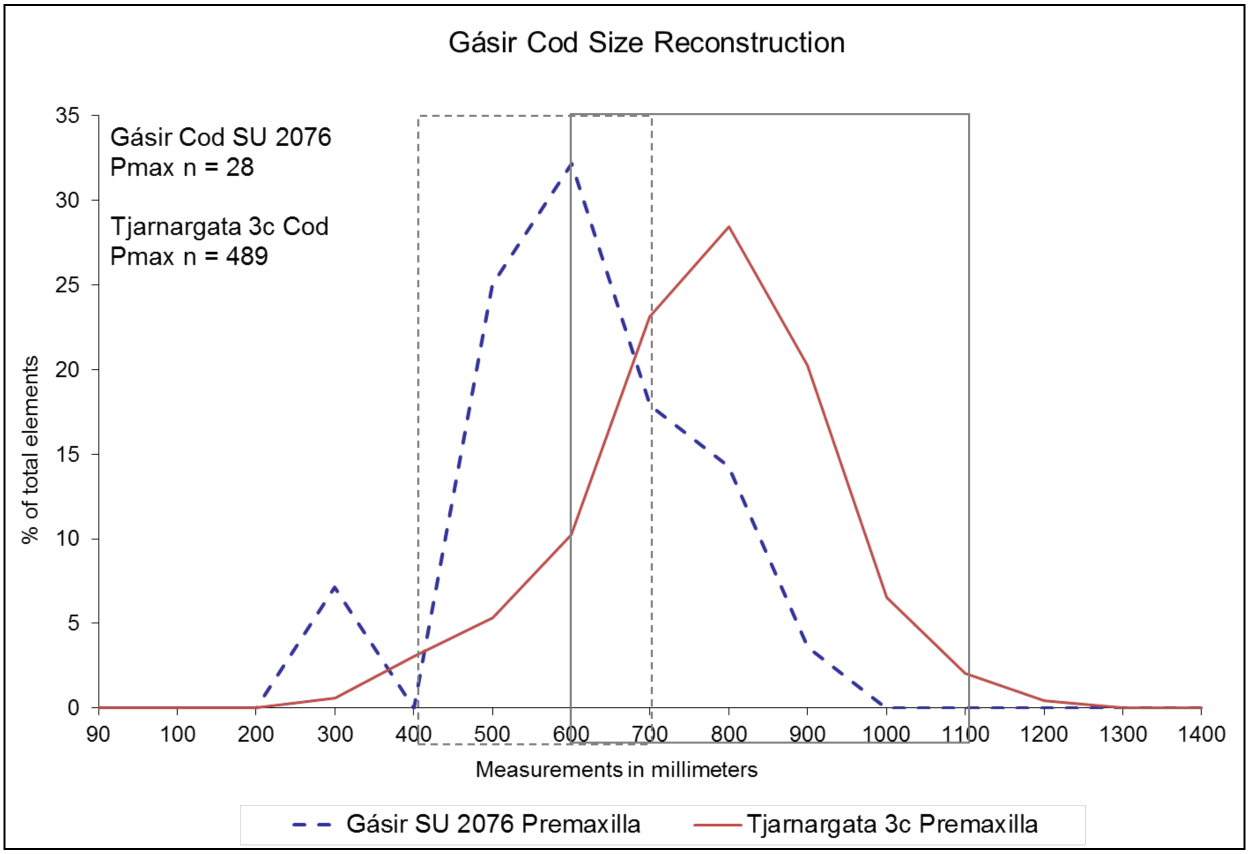


Figure 4.25. Gásir Cod Size Reconstruction from context 2076 compared to Tjarnargata 3c.

Figure 4.25 displays the cod size reconstruction in comparison with that of the 17th – 19th c.commercial (stock-) fish processing contexts from a site called Tjarnargata 3c in Reykjavik (Perdikaris et al 2002, 2004). As mentioned at the beginning of the Gásir fish section, the dried fish products from the medieval North Atlantic required near-freezing temperatures and also wind exposure to become durable enough for long journeys across the sea. Stockfish filets, dried in the round with the cleithrum attached to the product (but minus the skull and upper vertical vertebrae) needed to be of a certain size to become dried and not rot before the process was completed (Perdikaris et al 2004, Perdikaris 1996, Perdikaris & McGovern 2008). While the Tjarnargata 3c cod size constructions place that site's specimens into the "stock-fish window" of a reconstructed life cod size range between 600 and 1100 mm (Perdikaris et al 2004), those from

Gásir fit into a wide size range that cannot indicate specific fish processing for export purposes as it can be demonstrated for a site like Tjarnargata 3c or other Icelandic coastal sites as Akurvík and Gjögur mentioned earlier (Perdikaris & McGovern 2008:80).

Rather, the comparatively low number of randomly sized gadid remains indicates that these specimens were caught for on-site butchery and consumption within a short period of time. If this fish pit had contained high enough numbers indicating commercial scale gadid processing, an argument could be made for a split fish product (size range of 400 and 700 mm), smaller than the so-called stock fish filet dried in the round (size range of 600 to 1100 mm) (Perdikaris & McGovern 2008). Size reconstruction for the overall Gásir gadid remains, not including those from the fish processing feature, was not possible for the lack of measurable elements.

Gásir Cod size reconstruction together with the gadid species analysis on the fish remains from the pit fill, context 2076 suggest the presence or dumping of many 'natural' samples of cod and gadid. The Gásir 2076 fish remains therefore do not look like a stockfish processing deposit due to size constrictions and significant species variation (T.H. McGovern, personal communication, March 2013).

The general Gásir gadid and especially cod size and element pattern suggests that the Gásir seasonal settlement was not being cheaply provisioned with dried cod produced in the previous winter from fishing sites like Akurvík. Nor were the people staying at Gásir for some time during the year simply consuming part of the dried cod which may have been a proportion of the Icelandic bulk goods being exchanged at Gásir. Sturlunga Saga (dating to the mid-13th century) mentions a farmer who came to Gásir from Siglunes, bringing with him a boatload of fish to trade with the people who lived further inland (Vigfusson 1878). Continued analysis of the Siglunes archaeofauna may help determine whether the Siglunes site provided the commercial export product to be traded via Gásir, by providing large enough quantities of cod remains as proxy-indicators for large scale, commercial stockfish production.

4.11.2. *Freshwater Fish*

Only 25 (24 vertebral elements) bones of freshwater salmonids, probably all Brown trout (*Salmo trutta)*, were recovered during flotation. Gásir lies at the Hörgá River estuary which may have been the source of these freshwater fish, though many clear running streams in the region have good trout fishing, and smoked trout remains a local delicacy today (http://www.angling.is/en/waters/silungsveidiar/a-nordausturlandi/6479/, accessed 7.14.2012)

4.12. Craft Working.

The horse remains listed in the NISP table are mostly comprised of loose teeth and foot/lower leg fragments. It should be noted that context 220 and context 101 yielded more than 50% (8/15) of the horse bone assemblage present at the site. The nature of preserved horse bone fragments indicates craft working activities rather than horse meat consumption, since the elements found were mandibular, maxillary, or lower limbs. Whale bone: except for the porpoise-size

Figure 4.26. Whale bone artifact – possible clamp (context 1783).

whales, the majority of whale bones found at Gásir bear marks that derive from bone working. The one large whale element collected in 2003 represents a particularly good example for craft working, since it has been drilled.

Figure 4.26 displays one of the whale bone artifacts that were identified during the final stage of faunal analysis in 2008; two of these pieces (context 1783. 1569) may have been used as clamps and the artifact from context 2872 shows a perforation on its wider end for textile work, either for nets or wool processing (McGovern, CUNY Hunter, NORSEC Bioarchaeology laboratory director, personal communication, February 2009).

The total number of cattle Horn cores is 25; these rather large cattle horn cores can indicate on-site horn craft working, however, no clustering of areas with a high frequency of elements could be observed.

Figure 4.27. Cattle horn core, cranial view (context 2684).

4.13. Burning

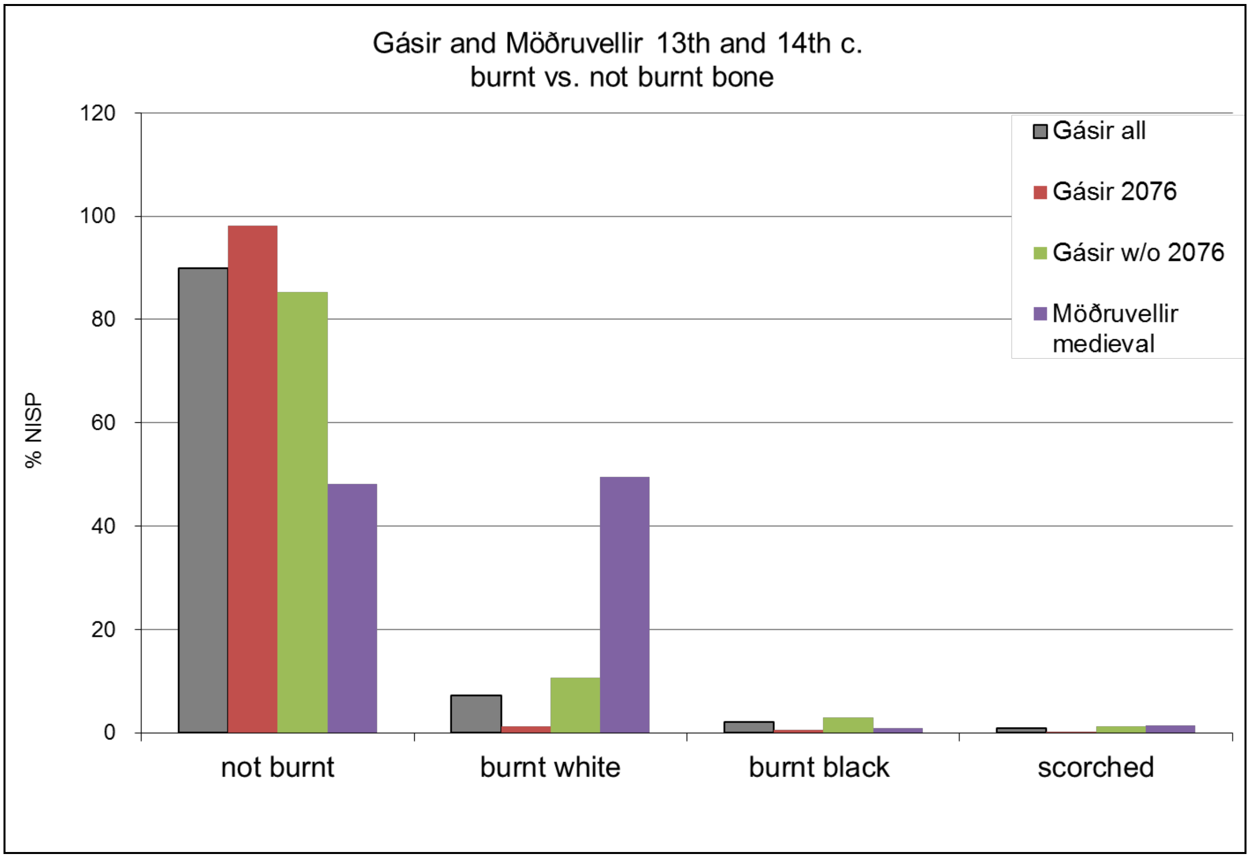


Figure 4.28. Gásir and Möðruvellir 13th and 14th c. burnt vs. not burnt bone comparisons.

Figure 4.28 presents 13th and 14th c. burnt bone data from Gásir and Möðruvellir. A comparison between the Gásir faunal remains including, excluding, and solely using context 2076 data is helpful when for questions on different practices of bone disposal. The graph indicates that no common practice of throwing the bone materials into the fire was in place. In fact, almost none of the bones from context 2076 were burnt. About 10% of the Gásir overall bones, excluding the 2076 bones, were burnt white, and less than 5 % burnt black. At medieval Möðruvellir, however, it seems to have been common practice to dispose of bone waste by burning it - likely in fireplaces. These contrasts in food waste disposal practices highlight again the difference in the nature of the excavation materials presented here: the one from Gásir is from a large scale, open area excavation of occupation surfaces and the one from Möðruvellir from a targeted midden excavation of deeply stratified midden materials. Another potential reason for the difference in bone burning behavior could be cultural preferences, with the Gásir remnants being the results of foreigners present. Another explanation could be that there may have been fires that were not burning as regularly due to the seasonal character of the site, whereas as in a year-round household the fires would be going continuously.

Woollett and McGovern write that bone, in Icelandic archaeological remains as in other parts of the medieval world, appears to have been very commonly tossed into open fires for disposal Woollett and McGovern 2003:15).. The hearth ash was commonly used to sweeten dirt flooring and byres, absorb moisture, and reduce mud in high traffic areas (Milek 2012a).

Chapter 5. **The Möðruvellir Data**

5.1. Möðruvellir Midden Excavation

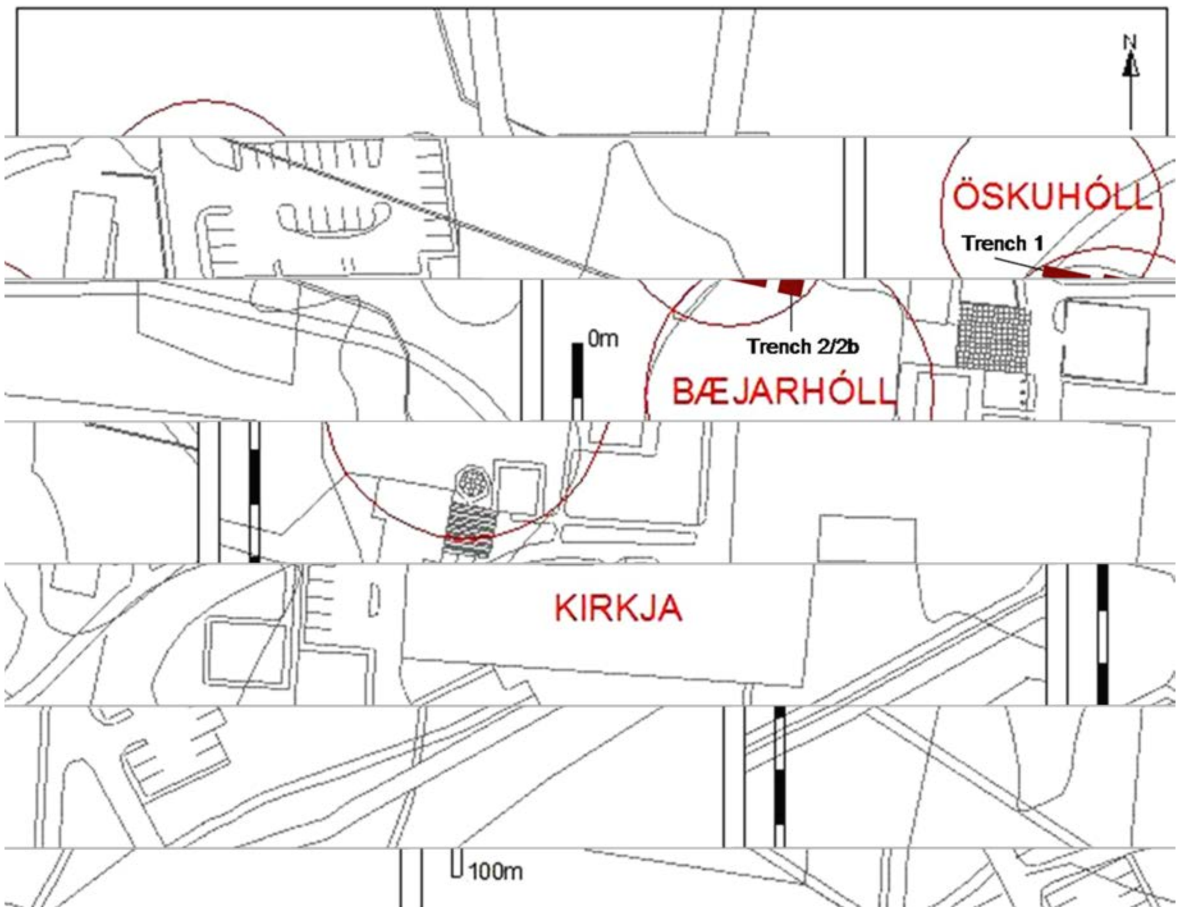


Figure 5.1. Approximate Möðruvellir midden trench locations. Öskuhóll = Ash hill/Midden Mound, Bæjarhóll = Farm Mound. Kirkja = Church; modern building from 1865. ((Map © FSI/HM Roberts 2004, trenches added by author).

5.1.1. *The 2006-2008 Möðruvellir Midden Excavation*

Möðruvellir, formerly a medieval House of Canons and for centuries a high status farm was undoubtedly connected with the high medieval Gásir trading site during that site's active period and throughout its own history maintained a central role in the Eyjafjörður economy and politics. The original farm and religious buildings have not been located with precision, but it is generally assumed that their remains are beneath the historic farm mound (*Bæjarhóll*) adjacent to the well-known Midden Mound or Ash Hill (*Öskuhóll*). The Möðruvellir farm mound and historic buildings represent a major cultural and archaeological monument with tremendous potential for future research. The farm mound itself measures some 80 m in diameter and centuries of occupational and construction remains have raised its top 4 – 5 meters above the surrounding farm land. The mound has seen continued use down to current times (Vésteinsson 2001), certainly a factor causing some minor disturbance to underlying archaeological deposits, not only to the structural deposits, but also the midden remains as is evidenced in the medieval midden phase (see Chapter 6).

5.2. Midden Chronology

The Harris Matrix at the end of this chapter indicates the various phases mentioned below:

Phase 4 – TR1 and TR2/2b - Uppermost Midden layers

The midden layers from this phase are the most recent / uppermost layers and were dated based on artifacts, with glass and ceramics providing the best temporal indicators (Lucas 2010).

Lucas was able to date the faunal and other materials from TR1 to ca. 1840-early 1900s; TR2/2b materials had a terminus *post quem* of ca. 1870, and thus provide a slightly later date of c. 1870s-early1900s. The label Phase 4 will be used interchangeably with '19th/20th. deposits' and 'Möðruvellir upper' throughout this chapter. The archaeofauna from the upper most portion of the midden thus gives insight into a very recent part of Icelandic history and archaeology (Karlsson 2000).

Phase 3 – TR1

The middle portion of the Möðruvellir Midden Trench produced materials dating from about the Icelandic post-medieval (ca. 1550s – 1700s) to the Early Modern period (ca. 1700s-1900s). Additional radiocarbon dating done on faunal remains will allow for more specific phasing of this part of the collection, but a relative chronology based on stratigraphy and artifact analysis currently suggests these midden materials were deposited earlier in time than the ones from Phase 4 above and later in time than those from Phases 1 and 2 below. The label Phase 3 will be used interchangeably with 'post-medieval/Early Modern period' and 'Möðruvellir middle' throughout this chapter.

Phases 1 and 2 - TR1

The lowest midden materials excavated from Möðruvellir were radiocarbon dated and can be placed into a time frame between the 13^{th} c. – early 15^{th} c. These lower faunal collections are thus contemporaneous with ones collected from the medieval trading station at Gásir, located along the coast some 3 km further southeast. Recent analysis of the Oddstaðir midden materials further in the Hörgárdalur interior (Harrison 2011c) provides another contemporaneous set of faunal remains. Except for the initial zooarchaeological overview and data tables (NISP tables) presenting presence and absence of species, phases I and II will be lumped together as either 'Möðruvellir lower' or '(Möðruvellir medieval)' phase.

Phase 2: late 13th/early 14th – early 15th c, (calAD)

Faunal materials from context [120] and above were all more clearly dated to a slightly later period than the ones below, with the exception of context [077], whose 13th c. faunal remains will only be included into general Phase 1 and 2 discussions, but not when discussing different trends observed between Phase 1 and Phase 2.

Phase 2 radiocarbon dates fall between ca. the *late 13th/the early 14th – the early 15th c.*, and faunal and other material remains from the included deposits are part of this later medieval period following Phase 1. Radiocarbon analysis from phase 2 bones resulted in three C14 date ranges: 1270 (95.4%) 1400calAD (context 075), 1292 (95.4%) 1400calAD, and 1297 (95.4%) 1409calAD (context 120). These dates place the phased contexts into a late 13th/early 14th – early 15th c. date range.

Phase 1: mid-13th – early 14th c, (calAD)

The radiocarbon multi-plot in figure 5.2 indicates a *mid-13th – early 14th* date range for context [129], the stratigraphically lowest deposit excavated from TR1. Thus, contexts physically under the more recent context [120], fall into an earlier time period and were grouped into midden phase 1, with a date range of 1250 (71.8% probability) 1320calAD (context 129), dating this phase to ca. *13th – early 14th c*. Context [077], with a radiocarbon date range of 1205 (95.4%) 1290cal AD. likely belongs to this phase. This bone element dated from context [077] is probably residual from the Phase 1 deposits and materials from this context are thus only included when Phase 1 and 2 are lumped together.

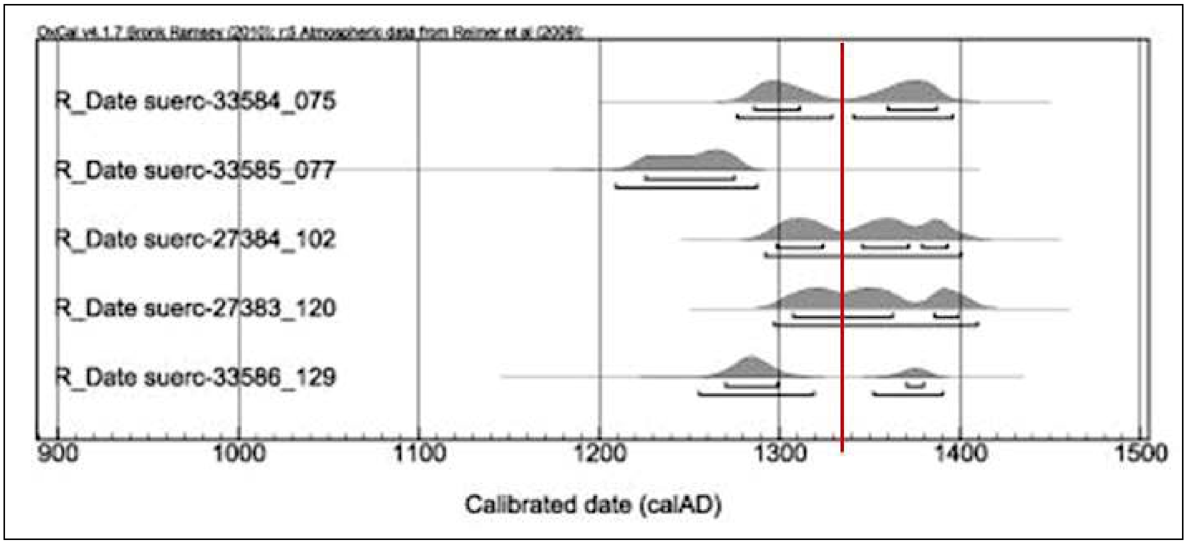


Figure 5.2. Möðruvellir Midden Trench I, Phase 1 and 2 Radiocarbon dates, the red line indicates division between the two medieval data sets. https://c14.arch.ox.ac.uk/oxcal/OxCal.html, v. 1.6, Bronk Ramsey 2010, Atmospheric data from Reimer et al. 2009).

Figure 5.2 and table 5.1 present the Möðruvellir calibrated Radiocarbon date information discussed in this section; the dates are presented on a probability curve and in tables indicating 1 and 2 Sigma probability ranges.

SUERC #	GU #	Phase	Cont. #	Radiocarbon years BP	Age error	2 SIGMA (95.4 %) probability	1 SIGMA (68.2 %) probability
33584	23515	2	075	655	35	1276(45.8%)1329calAD 1341(49.6%)1396calAD	1286(32.1%)1311calAD 1360(36.1%)1387calAD
33585	23516	1 & 2	077	770	35	1209(95.4%)1287calAD	1225(68.2%)1275calAD
27384	20698	2	102	620	30	1292(95.4%)1400calAD	1298(27.3%)1324calAD 1346(26.7%)1371calAD 1379(14.1%)1393calAD
27383	20697	2	120	600	30	1297(95.4%)1409calAD	1307(55.1%)1362calAD 1386(13.1%)1399calAD
33586	23517	1	129	700	35	1255(72.0%)1319calAD 1352(23.4%)1390calAD	1270(57.5%)1299calAD 1370(10.7%)1380calAD

Table 5.1. Möðruvellir Midden Trench I, Phase 1 and 2 Radiocarbon dates, date range probabilities.

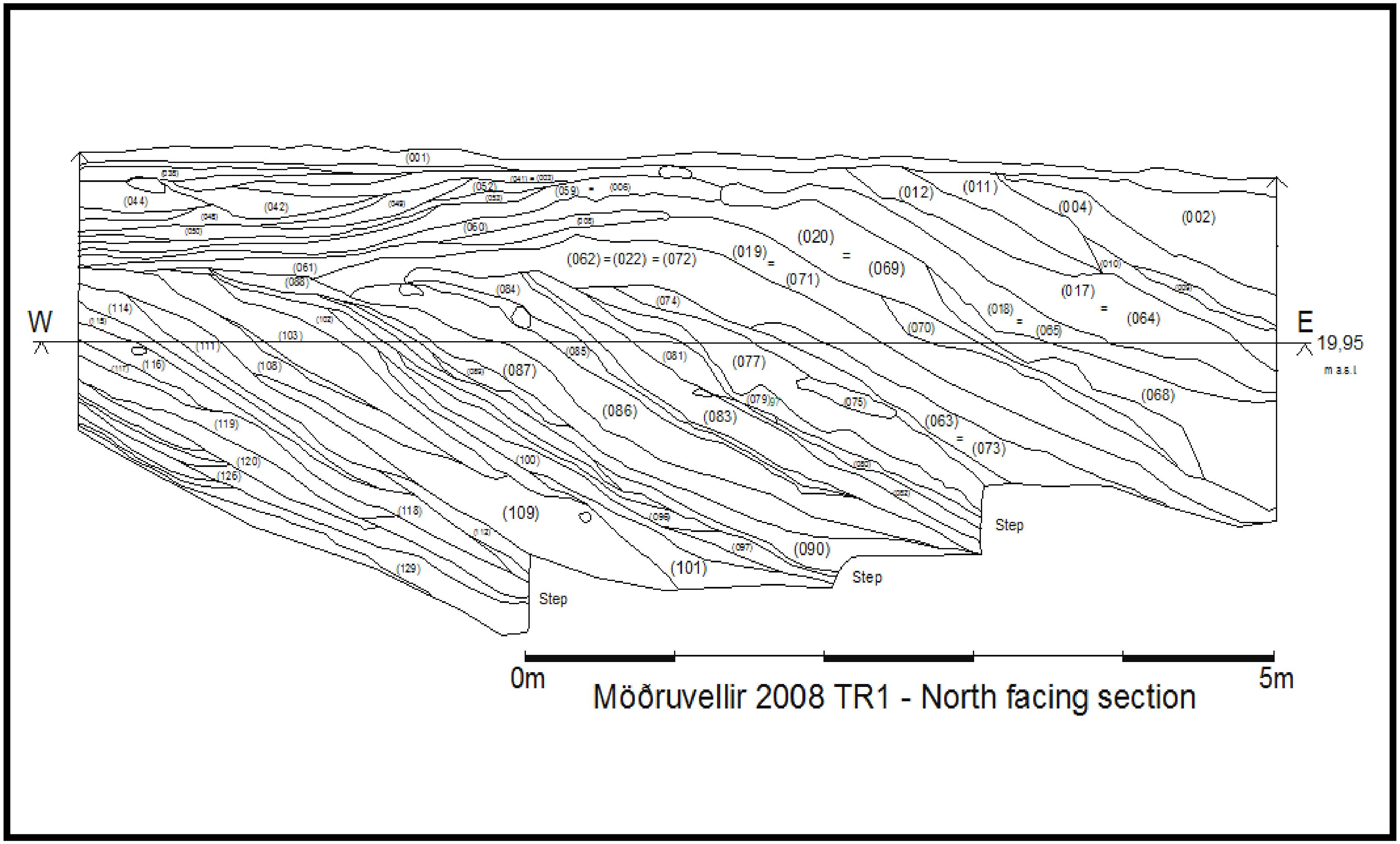


Figure 5.3. Möðruvellir Trench 1, North facing Section

Figure 5.4. Möðruvellir, TR1 and TR2b. Left: Möðruvellir TR1, Segment of northern profile. Right: Möðruvellir TR2b, viewed toward east.

5.3. Summary of the Möðruvellir Archaeofaunal Results

This chapter presents a general overview on the Möðruvellir faunal remains recovered from TR 1 and TR2/2b.

As mentioned in the introduction, the basal most midden layers could not be reached due to reasons of safety. Should there be a future attempt at reaching the basal midden layers, it is likely that structural remains will also need to be excavated.

The Möðruvellir Midden Total Number of Fragments (**TNF**) count is **26,332**, with a Number of Identified Specimens (**NISP**) of **8,005.** The bone preservation in the Early Modern layers is excellent but increasingly degraded in the earlier midden deposits. Centuries of peat and wood ash dumping episodes have created a highly acidic midden environment, leaving occasional bone butter behind in the basal layers encountered. In contrast, textile remains (analyzed by Michele Hayeur Smith) could be retrieved from those layers where bone collection was problematic.

Further division of the total NISP according to phase results in:

- Phase 4 = a *NISP of 6,466;*
- Phase 3 = a *NISP of 302;*
- Phase 2 = a *NISP of 1,045;*
- Phase 1 = a *NISP of 150*

Context [077] faunal analysis resulted in a *NISP of 42*.

The poor bone preservation in Phases 1, 2, and especially 3 vs. the excellent bone preservation in Phase 4 is indicated by the TNFs vs. NISPs counted:

Phase	TNF	NISP	Percentage of archaeofauna identified to family or species level
1	772	150	19%
2	5,520	1,045	19%
3	9,447	302	5%
4	10,430	6,466	62%

Table 5.2. Percentage of archaeofauna identified to family or species level per Möðruvellir Midden Phase.

In all four phases, the domesticate category was dominated by **caprines. Cattle** element numbers vary quite markedly between Phase 4 and the early phases. The Phase 4 domesticate archaeofauna only contained 7.83 % of cattle bone, while that of Phase 3 contained 21.69 %, and the medieval one 25.03 % of the domesticate group, with 27.3 % for Phase 2, and 10 % for Phase 1. **No pig remains** were analyzed. This could be partially due to the poor bone preservation in phases 1, 2 and 3, but survival of skull or dental remains could be expected had a number of these animals been present or at least consumed on site. Except for Phase 1, **horse** bones were noted in all phases, most elements were teeth.

Phase 2 contained the only **dog** bone found in the collection, but all phases except Phase 1 contained bones with dog **tooth marks**, especially Phase 4. One of the Phase 4 elements showed tooth marks resulting from rodent gnawing (context [004]. Few **cetacean** and **seal** bones were recovered from Phases1 and 4; none could be analyzed to species level, but three were placed into the more specific porpoise/dolphin sized category.

No arctic fox remains that are often part of the **wild mammal** assemblage were analyzed from the Möðruvellir Midden. **Bird** bones from Phases 2 and 4 were mostly from Auks; many could be analyzed to Uria sp. Level, and are either from Guillemot (*Uria aalge*) or Common Murre (*Uria lomvia*). These two phases also contained several Ptarmigan elements. Phase 4 contained the majority of an articulated Mallard skeleton (context [006]). The few birds grouped to species or family level in Phase 3, however, were Eider and Swan. Despite making up the smallest NISP number out of the three Phases, the Phase 3 birds take up a higher relative proportion of the total NISP collection than the avians in the other two phases.

Fish bone proportions differ quite clearly between Phase 1 (41.33 % of total archaeofauna) and Phase 2 (17.13 % of total archaeofauna), to increase slightly again for Phase 3 (21.19 % of total archaeofauna), to peak in Phase 4 (83.94 % of total archaeofauna), coinciding perhaps to some degree with a better bone preservation in the upper most phase. In contrast, with a small NISP as in Phase 1 and 3, the relative fish percentages get inflated somewhat. A clear decline in cattle consumption over time and possibly a marked shift from mammals to fish as major food supply resources can be observed from the multi-period faunal collections. It is possible that Möðruvellir was increasingly preparing fish caught in large numbers during the 18th/19th c. **Mollusk** proportions in all phases are below 10% of the total NISP counts, with Phase 3 producing the relatively highest percentage despite a low total NISP number. The mollusk species analyzed to species level the most frequently was the hard shell clam.

Table 5.3 presents the Möðruvellir archaeofauna as a Total Count. NISP (number of identified specimens) refers to all fragments that could be identified to a useful level. Here, only the major historic phases are compared: medieval, post-medieval/Early Modern, 19th/20th c. The medieval phase then is divided further into the Phase 1 and 2 data in table 5.4.

Möðruvellir Element Count Table

Möðruvellir - Element Counts	Midden Phases							
Taxon	Phases 1 & 2 - medieval		Phase 3 – post-medieval/Early Modern		Phase 4 – 19th/20th c.		All Phases Total NISP	
Human *(Homo sapiens)* - 1 lower permanent molar					1 - not included in NISP count			
Domestic mammals	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP	% NISP
Cow (Bos taurus (L.))	228	18.43	41	13.58	71	1.10	340	4.25
Horse (Equus caballus (L.))	4	0.32	2	0.66	2	0.03	8	0.10
Dog (Canis lupus fam. (L.))	1	0.08					1	0.01

Goat (Capra hircus (L.))	2	0.16			6	0.09	8	0.10
Sheep (Ovis aries (L.))	33	2.67	14	4.64	85	1.31	132	1.65
Unidentified caprine	638	51.58	132	43.71	736	11.38	1,506	18.81
Total caprine	673	54.41	146	48.34	827	12.79	1,646	20.56
Total domestic	906	73.24	189	62.58	900	13.92	1,995	24.92
Wild Mammals								
Large seal	1	0.08					1	0.01
Unidentified seal species	2	0.16		0.00	8	0.12	10	0.12
Small cetacean / Porpoise or Dolphin	1	0.08		0.00	2	0.03	3	0.04
Unidentified whale species	1	0.08					1	0.01
Total wild mammal	5	0.40		0.00	10	0.15	15	0.19
Birds								
Guillemot sp. (Uria sp)	15	1.21			2	0.03	17	0.21
Auk family (Alcid sp.)	5	0.40			1	0.02	6	0.07
Eider (Somateria molissima (L.))			2	0.66			2	0.02
Mallard ((Anas platyrhynchos (L.))				0.00	1 (33)	0.02	0	0.00
Swan sp. (Cygnus sp.)			1	0.33			1	0.01
Goose sp. (Anser sp.)	1	0.08					1	0.01
Dom. chicken (*Gallus gallus (L.*))					4	0.06	4	0.05
Ptarmigan (grouse) (*Lagopus muta* *(Montin))*	2	0.16			3	0.05	5	0.06

Möðruvellir Element Count Table continued

Unidentified bird species	23	1.86	23	7.62	45	0.70	91	1.14
Total bird	44	3.56	27	8.94	56	0.87	127	1.59
Fish		0.00		0.00		0.00	0	0.00
Cod (*Gadus morhua* (L.))	4	0.32	7	2.32	1,050	16.24	1,061	13.25
Haddock (*Melanogrammus aeglefinus* (L.))	29	2.34	2	0.66	480	7.42	511	6.38
Saithe (*Pollachius virens* (L.))	2	0.16	1	0.33	11	0.17	14	0.17
Cusk (*Brosme brosme* (L.))					1	0.02	1	0.01
Atlantic Halibut (*Hippoglossus hippoglossus* (L.))			1	0.33			1	0.01
Gadid species	86	6.95	23	7.62	1,211	18.73	1,320	16.49
Wolfish (*Anarhichas lupus* (L.))					33	0.51	33	0.41
Trout (*Salmo trutta* (L.))					1	0.02	1	0.01
Fish non-speciated	128	10.35	30	9.93	2,640	40.83	2,798	34.95
Total fish	249	20.13	64	21.19	5,427	83.93	5,740	71.71
Mollusca								
Soft shell clam (Mya spp.)					5	0.08	5	0.06
Hardshell clam (*Arctica islandica (L.)*)	23	1.86	4	1.32	18	0.28	45	0.56
Mussel (*Mytilus edulis* (L.))					15	0.23	15	0.19
Periwinkle species (Littorina sp.)		0.00	1	0.33			1	0.01
Common whelk	2	0.16			2	0.03	4	0.05

(*Buccinum undatum (L.)*)								
Whelk sp. (*Buccinidae*)	1	0.08			1	0.02	2	0.02
Unidentified mollusc species	7	0.57	17	5.63	32	0.49	56	0.70
Total mollusca	33	2.67	22	7.28	73	1.13	128	1.60
Total Number of Identified Species	1,237	100	302	100	6,466	100	8,005	100
Large terrestrial mammal	255		99		124		478	
Medium terrestrial mammal	678		676		1,077		2,431	
Small terrestrial mammal			3				3	
Unidentified mammal fragments	4,270		8,259		2,756		15,285	
Unidentified marine mammal fragments					5		5	
Unidentified fragment	15		108		2		125	
Total number of fragments	*6,455*		*9,447*		*10,430*		*26,332*	

Table 5.3. Möðruvellir Element count by taxon/phase.

The Phase 1 and 2 data added together in table 5.3 are broken down into Phase 1, Phase 2, and Context [077] in table 5.4 below. Due to the small number of identified remains from the Phase 1 assemblage, phases 1 and 2 will be lumped together for any further analytical and comparative use from hereon.

Möðruvellir Medieval Deposits Element Count Table.

Möðruvellir - Element Counts	Midden Phases						Total Medieval NISP
Taxon	Phase 1, 13th - early 14th c.		Phase 2, late 13th /early 14th - early 15th c.		Context [077] - 13th c.		Total
Domestic mammals	NISP	% NISP	NISP	% NISP	NISP	% NISP	NISP
Cow (Bos taurus (L.))	8	5.33	217	20.77	3	7.14	228
Horse (Equus caballus (L.))			4	0.38			4
Dog (Canis lupus fam. (L.))			1	0.10			1
Goat (Capra hircus (L.))			2	0.19			2
Sheep (Ovis aries (L.))	1	0.67	30	2.87	2	4.76	33
Unidentified caprine	71	47.33	541	51.77	26	61.90	638
Total caprine	72	48.00	573	54.83	28	66.67	673
Total domestic	73	48.67	795	76.08	31	73.81	899
Wild Mammals							
Unidentified seal species			2	0.19			2
Small cetacean / Porpoise or Dolphin			2	0.19			2
Total wild mammal			5	0.48			5
Birds							
Guillemot sp. (Uria sp)			15	1.44			15

Möðruvellir Medieval Deposits Element Count Table continued

Auk family (Alcid sp.)			5	0.48			5
Goose sp. (Anser sp.)			1	0.10			1
Ptarmigan (grouse) (Lagopus muta (Montin))			2	0.19			2
Unidentified bird species	4	2.67	15	1.44	2	4.76	21
Total bird	4	2.67	38	3.64	2	4.76	44
Fish							
Cod (Gadus morhua (L.))	2	1.33	2	0.19			4
Haddock (Melanogrammus aeglefinus (L.))	3	2.00	25	2.39	1	2.38	29
Saithe (Pollachius virens (L.))			2	0.19			2
Gadid species	19	12.67	65	6.22	2	4.76	86
Fish non-speciated	38	25.33	85	8.13	5	11.90	128
Total fish	62	41.33	179	17.13	8	19.05	249
Mollusca							
Hardshell clam (Arctica islandica (L.))			22	2.11	1	2.38	23
Common whelk (Buccinum undatum (L.))	1	0.67	1	0.10			2
Whelk sp. (Buccinidae)			1	0.10			1
Unidentified mollusc species	3	2.00	4	0.38			7
Total mollusca	4	2.67	28	2.68	1	2.38	33
Total # of Ident. Species	**150**	**100**	**1,045**	**100**	**42**	**100**	**1,237**

Table 5.4. Möðruvellir medieval archaeofauna listed by taxon.

5.3.1. *Major Taxa*

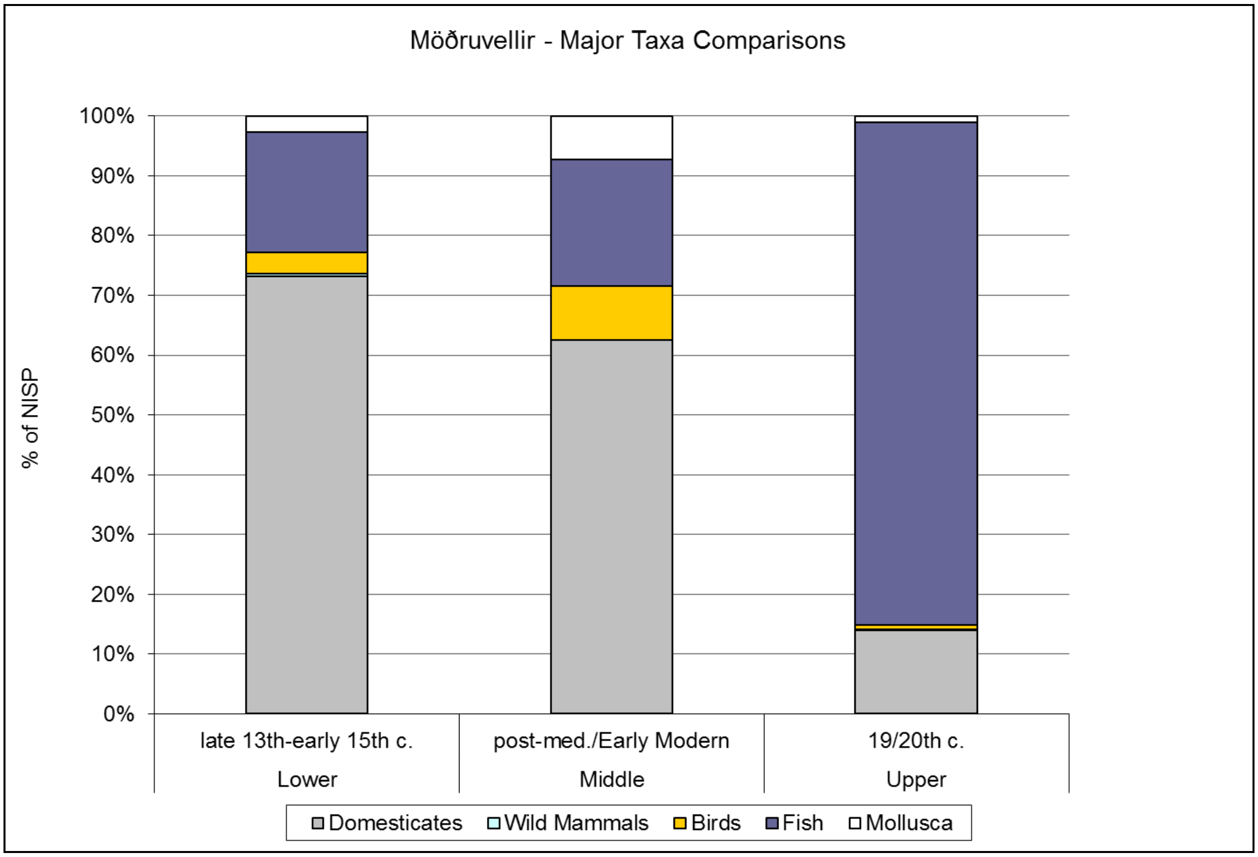


Figure 5.5. Möðruvellir major taxa graph.

The major taxa graph indicates domesticate proportions much higher in the medieval phases and also the post-medieval/Early Modern one than in the $19^{th}/20^{th}$ c. collection. Besides the obvious taphonomic issues, this is also an observable change in food source utilization. The low number of fish remains in the earlier deposits indicates partially the preservation stage of those faunal remains (see burning, fragmentation and butchery discussions below), but there may have been a relatively smaller amount of fish present to begin with. Possibly, the fish bones were discarded at higher numbers elsewhere as the trenches dug into the large midden and farm mound areas only provide samples of all the materials deposited there. Alternatively, there may simply have been less fish consumed relative to domesticates during the earlier phases. Usually, gadid fish bones survive relatively well, even in poorly preserved contexts. They do, however, not withstand acidic soil conditions well (Wheeler and Jones 1989:63), and the ph levels for the lower Möðruvellir midden deposits were below 6 to 3.5.

Even if a portion of the missing fish can be explained through Taphonomy for the medieval (lower) and post-medieval/Early Modern (middle) phases, the fact that a large number of domesticates/mammals are preserved tells us that there is also an element of active decision making involved prior to either consumption or deposition of these taxa and before post-depositional taphonomic processes took place. Relatively high numbers of i.e. sheep/goat and cattle bones are still available from the two lower midden phases. While there is a difference in bone preservation quality, and while a large proportion of the upper midden bones could be analyzed to species and family level, the low number in cattle remains there compared to the lower and middle Möðruvellir domesticate assemblage, is one indicator for changes in the occupants' consumption patterns over time.

When comparing the Möðruvellir cattle vs. caprine percentages, those from the middle and lower Phases are the most similar in relative terms, with a caprine proportion of 77% and 74%, respectively. The upper phase has a total caprine proportion of 92%.

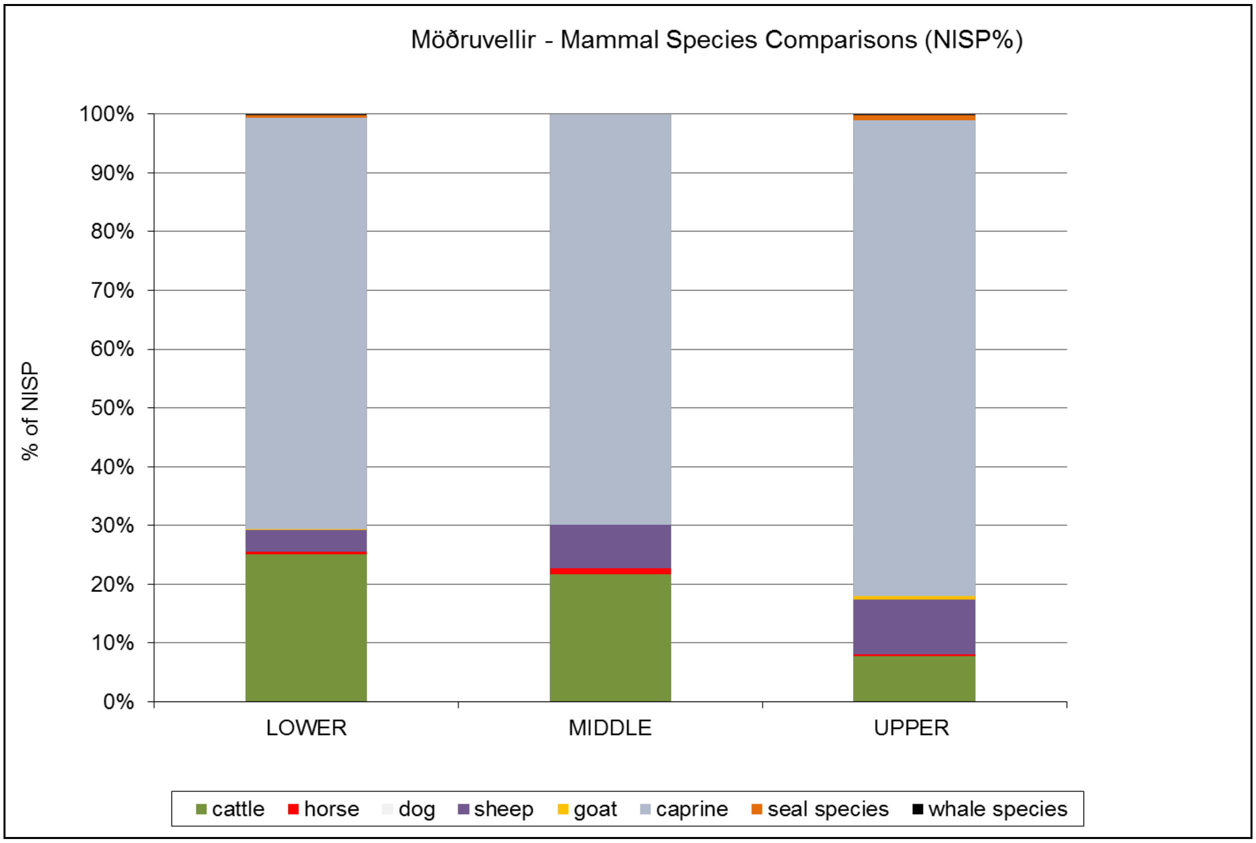


Figure 5.6. Möðruvellir mammal species distributions.

5.4. Domesticates

5.4.1. *Historical Information about Möðruvellir Domesticates from the Later Middle Ages*

Since the medieval Möðruvellir faunal assemblage has suffered from poor preservation conditions, it is helpful to consider the available information about livestock owned by the farm and either kept at Möðruvellir or at one of its rental farms in the later Middle Ages. Three registers from the 15th c., and one from the 16th c. are presented here. It should be kept in mind that in 1402-04, a plague had killed off a large part of the population, leaving many farmsteads abandoned. It can be assumed, therefore, that the 1429 inventory was on the lower range of potential livestock owned by the House of Canons before the plague, with the 1447 inventory already indicative of a recovery period, and the one from 1461 potentially the most representative of Möðruvellir´s 14th c. farming operation (O. Vésteinsson, personal communication January 2013).

- In **1429**, the House of Canons´inventory listed the following livestock numbers (Diplomatarium islandicum IV, 373):

<u>At rental farms:</u>

105 cow equivalents

<u>At Möðruvellir:</u>

- Cattle : 24 cows; 8 calves; 3 oxen, 4 winter old; 2 oxen, 5 winter old; 12 oxen 2 winter old; 23 oxen, 1 winter old

- Sheep: 55 ewes: 31 wethers, 2 winter old incl. rams;

20 wethers, 1 winter old

- Horses: 8 horses; 25 mares

- By the year **1447**, the House of Canons owned the following livestock numbers (Diplomatarium islandicum IV, 710-12):

<u>At rental farms:</u>

202 cow equivalents, indicating the recovery after the plague in 1402-04, although still at that time, 28 of its 60 farms were deserted. In normal times, Möðruvellir´s cow equivalents could have been significantly more numerous (although not proportionately as the deserted farms were as a rule smaller properties than the occupied ones) (O. Vésteinsson, personal communication January 2013).

- In **1461** the House of Canons register listed the following livestock numbers (Diplomatarium islandicum V 286 291):

At rental farms:

180 cow equivalents

At Möðruvellir:

- Cattle: At Öxnhóll and at home (Möðruvellir): 70, including milch-cows and ewes;

40 oxen, 3 winters old or older; 10 oxen, 1 or 2 winter old;

- Sheep: 120 wethers; 75 sheep, 1 winter old

- Horses: 8 old mares; 2 mares, 1 winter old; 25 horses, 3 winter old or older; 6 horses, 1 winter old.

These numbers may have been more representative of the 14th c., although it is not known whether or not Möðruvellir owned Öxnhóll then (O. Vésteinsson, personal communication January 2013).

- In **1525,** 46 farms are listed as being owned by Möðruvellir (Diplomatarium islandicum IX 316-320)
- In **1569,** 53 farms are listed as being owned by Möðruvellir (Diplomatarium islandicum XV, 363-367)

At rental farms:

187.5 cow equivalents, reflecting a national trend towards fewer rental cow equivalents overall (O. Vésteinsson, personal communication January 2013).

5.4.2. *Analysis of Domesticate Proportions and Age at Death from the Midden Excavation*

The data presented here focus on the data from the faunal analysis instead of those presented by the written sources. As indicated by the low NISP vs. TNF numbers in the medieval data, this information is presented here for completion of the analysis, but needs to be understood in light of the data from the inventories.

As indicated already in the comparative mammals graph above, the relative proportion of cattle vs. caprines changes over time, with cattle numbers declining to below 10 % in the 19th/20th c. Even the small NISP for the post medieval/Early Modern phase containing the middle midden layers indicates a much larger proportion of cattle than the most recent phase. In general, a medieval Icelandic farm with a caprine vs. cattle ratio of 3:1 as suggested for Phase 2 in figure 7, was likely of medium to high social standing, (McGovern et al 2004, 2007, 2009, Harrison 2010a, b, 2006).

A few goat elements were collected from even the most recent period, whereas they generally disappeared in many areas of the post-medieval Icelandic farm economy (McGovern et al 2004, 2007, 2009). The differences in faunal preservation at the Möðruvellir Midden Mound do not allow for a stronger statement, as many of the elements from the medieval phase lumped into the ovi/caprine category might have been determined to be either goat or sheep species had they been in better preservation states. Therefore, the proportion of sheep vs. goat elements of ca. 14:1 in the upper Phase may be an accurate estimate of the actual ratios of these animals present on the estate during that time period

Taxon	LOWER		MIDDLE		UPPER	
	NISP	% group	NISP	% group	NISP	% group
Bos taurus (L.)	228	25.17	41	21.69	71	7.89
Equus caballus (L.)	4	0.44	2	1.06	2	0.22
Sus scrofa (L.)						
Canis familiaris (L.)	1	0.11		0.00	0	0.00
Capra hircus (L.)	2	0.22		0.00	6	0.67
Ovis aries (L.)	33	3.64	14	7.41	85	9.44
Ovis/Capra sp.	638	70.42	132	69.84	736	81.78

Table 5.5. Möðruvellir element count and relative % of domesticates per phase

The complete absence of pig bones from all phases is a very clear indicator that at least on this estate pork was not consumed in sizeable numbers, if at all. Very occasional consumption of horse meat is indicated by the very low numbers of horse bones found in all the midden layers. In contrast, the people at Möðruvellir left considerable amounts of bovine and caprine bones as evidence for consumption of those species, as is usual for midden materials associated with Icelandic farms.

5.4.3. *Reconstructing Domesticate Mortality Patterns*

5.4.3.1. Cattle

With a considerable number of cattle remains recovered from Möðruvellir lower levels (Phase 1), a comparison of this site's neonatal elements vs. other contemporaneous ones is presented in the graph below. The figure caption locates the various faunal collections in general time and place. The sites presented here range from: special-purpose sites at Gásir (trading center) and Bessastaðir (Seat of the Governor for the Danish Crown) (McGovern 1990, Amorosi et al 1992), to 11th-13th c. lower status farms at Skuggi in Hörgárdalur (Harrison 2010a,b) Sveigakot (McGovern et al 2004, 2007), and Steinbogi (Brewington et al 2004) in Mývatnssveit, compared to a few high status farm estates (Stóraborg - Amorosi 1996, Hofstaðir – i.e. McGovern et al. 2009) at times associated with religious institutions (Viðey – Amorosi 1996).

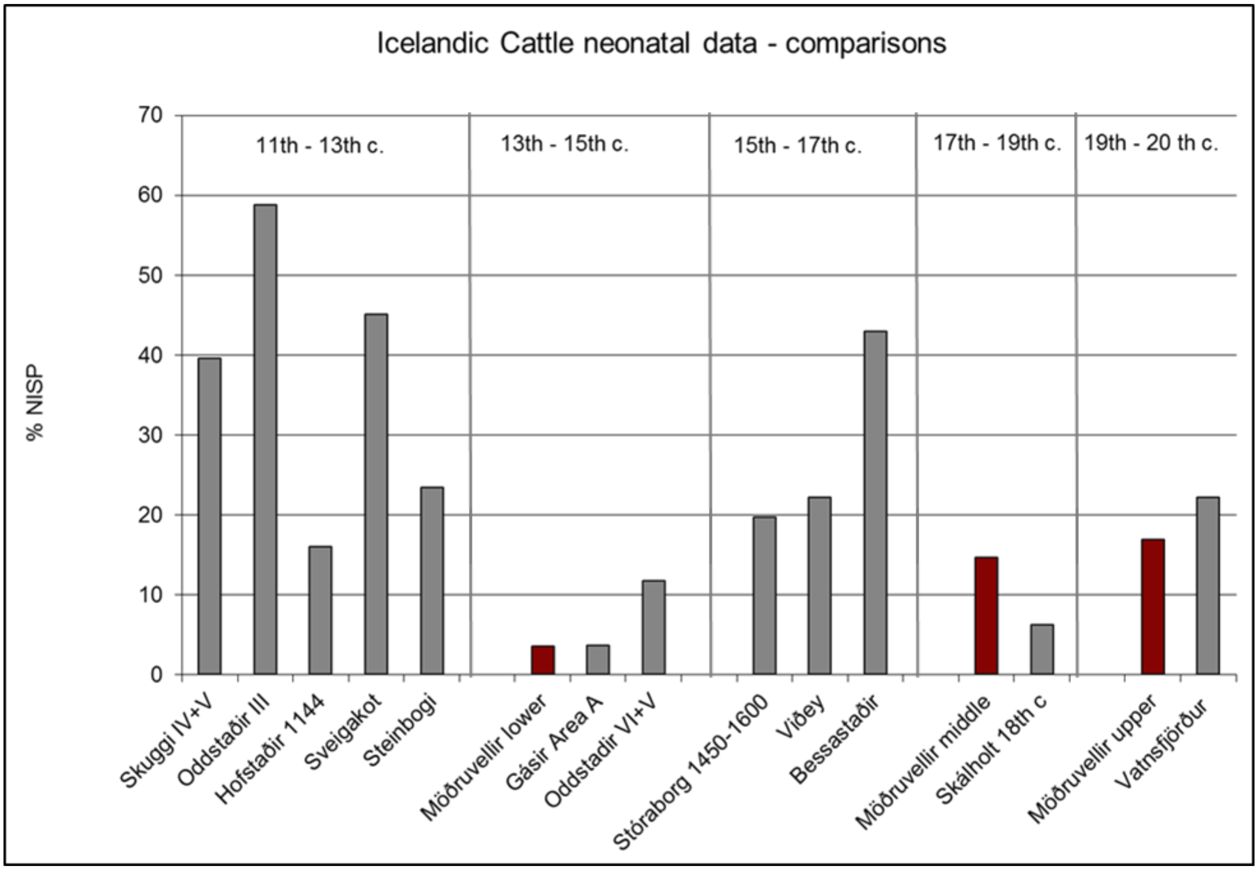


Figure 5.7. Möðruvellir bovine neonatal data compared to those from other Icelandic sites. Sveigakot (McGovern et al 2004), Hrísheimar (McGovern & Perdikaris 2002), Selhagi (McGovern & Perdikaris 2003, Draft) and Steinbogi (Brewington et al 2004) in Mývatnssveit; Viðey in Reykjavík (Amorosi 1996, 403), Stóraborg in the Southwest (Amorosi 1996:373), Bessastaðir (Amorosi 1996: 335) close to Reykjavík, Vatnsfjördur (NABO 2007 data).

Figure 5.7 presents a relative percentage of neonatal (newborn) calf bones in a number of sites from N and S Iceland. A range of ca. 15-50 % neonates among the total cattle bone count is generally interpreted as evidence of dairy herd management, with most milk being reserved for humans (Halstead 1998). The data presented here (red bars) suggest the Möðruvellir farm was not keeping the cattle for primarily dairying purposes, at least not until the 19th/20th although even then the neonatal cattle proportion is not much beyond 15 % and thus very similar to that from the 17th /18th c.

The graph compares the medieval Möðruvellir Midden fauna to sites within the region and in other regions of Iceland: contemporaneous Gásir and Oddstaðir collections (both Eyjafjörður); Stóraborg, Viðey, Bessastaðir, all later medieval mid-high status farm estates in the south of Iceland. The post-medieval/Early Modern Möðruvellir faunal data are compared with the Early Modern archaeofauna from the high-status ecclesiastic farm estate at Skálholt.

The most recent Möðruvellir deposits are compared to the 19th/20th c. deposits from the high status Vatnsfjörður farm in the Icelandic Westfjords (NORSEC data used from the 2007 VSF access database). For earlier data from ca. 11th to 13th c., the lower status farm Skuggi in Eyjafjörður and the middle midden deposits from Oddstaðir, are compared to the post VA/earlier medieval layers at the church farm at Hofstaðir, and the lower status farms at Sveigakot and Steinbogi (all Mývatnssveit; McGovern et al 2004, 2007, 2009, Harrison 2006, Harrison et al 2008, Hambrecht, 2007, Pálsdóttir et al 2008:4). Compared to all other sites listed here, the Möðruvellir neonatal proportion of 3.51 % is the lowest one observed.

Such a distinct lack of neonatal bones from a farm site can partially be the result of poor preservation conditions, especially when learning that in 1429, the House of Canons owned 8 calves, 24 milch cows and 40 oxen that were held on its own farm (Diplomatarium islandicum IV:373). Altogether, there were 72 cattle present, with 8 listed as calves, making up 11 % of that category. There was however still a relatively low number of calves present, and if one assumes that not all of those are neonates, but possibly some of them between 0.5 and 1 year old, then the data from the archaeofauna seem to fit better than expected, thus suggesting that, while preservation issues certainly need to be considered, the archaeological data are quite reliable.

The neonatal remains from the middle deposits at Möðruvellir, where the same bad faunal preservation exists (see TNF vs. NISP numbers above), demonstrate a clearly different pattern, with 14.63 % of neonatal cattle bones recorded. Similarly, the very well preserved faunal elements form the Oddstaðir midden trench presented in the same graph also suggest low percentages of cattle neonates during the 13th – early 15th c. Analysis of the 19th/20th c. Möðruvellir faunal collection resulted in a 16.90 % neonatal cattle proportion. Based on this data, at least the medieval faunal remains do not indicate large scale, on-site cattle dairying practices on this part of the Möðruvellir farm.

It is possible that the dairy products produced there and elsewhere in the valley were delivered to the Möðruvellir farm for consumption. This could have been so in payment of livestock rents from farmsteads such as Oddstaðir (see for example Júlíusson 2007, Blinkhorn 1999:9).

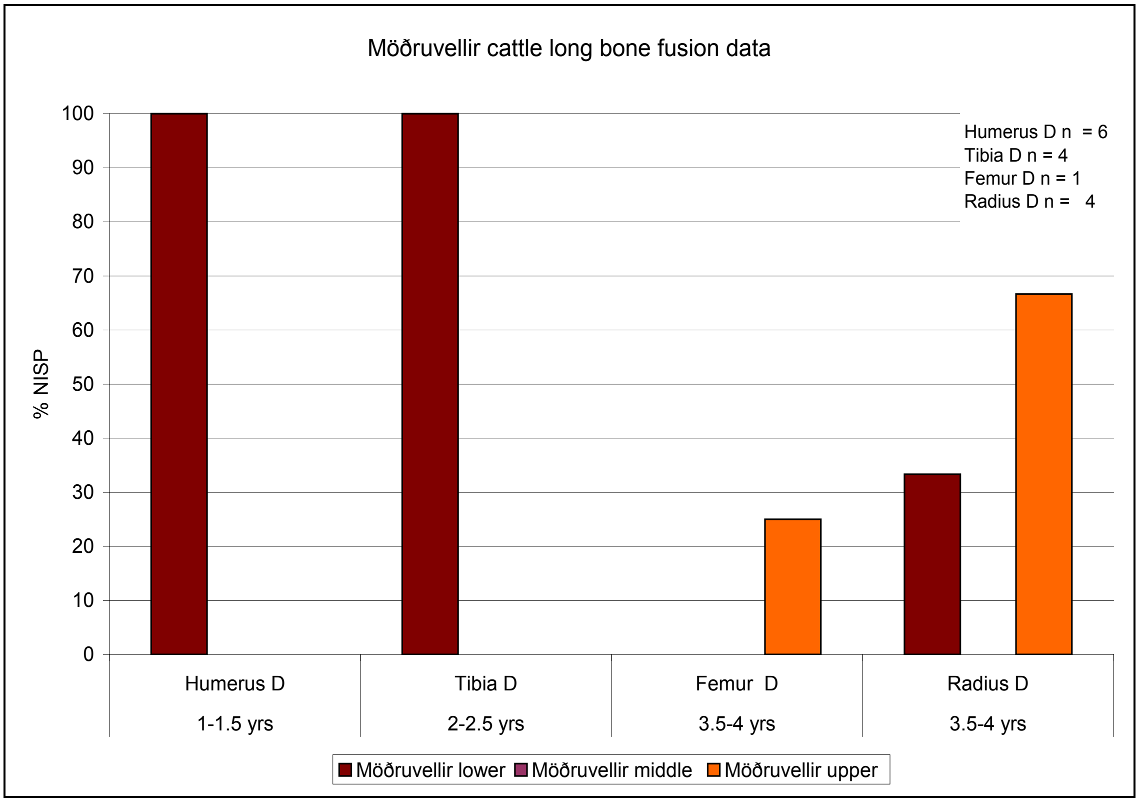


Figure 5.8. Möðruvellir cattle long bone fusion data. Möðruvellir lower = medieval phases (ca. 13th – early 15th c.); Möðruvellir middle = post-medieval/Early Modern phase; Möðruvellir upper = 19th/20th c. The text box indicates the total number of elements available per category.

The long bone fusion data graph only utilizes the percentage of completely fused bones from a total set of specific skeletal elements which when the epiphysis is fused to the diaphysis can be associated with certain animal age stages. For example, an element assemblage can be: a) fused distal humerus, b) unfused distal humerus, or c) partially fused distal humerus. All of them together are counted as 100% of the specific skeletal element assemblage (here: 100% of the humerus elements equal 6). The percentage of the specific skeletal assemblage (here: humerus, and in this case, all six elements were fused) made up by the fused element associated with the age stage is used for the graph above.

The combined number of Möðruvellir cattle elements for all phases available for long bone fusion analysis is 15. This low number does not allow for a discussion of the Möðruvellir cattle management based on the surviving long bone fragments. The most abundant yet still few (NISP = 10) c. elements suggest a 92 % survival of cattle beyond their 3rd and a 67 % beyond their 4th winter. In this case, the documentary sources are more reliable indicators of use and age at death of the animal and.

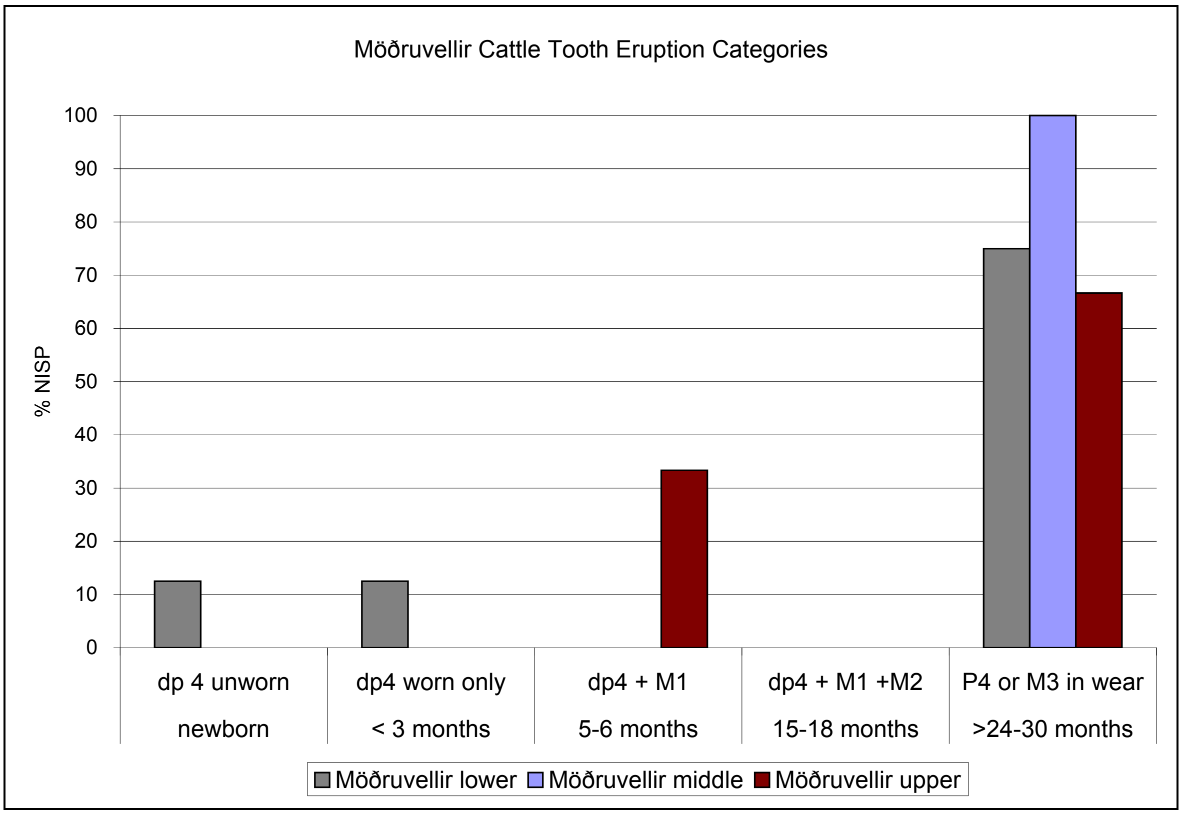


Figure 5.9. Möðruvellir cattle tooth eruption comparison. Möðruvellir lower: NISP = 8; Möðruvellir middle: NISP = 1; Möðruvellir upper: NISP = 3.

Similar to the long bone fusion analysis, the Möðruvellir cattle teeth available for eruption analysis (for information on age calculations based on tooth eruption and wear stages see Hillson 2005:223-253) were few in number. It is therefore not possible to suggest a general cattle age at death for the middle midden phase. With excellent bone preservation in the upper deposits, the very low number of usable cattle mandibular and maxillary elements available may be an approximate reflection of the very low cattle number recovered in total. The 19th/20th c. data indicate culling of 1/3 of the animals before their first winter, and the rest after their second winter. Numbers for the lower midden phase are higher and it seems that during medieval occupation of Möðruvellir, a majority of cattle (75 %) generally survived until past their second winter and third summer; with 12.5 % culled before, and another 12.5 % culled after their first summer.

The different age at death data presented above - despite preservation issues - suggest that cattle dairying was not practiced at a large degree at the then medieval monastic estate associated with the archaeofauna from Phase 1. Data sets for the post-medieval/Early Modern and 19th/20th c. collections are not suitable for any zooarchaeologically derived conclusion on the post-medieval cattle management strategy at Möðruvellir.

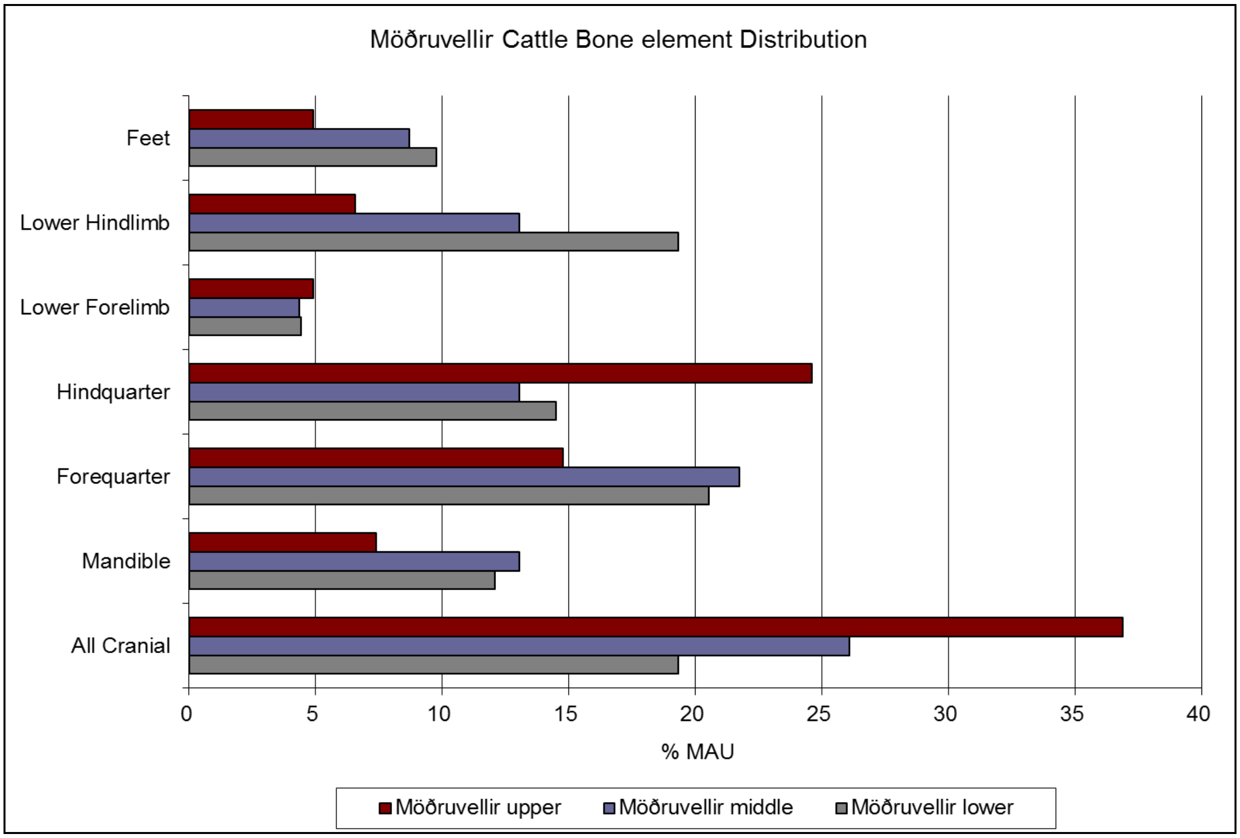


Figure 5.10. Möðruvellir cattle skeletal element distribution per phase. MAU is "the minimum number of animal units necessary to account for the specimens observed (Lyman 1994:511)." MAU normalizes differences in number of bones in the skeleton, so in a complete and un-fragmented cattle skeleton these bars would be equal length.

Figure 5.10 presents the Möðruvellir bovine skeletal distribution by phase, indicating which parts of the animals' skeleton were present in the midden layers. Generally, the cattle skeletal distributions indicate that whole animals are likely slaughtered on site and parts of the entire body are represented in the graph. The denser skeletal elements better withstand the taphonomic processes that deteriorate dense hard tissue more rapidly than the stronger bones such as certain long bone endings and certain cranial elements and teeth (Lyman 1994). Also, cranial fragments tend to shatter and their high proportions may be a reflection of fragmentation.

An analysis of medieval cattle bone burning (see figure 5.11 below) suggests that the signature seen above is not caused by the fact that these elements were used for fuel and just happened to end up on the midden together with food remains. Instead, more than 85% of the cattle bone from the medieval contexts were not burnt. Keeping taphonomic factors and the relatively small sample of cattle elements available for this study in mind, the graph above most likely represents on-site butchery.

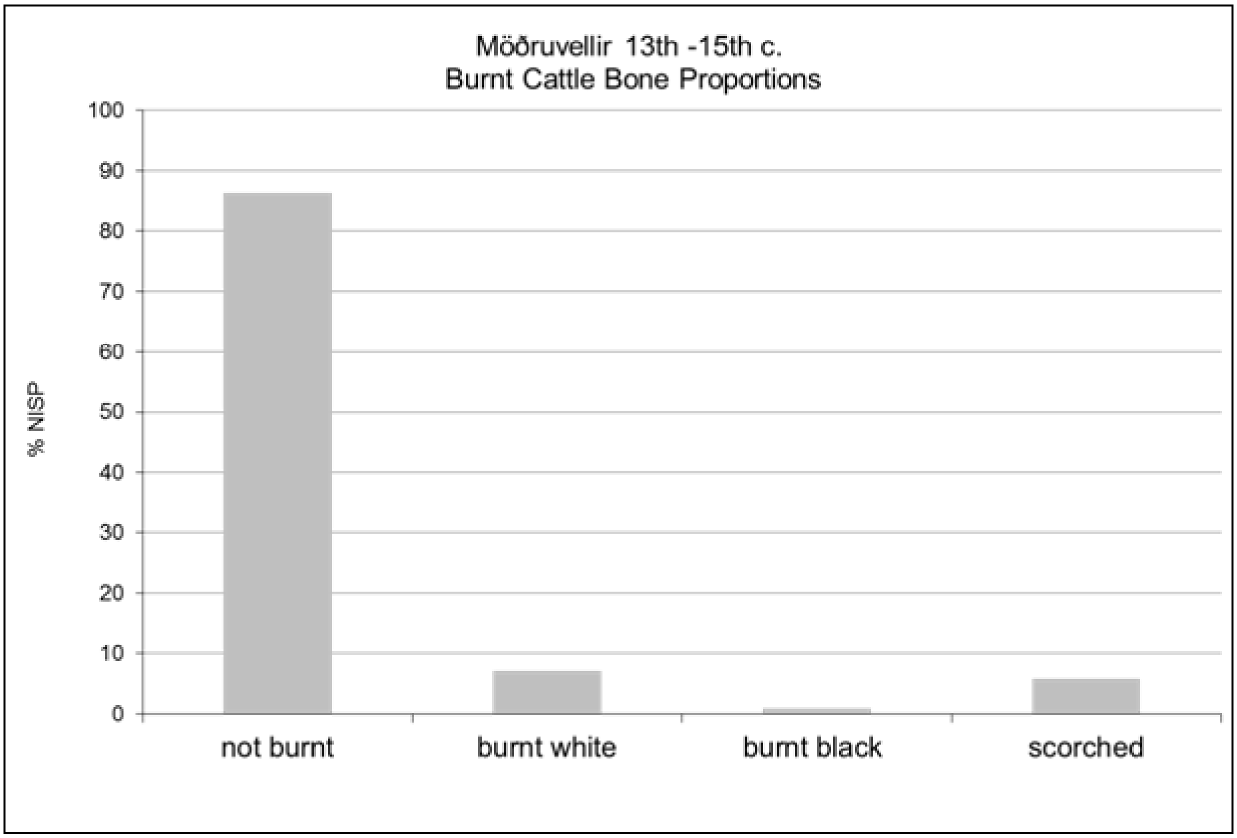


Figure 5.11. Möðruvellir medieval burnt cattle bone proportions.

The post-medieval/early modern collection behaves slightly differently, with still the most numerous skeletal elements equivalent to highest ranking food utility. In this period, people consuming beef may have made use of lesser quality meat-bearing skeletal elements more frequently, whether for consumption or for other purposes.

The Möðruvellir upper layers from the 19th/20th c. contained mostly cattle skeletal elements of high food utility ranking. An elevated amount of least-meat-bearing elements is noted here, possibly indicating marrow and grease extraction.

5.4.3.2. Caprines

As displayed in tables 5.2 and 5.3, the Möðruvellir ovi/caprines numbers are considerably higher than those of cattle, and thus provide better data for age at death profiles.

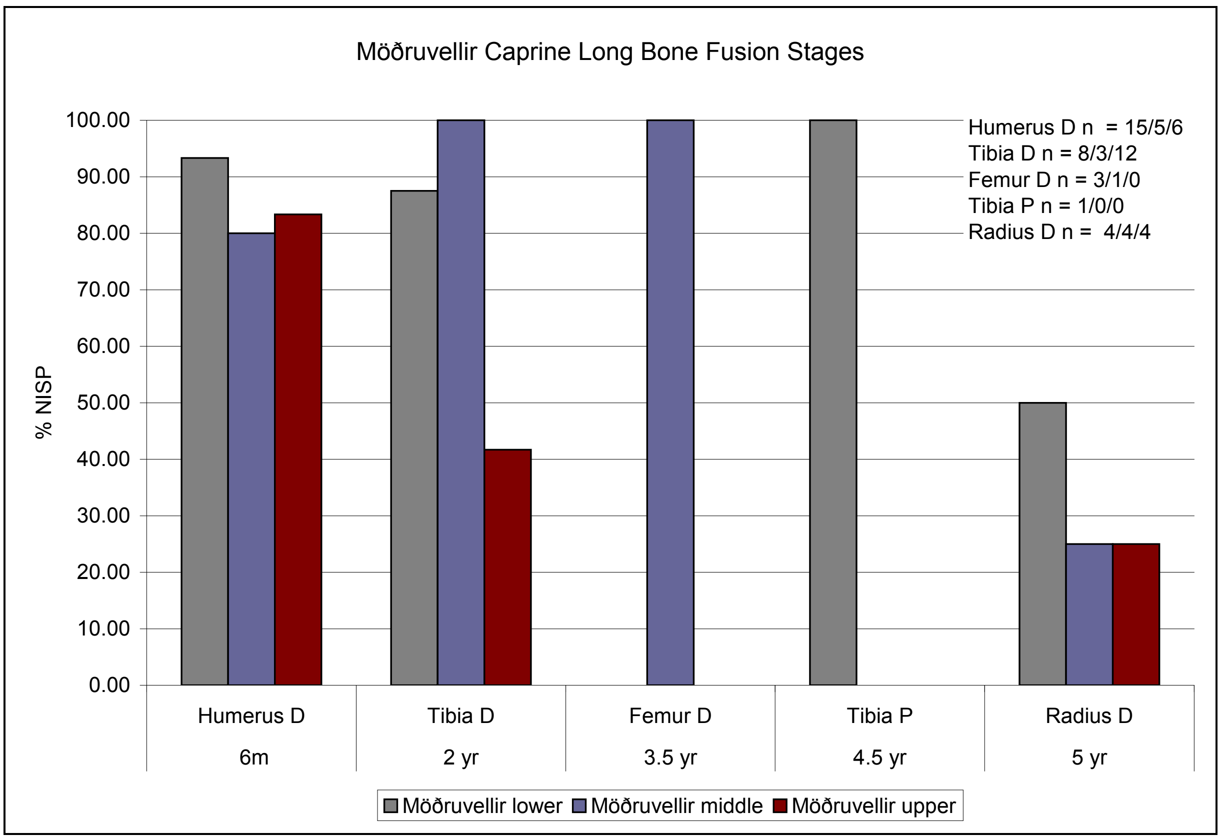


Figure 5.12. Möðruvellir caprine long bone fusion comparison. The text box indicates number of elements available per category and phase. For explanation of how the percentages are rendered, please consult the cattle long-bone fusion discussion.

The caprine long bone fusion data is somewhat better suited for a comparison of specific long bone elements. Categories where one element makes up 100 % of the NISP are still present, however, and clearly no suggestion on animal age at death can be made in those instances. Since taphonomy is an issue with the medieval and early modern layers, only the earliest and last age at death assessment are discussed, since they seem to be the most reliable (T.H. McGovern, personal communication January 2013). The graph suggests a first summer survival of 80 % of the Möðruvellir sheep/goats for all three phases and that about half of the animals from the medieval period were about five years or older at time of death. The high survival rate to relatively older age of the caprines collected from the medieval period suggests a wool producing economy (i.e. McGovern et al 2004). The post-medieval/early modern data is not of use for this age category, but the $19^{th}/20^{th}$ c. data indicates a 40 % sheep/goat survival rate beyond their second winter, which is much lower than the medieval one.

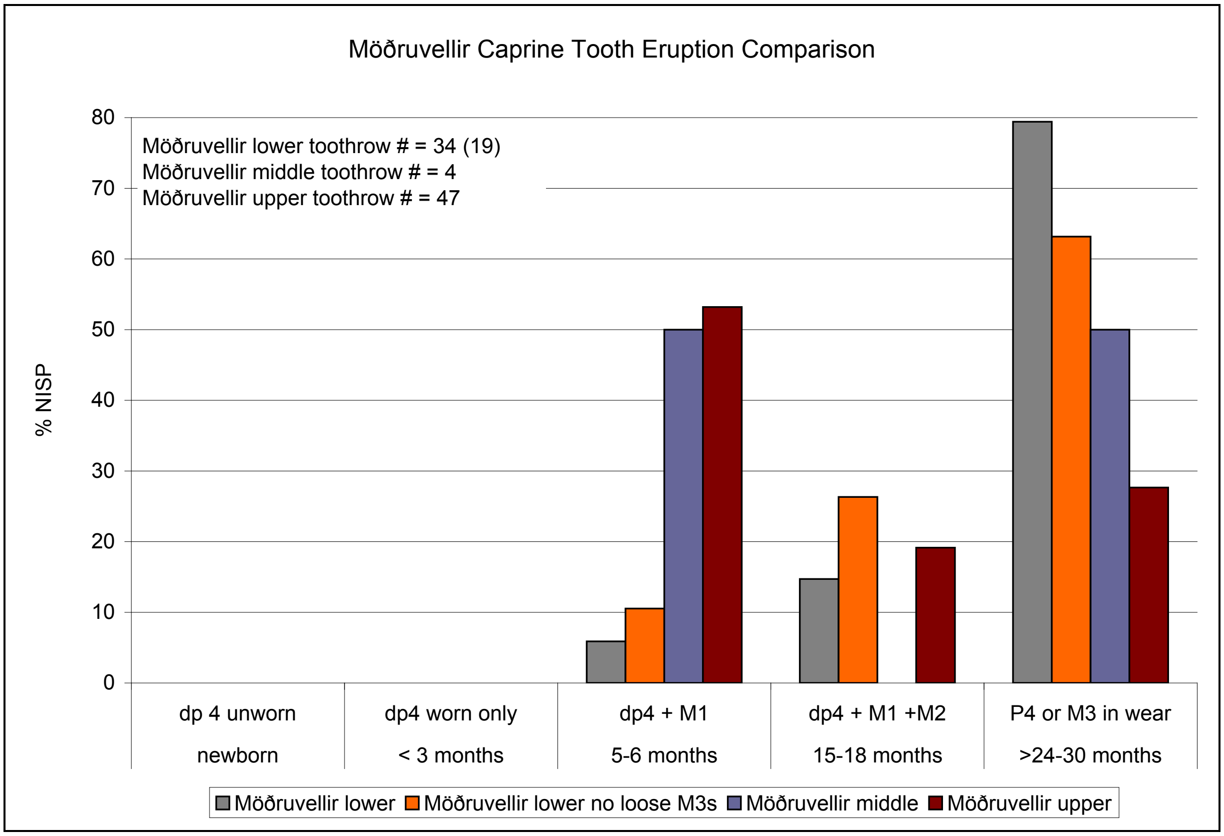


Figure 5.13. Möðruvellir **c**aprine tooth eruption comparison.

Figure 5.13 displays a phased Möðruvellir ovi/caprine mandibular and maxillary tooth eruption analysis, indicating that in all three phases, animals lived through their first three months of life. The tooth wear data for the medieval faunal collection are presented including loose M3 teeth (gray bars) and excluding loose M3 teeth (orange bar) and the latter data set will be presented in parenthesis as it is merely used to correct for a potential error due to preservation issues. Since mandibular M3s are very good indicators for the eruption stages of an entire mandible, their inclusion need not be disregarded. The M3 data then suggest that in the medieval phase, 79 % (63 %) of caprines seem to have survived at least until the age of 2 to 2 ½ years. With this mode of analysis, it is not possible to determine the animal's age further, but the information derived from the tooth eruption data is enhanced through the mandibular M3 Tooth Wear Stage (TWS) data presented below.

The 19th/20th c. faunal collection suggest a different culling age for the majority of the Möðruvellir sheep/goats: 53 % were culled before their first winter, with 47 % surviving their first and 28 % surviving their second winter. The Möðruvellir caprine culling patterns from the available faunal samples imply that dairying activities were carried out, but at likely smaller scale than wool and meat production. .

As observed from the cattle data, it is possible that animals belonging to the estate and delivering the dairy products supplying the estate were stationed elsewhere, possibly in shielings or animal winter shelters located further in the Hörgá valley's interior, but also likely in other valley systems, especially the adjacent Öxnadalur. According to Vésteinsson (personal communication, October 2012), two common cattle and sheep herd management practices in medieval Iceland might explain these patterns. It is possible, that the Hörgárdalur farms participated in the so-called *lambseldi,* a system under which tenants and other dependent farmers took care of and fed one or several lambs and/or sheep belonging to the Möðruvellir estate. The other management issue is the need of large landowners to be able to replace rented livestock. Although landowners tried to make tenants replace their rented livestock with its own offspring they always needed to supplement the system to keep it going and this might explain the emphasis on producing a high proportion of live animals. The patterns observed from the caprine tooth eruption data are more reliable than those from the long bone fusion analysis since teeth tend to survive best in archaeological deposits (Hillson 2005).

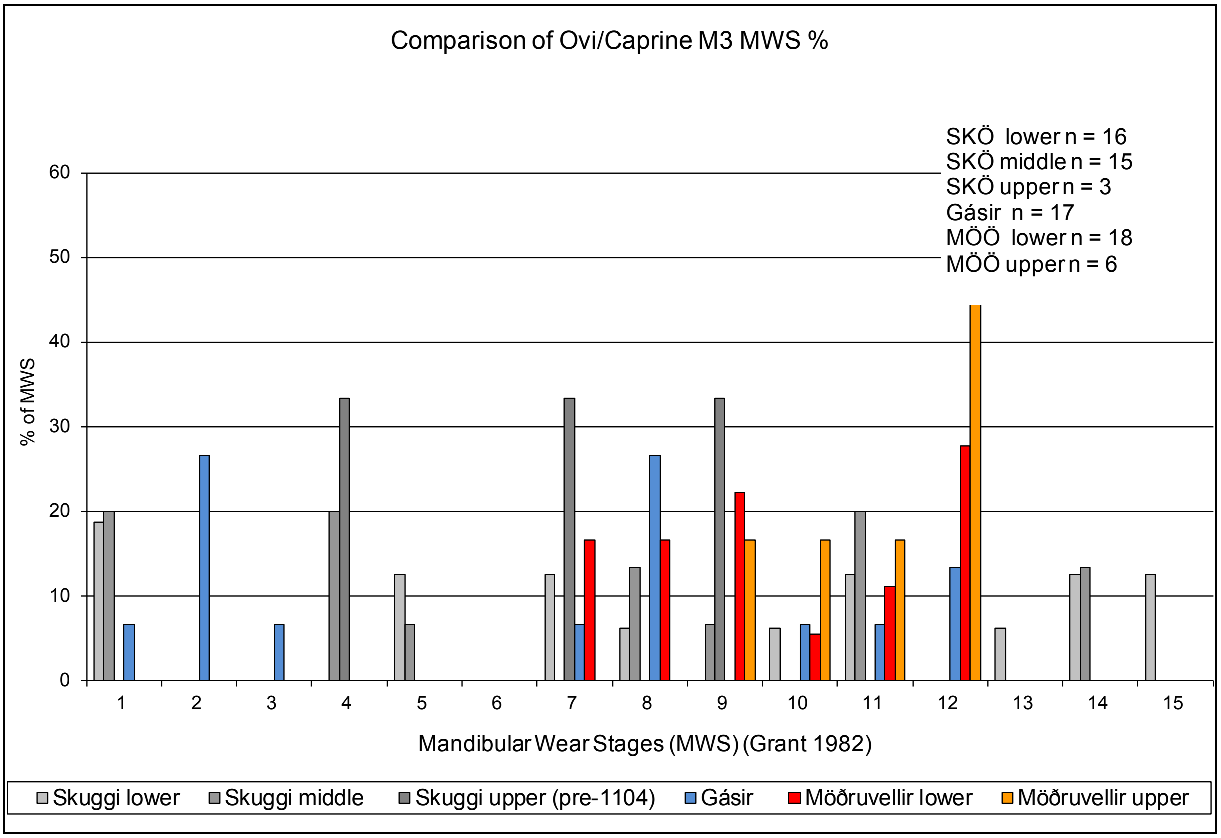


Figure 5.14. Ovi/Caprine M3 MWS (Mandibular Wear Stage, after Grant 1982) comparisons. SKÖ = Skuggi (ca. AD 950 – 1100); Gásir archaeofauna contemporaneous with Möðruvellir (MÖÖ) lower midden deposits, 13^{th} – early 15^{th} c.

The Möðruvellir M3s available for tooth wear state grading were all graded on a range between b with a score equal to 1, and g with a score equal to 12 (Grant 1982 in Hillson 2005:319). This suggests the animals were mature, but not of old age. Skuggi ovi/caprines included some older animals, with M3 MWS (Mandible Wear Stage, Grant 1982) up to 15. None of these animals had scores between 15 and 20 (categories 0, 16, 17, 18, 19, 20 had no y-values and were eliminated for a less crowded presentation of the individual data columns), indicating a Möðruvellir presence of mature but not very old animals. Compared to the other ovi/caprine M3 MWS, the one from Möðruvellir suggests a relatively narrow age range for these animals. Just as there seem to be no very young ovi/caprines culled at Möðruvellir, figure 5.14 also indicates absence of very old animals. Therefore, a typical management of a dairy herd seems not reflected in the Möðruvellir ovi/caprine remains (see Harrison et al 2008, McGovern et al 2007).

Three sheep (*Ovis aries*) mandibles from context [041], upper midden phase, displayed P4 pathologies. These heavily impacted P4 patterns in sheep jaws are believed to be associated with ingestion of volcanic grit and the phenomenon is called "Broken Mouth disease" (e.g. McGovern et al. 2004, 2009). All three sheep tooth rows have their M3 in wear, with a TWS of g – score of 12 (according to Grant 1982), indicating mature animals (Harrison 2006, 2009).

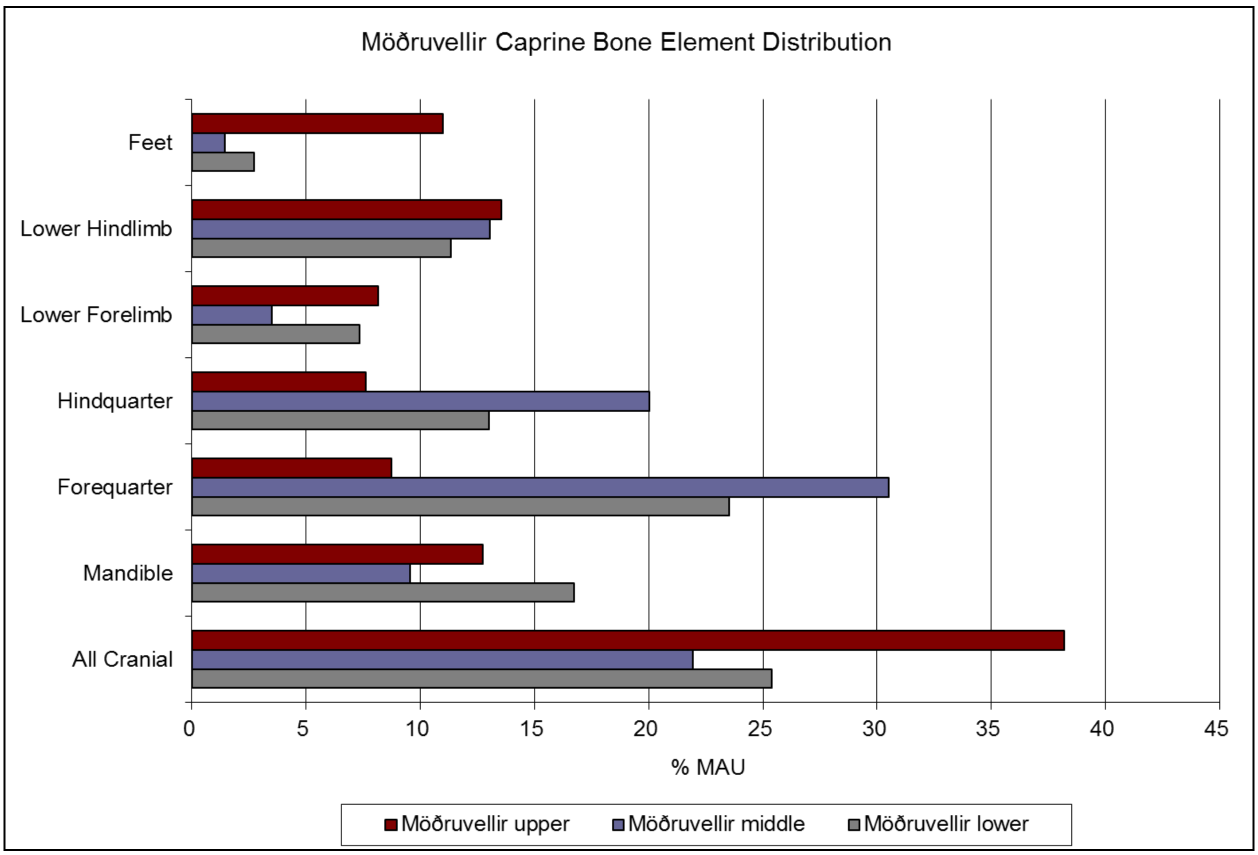


Figure 5.15. Möðruvellir Caprine skeletal element distribution per phase.

All three Phases contained caprine elements from the entire skeleton, albeit at varying degrees. Since the upper midden layers exhibit the best organic preservation, the 19th/20th c. skeletal distribution can be viewed as the most representative of the actual faunal remains deposited during midden formation. The other two faunal collections exhibit presence of skeletal elements or portions of caprines that coincide with bone density factors, displayed more clearly in the graph below. The general absence of vertebral and rib elements again is due to the practice of placing sheep and goat sized animals into the MTM category to not mistakenly place other mammal species of similar size into the caprine category.

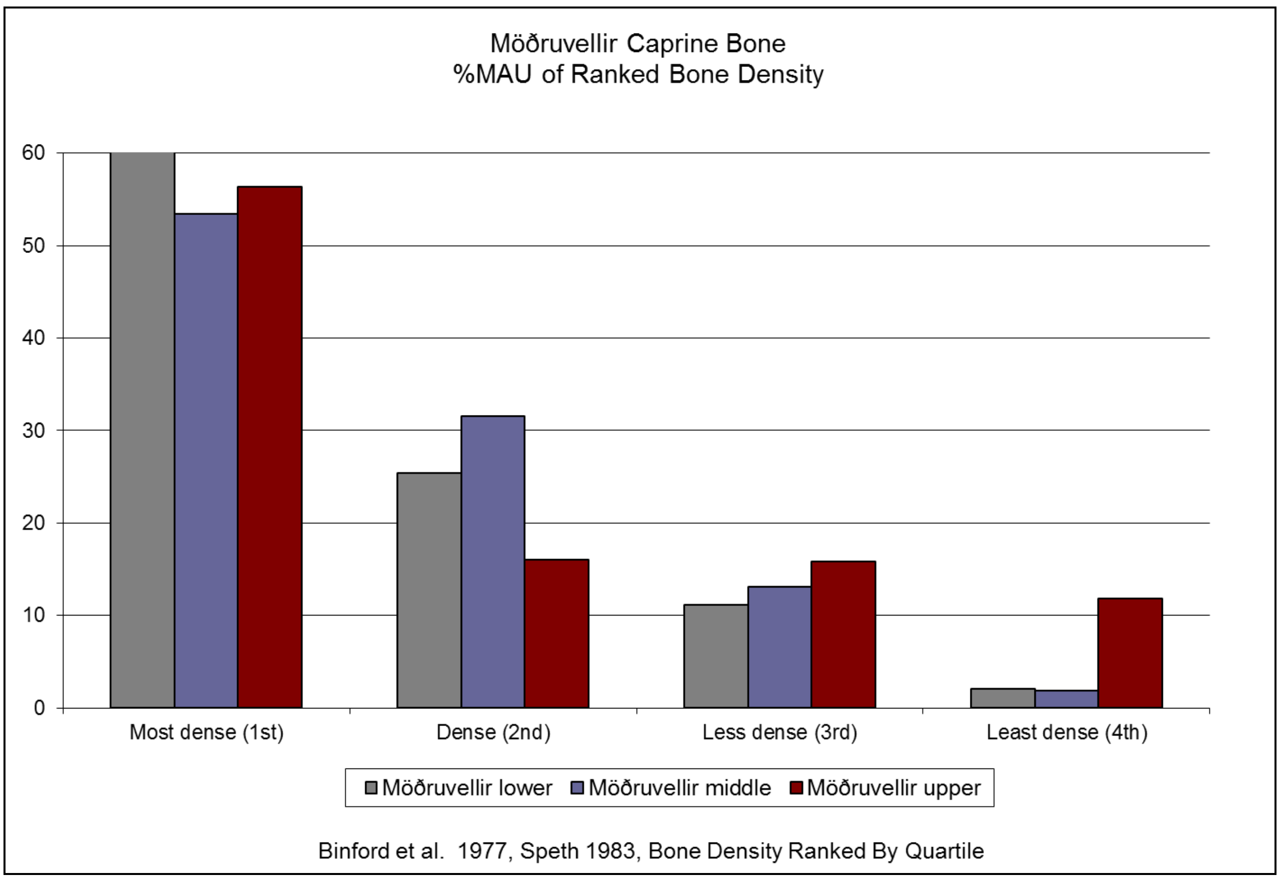


Figure 5.16. Möðruvellir – analysis of caprine bone density ranks.

The ovi/caprine density ranking comparisons indicate a sharp decrease in skeletal elements of lower ranks for the medieval caprine remains, with the post-medieval/Early Modern ones displaying a very similar pattern, indicative of poor faunal preservation. The well preserved 19th/20th c. caprine bones suggest a higher proportion of skeletal elements that are not the densest ones. Since this again is an indication for a relatively realistic sample of the actual collection preserved from the upper midden deposits, the results in the MGUI ranking below can be used to make a statement on how people in the 13th and 14th c. managed their caprine resources at Möðruvellir.

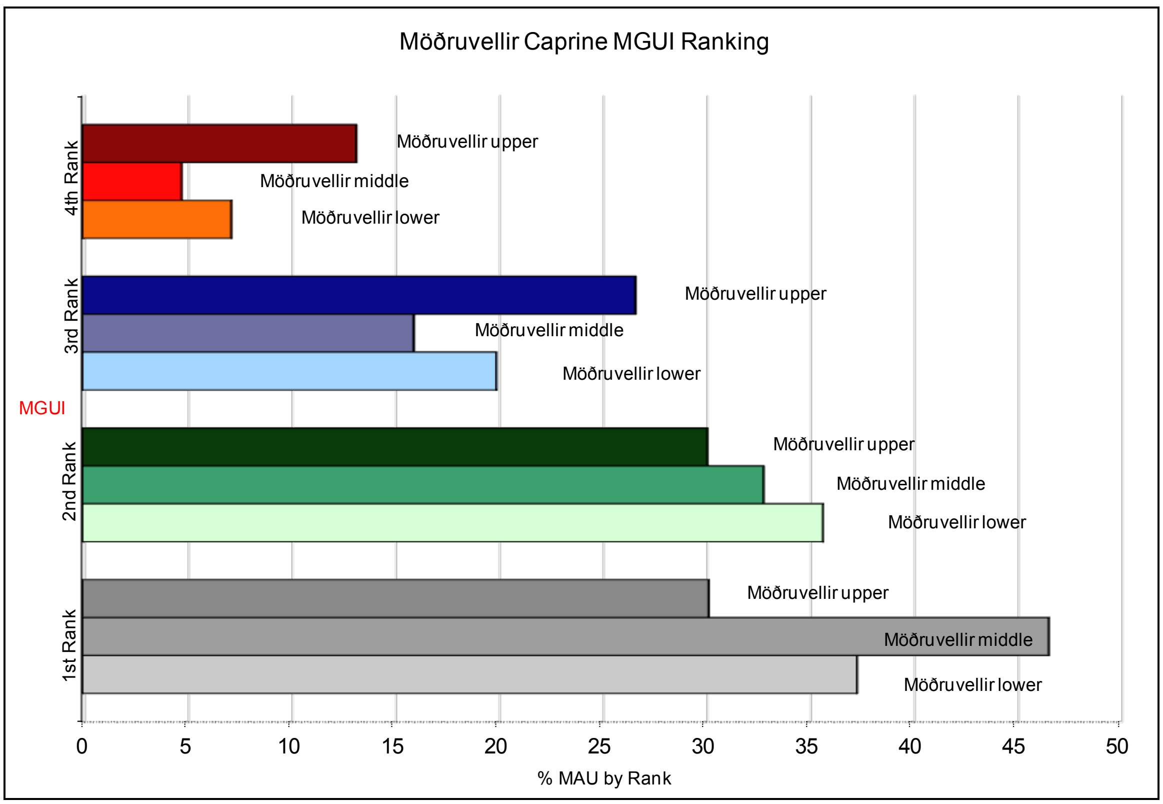


Figure 5.17. Möðruvellir – Caprine MGUI rankings.

The percentage for the medieval caprine skeletal elements with the highest food value is almost the same as that for the one ranked second. This pattern resembles the one from the

19th/20th c. archaeofauna to a degree, with differences observed for skeletal element proportions that have a food utility index rank of 3 and 4. There, the caprines from the most recent midden deposits may display more complete skeletons that have not been as much affected by taphonomic factors as those from the earliest phase. The MGUI ranking for the post-medieval/Early Modern sheep and goats suggests prevalence of skeletal elements of higher food value with a progressive decline in proportions of skeletal elements relative to their MGUI.

5.4.4. *Horse*

Phasing	Context	Species	Skeletal element	Count
Phase 4 upper midden	065	Equus caballus	Mandibular premolar	1
Phase 4 upper midden	602	Equus caballus	Patella	1
Phase 3 middle midden	073	Equus caballus	Tibia	1
Phase 3 middle midden	019	Equus caballus	Maxillary molar	1
Phase 2 lower midden	101	Equus caballus	Mandibular premolar	1
Phase 2 lower midden	087	Equus caballus	Mandibular molar	1
Phase 2 lower midden	120	Equus caballus	Mandible	1
Phase 2 lower midden	120	Equus caballus	Mandibular premolar	1

Table 5.6. Horse elements recovered from the Möðruvellir midden.

All three Möðruvellir midden phases produced a small number of horse elements. The lower phase contexts contained at least three, possibly 4 different individuals. This is a very small number of animals slaughtered or consumed over the course of several centuries. The occasional horse meat may still have been consumed on the farm, although those people following a strictly catholic diet there might have not been the ones enjoying the occasional horse meat. This pattern of occasional horse meat consumption was also observed in the faunal collections from the other sites discussed. Context [120] contained two equine mandibular elements that were possibly from the same mandibular fragment recovered from the same context. Except in cases of lacking alternative resources, the consumption of horse meat was never fashionable (Sveinsson 1962), but element numbers recovered from the 19th/20th c. midden deposits are lower than might have been expected.

5.4.5. *Dog*

A single fragmentary tooth from the lower midden deposits at Möðruvellir was collected. It is not even clear if this tooth represents an animal that had died and was discarded, or if this is simply a lost tooth. Evidence of dogs present at Möðruvellir can be observed from a number of elements marked by dog gnawing.

Context number	Phasing	Gnaw	Count
013	Phase 4- ca. 1870 early 20th c.	Dog gnawing	1
014	Phase 4- ca. 1870 early 20th c.	Dog gnawing	1
018	Phase 4 - ca. 1870 early 20th c.	Dog gnawing	1
039	Phase 4 - ca. 1870 early 20th c.	Dog gnawing	15
041	Phase 4 - ca. 1870 early 20th c.	Dog gnawing	3
500	Phase 4 - ca. 1870 early 20th c.	Dog gnawing	1
505	Phase 4 - ca. 1870 early 20th c.	Dog gnawing	2
601	Phase 4 - ca. 1870 early 20th c.	Dog gnawing	2
603	Phase 4 - ca. 1870 early 20th c.	Dog gnawing	3
			29
019	Phase 3 post-medieval/Early Modern	Dog gnawing	3
			3
082	Phase 2 - late 13TH - early 15TH c	Dog gnawing	1
086	Phase 2 - late 13TH - early 15TH c.	Dog gnawing	1
			2

Table 5.7. Dog gnawed elements recovered from the Möðruvellir midden.

5.5. Wild Mammals

As indicated by the NISP table, the number of wild mammals at Möðruvellir is very low. The few marine mammal bones recovered from the midden trenches were all non-diagnostic skeletal elements, and so could only be grouped into more general categories, i.e. large phocid vs. small phocid, large cetacean vs. small cetacean (of dolphin or porpoise size).

One terrestrial mammal bone displayed marks from what was likely rodent gnawing.

5.5.1. *Seals*

Phasing	Species	Bone	Count
Phase 4- ca. 1840-E20th c.	Phocid	2nd Phalanx	1
Phase 4 - ca. 1840-E20th c.	Phocid	Rib; five in total, but not recovered articulated	5
Phase 4 - ca. 1870-E20th c.	Phocid	Thoracic vert.	1
Phase 4 - ca. 1870-E20th c.	Phocid	Rib	1
total			8
Phase 2 – early 14th -early 15TH c.	Phocid	Canine	1
Phase 2 - early 14th -early 15TH c.	Large phocid	Canine	1
Phase 2 - early 14th -early 15TH c.	Phocid	Rib	1
total			3

Table 5.8. Seal elements recovered from the Möðruvellir midden.

Only the upper and lower midden deposits contained bones from seal, none were diagnostic enough to be speciated beyond general sizes, but the majority of the 10 elements were likely from Harbor seal (*Phoca vitulina*) and the large-phocid canine could be from a Gray seal (*Haliocherus grypus*). Both seal species give birth on the sandy Icelandic coastal strips. In the middle ages, there used to be several known seal hunting places in Eyjafjörður (Kristjánsson 1989 I: 315), and while there are very few seal elements collected from the Möðruvellir lower phase deposits, these animals could have originated in one of those areas.

It is likely that the five phocid ribs from context [041] belonged to the same individual, but they were not recovered as an articulated unit.

5.5.2. *Cetaceans*

Of the four identified cetacean elements listed in the NISP table, three could be placed more securely into a porpoise/dolphin sized category; one vertebral element from context [039], one series of five articulating chopped lumbar vertebrae from context [041][6], and one tooth from context [103]. Porpoises (*Phocoena phocoena*) and at least the White-beak dolphins (*Lagenorhynchus albirostis (Gray)*) are relatively frequent in Icelandic coastal waters, especially during the summer months (Feilberg & Gensbøl 2003:133-35)

[6] Context [041] also contained a blue painted caprine mandible likely a toy (Gísladóttir et al forthcoming).

Figure 5.18. Möðruvellir – porpoise/dolphin chopped lumbar vertebral column sequence from the Möðruvellir upper midden phase ([041]).

Context	Phasing	Species	Bone	Count
039	Phase 4 - ca. 1840-E20th c.	Dolphin/Porpoise	Vertebra	1
041	Phase 4- ca. 1840-E20th c.	Dolphin/Porpoise	5 articulating lumbar vert. - articulated	1
total				2
089	Phase 2 - early 14th -early 15TH c.	Cetacean	Rib	1
103	Phase 2 - early 14th -early 15TH c.	Dolphin/Porpoise	Tooth	1
total				2

Table 5.9. Cetacean elements recovered from the Möðruvellir midden.

5.6. Birds

Möðruvellir	Midden Phases					
Bird species count	Lower - Phase 1& 2		Middle - Phase 3		Upper - Phase 4	
Identified Bird Species	NISP	% NISP	NISP	% NISP	NISP	% NISP
Migratory Waterfowl						
Mallard Duck (*Anas platyrh.*)					1 (33)	9.09
Eider Duck (*Somateria mollissima*)			2	66.67		
Swan species (*Cygnus sp.*)			1	33.33		
Anser species (Goose family)	1	4.35				
Sea birds						
Murre species (Uria species)	15	65.22			2	18.18
Auk family (Alcid familie)	5	21.74			1	9.09
Non Migratory Terrestrials						
(Ptarmigan/grouse (*Lagopus muta*)	2	8.70			3	27.27
Domestic chicken (*Gallus gallus*)					4	36.36

Table 5.10. Count of analyzed Möðruvellir bird species.

The total count of Möðruvellir bird bones is 127, translating to 1.60 % of the overall NISP. This number can be broken down by phase: the lower midden deposits (Phase 1 & 2) had a total bird bone count of 44 (33.56 % of NISP); the middle phase had a total bird count of 27 (8.94 % of NISP); the upper midden deposits produced a total bird count of 56 (0.87 % of NISP).

Out of a total of 37 bird elements identified to species or family level, 17 were from either Guillemot (*Uria aalge*) or Common Murre (*Uria lomvia*), with another 6 bird bones placed in the more general auk family. Both uria species' skeletal elements are very similar to each other. These are sea birds found and can be found along the sandy beaches and coastal waters of Eyjafjörður (and all of Iceland) in the winter (Hilmarsson 2000:30-31).

While the middle midden layers contained 2 Eider duck elements and one from swan, this phase did not produce any of the bird species found in the layers above or below. Eider ducks are found in Eyjafjörður (Harrison 2006), and their down collected for its insulation properties.

The articulated Mallard skeleton recovered from the upper phase, context [006], was discussed in an earlier Möðruvellir faunal report (Harrison 2007). The well preserved bone remains could be assigned to one specimen, including tracheal rings. The furcula (wishbone) shows extra bone growth on the left side of the skeleton, a pattern repeated in the bird's left scapula and humerus, possibly suggesting a sick bird discarded due to disease.

Both the medieval and $19^{th}/20^{th}$ c. deposits produced a few Ptarmigan remains, and the most recent layers also contained several domestic chicken bones.

Generally, the low amount of bird elements that could be placed into family and species categories does not indicate a heavy reliance on avian species for subsistence purposes. An occasional exception could be the consumption of auk species, especially Guillemot or Common Murre, possibly in the winter.

Ptarmigans may have been consumed by the monastic elites rather than the common farm servants or monks and could be viewed as social status indicators. Particularly, when considering a lack of Ptarmigan elements in other Hörgárdalur archaeofaunal collections, i.e. Skuggi (Harrison 2010) and only one element from the Viking Age phase at Oddstaðir (Harrison 2012). An added element to this explanation in the Hörgárdalur context could be that in Eyjafjörður, the best areas for Ptarmigan hunting are in the fjords north of Ólafsfjörður. Ptarmigan are found south from there also, but higher up in the mountains, thus harder to reach (Ólafur K Nielsen, Ptarmigan Specialist, Icelandic Institute of Natural History, personal communication February 2013).

5.7. Fish

As indicated by the NISP table, fish make up 20.13 % of the medieval archaeofauna, 21.20 % of the post-medieval/Early Modern archaeofauna, and 84 % of the $19^{th}/20^{th}$ c. archaeofauna. The only analyzed fresh water species element was from Brown Trout (*Salmo trutta)* and it is safe to suggest that at least the great majority of the unidentified Möðruvellir fish remains were marine species.

The Möðruvellir fish bone numbers for the earlier two midden phases are very small; only very general information can be gained from them, with almost no data available for the middle midden phase. The upper midden phase produced a large enough fish data set allowing for approximate fish live-size reconstructions and skeletal element pattern analysis. This most recent midden phase will therefore be discussed at length after a more general discussion of the Möðruvellir fish assemblage, paying specific attention to the sparse medieval fish remains.

5.7.1. *The medieval fish remains compared to the 19th/20th c. assemblage*

The low numbers of fish bones available for the lower midden deposits (NISP=249) and the middle midden deposits (NISP=64) are in strong contrast with those found in the upper midden deposits (NISP=5,427). Preservation is likely a factor, but the data also suggest that the Möðruvellir residents' preference for or reliance on certain animal foods changed over time. If the medieval phase once had a percentage of fish remains similar to that found in the 19th/20th c. deposits, the NISP of fish in the medieval phase would have to be 2,809 instead of 121, following an upper phase ratio of domestic mammals compared to the identified fish elements of 1 to 3.10. This would be similar to the 2,787 identified fish bones from that upper level. If one were to assume that same ratio for the middle phase that number of identified fish would have to be 589 instead of 34.

Table 5.11 demonstrates the relatively higher species diversity and the higher number in skeletal elements in the 19th/20th c. phase. The medieval assemblage of analyzed fish elements is predominantly made up of haddock elements, with a few cod and even fewer saithe bones. The upper assemblage, beyond the typical gadid species of cod, haddock, occasional saithe and cusk, also contained a number of wolfish bones and a single trout element.

Fish Element Counts	Midden Phases			
	LOWER - Phase		UPPER - Phase	
TAXON	NISP	NISP %	NISP	NISP %
Cod (Gadus morhua (L.))	4	1.61	1,050	19.35
Haddock (Melanogrammus aeglefinus (L.))	29	11.65	480	8.84
Saithe (Pollachius virens (L.))	2	0.80	11	0.20
Cusk (Brosme brosme (L.))		0.00	1	0.02
Atlantic Halibut (Hippoglossus hippoglossus (L.))		0.00		0.00
Gadid species	86	34.54	1,211	22.31
Wolfish (Anarchichas lupus)		0.00	33	0.61
Trout (Salmo trutta)		0.00	1	0.02
Marine fish non-speciated	128	51.41	2,640	48.65
Total fish	249	100.00	5,427	100.00

Table 5.11. Fish element counts for Möðruvellir lower and upper phases.

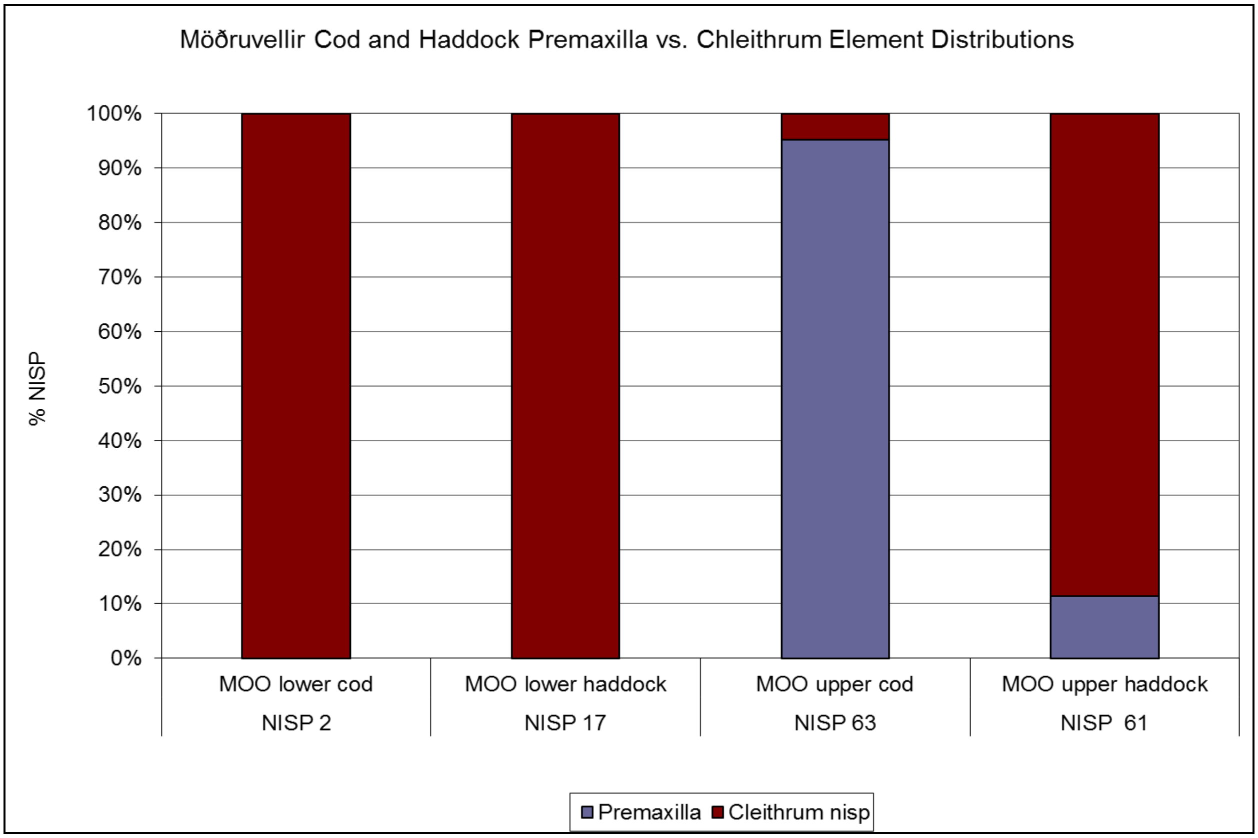


Figure 5.19. Cod and Haddock premaxilla vs. cleithrum distributions; Möðruvellir lower and upper midden phases compared.

Figure 5.19 compares the medieval and 19th/20th c. cod and haddock cleithrum (large bone from pectoral region) vs. premaxilla (jaw bone) distributions. The premaxilla tends to be discarded in relatively high numbers at the point of fish cleaning and preparation for drying or consumption, and therefore is associated with fish-producing activities. The cleithrum is often used as indicator for a preserved fish filet and usually found on sites where consumption of preserved fish (of cod and haddock in this instance) took place.

A complete lack of premaxillary elements in the medieval cod and haddock assemblages indicates that Möðruvellir seems to have been provisioned with preserved gadids. At 95%, the 19th/20th c. cod premaxillary proportions are indicative of fish processing (i.e. removal of fish head from trunk and potentially a consumption of the cod filets either elsewhere or outside the estate). The Möðruvellir haddock assemblage from the upper period suggests that haddock filets were either brought to site, or that these gadids were obtained fresh and processed elsewhere on site.

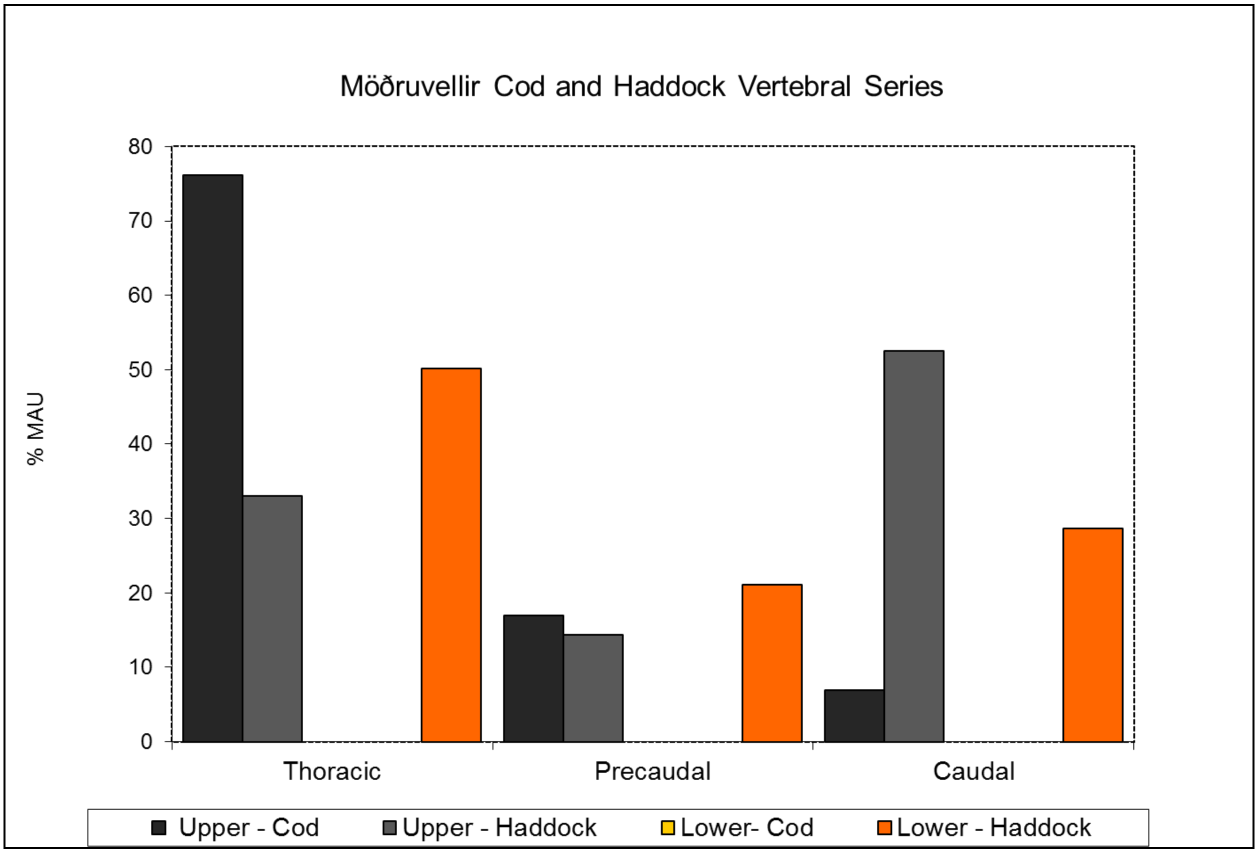


Figure 5.20. Cod and Haddock vertebral series; lower and upper Möðruvellir midden phases compared.

In addition to the cleithrum, a certain proportion of the spinal column is often indicative of a specific kind of preserved fish: for example dried in the round, with the thoracic vertebrae included in the element distribution. Another dried fish filet signature can be signaled by the presence of cleithra and predominantly precaudal and caudal vertebrae, but very few thoracic vertebrae. This would likely signify a smaller filet, dried in split form (Perdikaris et al 2004, Perdikaris and McGovern 2007, 2008, McGovern et al. 2009, also Harrison et al 2008).

There are no cod vertebral elements available for the medieval assemblage, but the haddock vertebral elements are suggestive of a fish filet with most of the vertebral elements present. The 19th/20th c. Möðruvellir cod skeletal remains suggest on-site processing of fresh cod fish into either fresh or dried fish filets. Another explanation could also be that dried heads were bought, as was common in the 19th c. (Vésteinsson, personal communication May 2013). A considerable number of people likely present on the Möðruvellir premises during the 19th/20th c. may have needed a secure food storage solution for the winter and therefore it is possible that cod filets were prepared on site for the occupants of the school or the governor's house. Alternatively, these fish products may have been served fresh, especially if they were aimed for the high official residing at Möðruvellir (Vésteinsson 2001). Haddock remains also included vertebrae, mostly from the pre-caudal and caudal portion, generally suggesting consumption remains rather than processing remains.

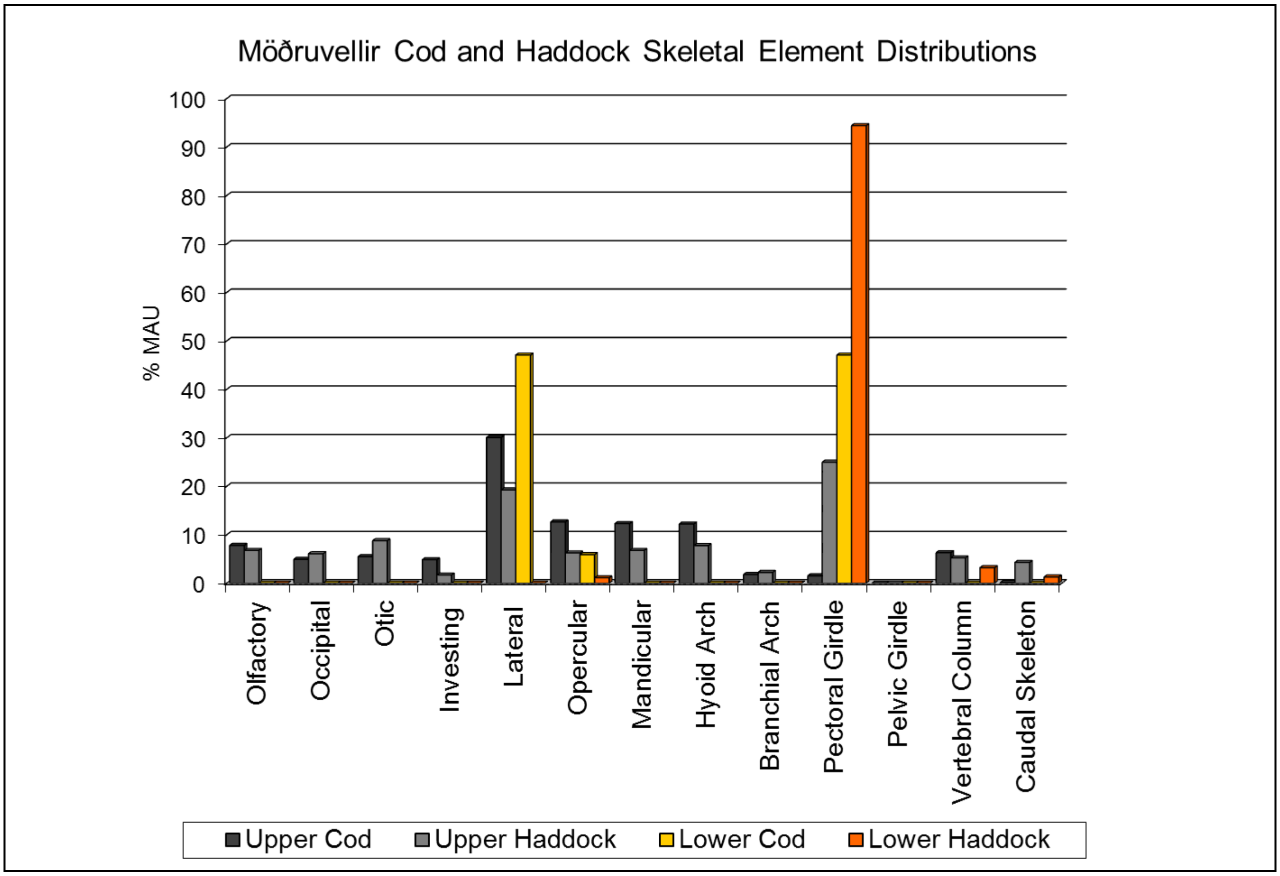


Figure 5.21. Möðruvellir, medieval and 19th/20th c. Cod and Haddock skeletal element distributions comparison.

The 19th/20th c. cod and haddock skeletal element distributions from the upper midden layers are presented in figure 19. A predominance of cod remains from the head rather than the post cranial area, save the thoracic vertebrae (fig. 20) is indicated.

The haddock skeletal element distribution pattern on the other hand suggests a different processing and consumption pattern; potentially, a haddock product was consumed in the activity area associated with this household midden deposit. Consistent with the haddock cleithrum vs. premaxilla ratio, the high number of pectoral elements indicates the presence of a higher number of haddock cleithra than in cod category (for a discussion on cod/had elements representing certain parts of the fish, see Perdikaris and McGovern 2008, McGovern et al. 2009, also Harrison et al 2008, and Chapter 4). The medieval haddock skeletal distribution again indicates that haddock and likely also cod were probably brought to site as preserved filet, basically missing most of the skull bones and showing a large amount of pectoral elements.

5.8. Mollusks

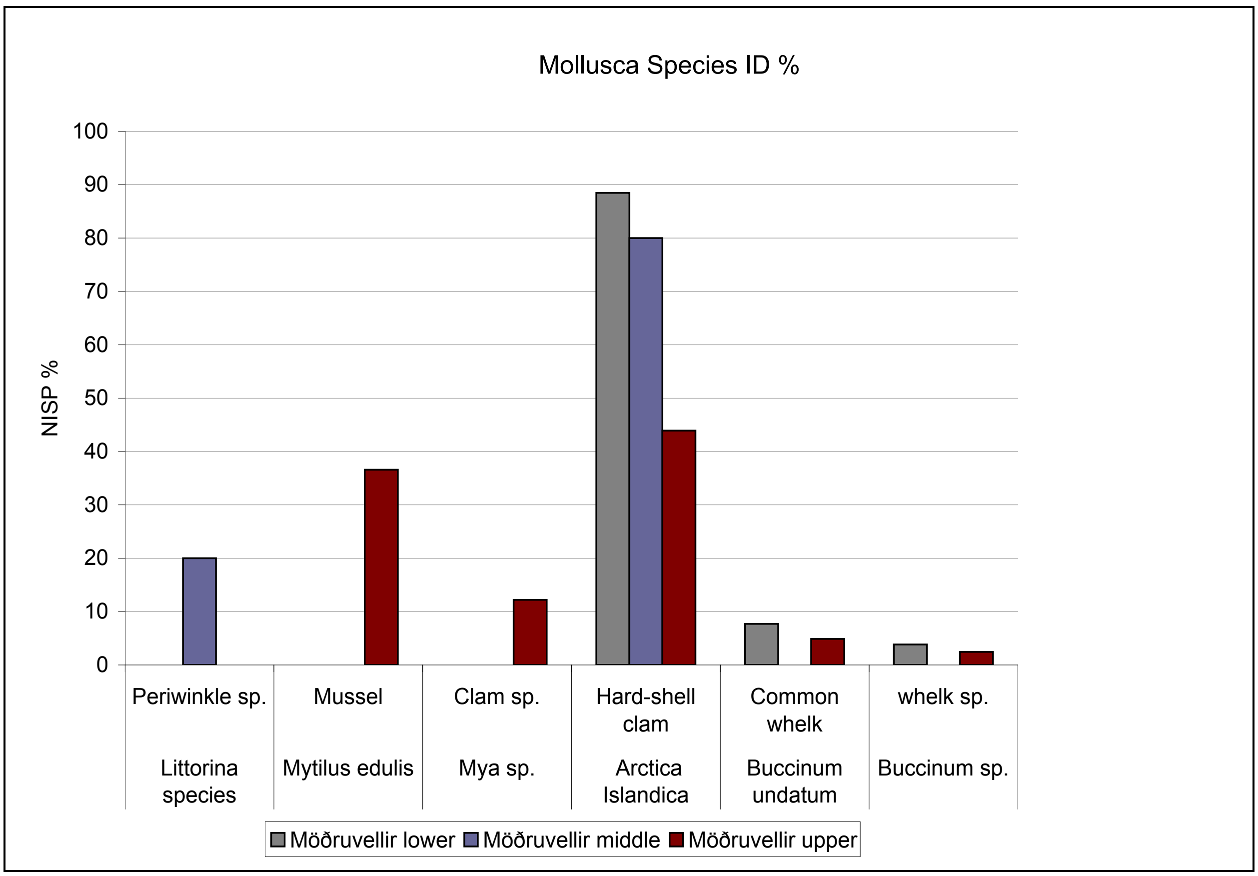


Figure 5.22. Möðruvellir Mollusks identified to species level from all phases.

The total mollusk numbers (and NISP %), including unidentified mollusk species per phase are as following:

Phase 1 & 2 – lower midden = 33 (2.67%); Phase 3– middle midden = 22 (7.28 %); Phase 4 – upper midden = 73 (1.13 %).

With the exception of faunal remains from the post-medieval/Early Modern phase, the mollusk proportions of the total NISPs are less than 5 %, and even that one is less than 8 %. Based on their size of up to 10 cm, it is possible that some of these mollusks were consumed by humans, as Möðruvellir is situated 4 kilometers from the nearest beach and therefore discarded fishing bait remains would likely be found closer to the sea.

All the mollusks retrieved from the various midden deposits are found in North Atlantic waters, and none of these species are thus out of the ordinary (In Kristjánsson 1989 I:147-149). Preservation of the Möðruvellir mollusks was relatively good, and therefore the clams could be put into soft-shell (Mya species, most likely *Mya truncata* (Kristjánsson 1989 I:143)) and hard-shell categories. Given the geographic location, it is reasonable to suggest these hard-shell clam remains to be *Arctica islandica*, an edible, long-living, intertidal clam fund that is still used commercially in Iceland and is caught also in Eyjafjörður (www.fisheries.is/ main-species/invertebrates/ocean-quahog/). Traditionally, *Arctica islandica* (Isl. *kúfskel/kúskel)* was one of the most prevalent shellfish species collected; others were Blue mussel (*Mytilus edulis*), and Horse mussel (*Modiolus modiolus*) (Kristjánsson 1989 I:144). *Arctica islandica* was also one of the shellfish species consumed by humans rather than primarily used for bait (Kristjánsson 1989 I: 151).

5.9. Taphonomy

Skeletal element distribution analyses for bovine and caprine elements above already point to a higher degree of bone degradation in the medieval and post-medieval/Early Modern faunal collections at Möðruvellir when compared to the 19th/20th c. archaeofauna. The following analyses will highlight the degrees of burning, fragmentation, and butchery per phase and provide thus another indicator for overall bone preservation from midden trenches TR1 and TR2/2b.

5.9.1. *Burning*

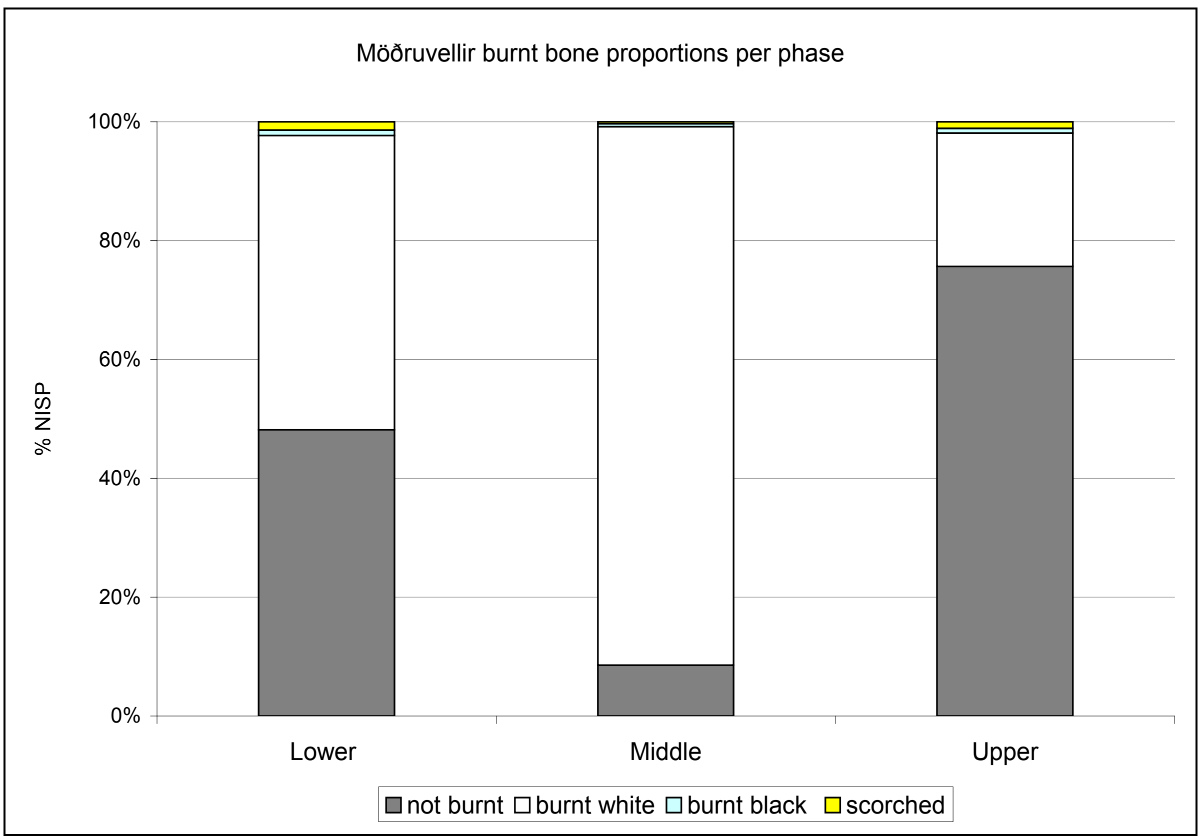


Figure 5.23. Möðruvellir burnt bone percentages per midden phase.

The percentage of white burnt bone presented in figure 5.23 partially explains the preservation conditions of the Möðruvellir archaeofauna. About half (52 %) of the bones from the medieval layers indicated exposure to fire/heat, almost all of these bones were burnt white, or calcined. When the bone is exposed to high heat for a prolonged period of time, all the organic materials break down and leave a calcined bone behind (Lyman 1994). These elements shatter very easily and may explain why the numbers of unidentified mammal bones were so high for the medieval phases, and especially for the post-medieval/Early Modern phases.

As much as 90.60 % of the faunal remains from the middle midden deposits are burnt white, with only 9 % not burnt. In contrast, almost 76 % of the $19^{th}/20^{th}$ c. faunal remains were not burnt, with 22.50 % burnt white. This change in burning proportions throughout time could potentially be connected to fuel utilization practices at Möðruvellir. Analysis of soil-micromorphological samples from the Midden deposits is ongoing. This analysis is carried out under supervision of Dr. Simpson from Stirling University.

5.9.2. *Fragmentation*

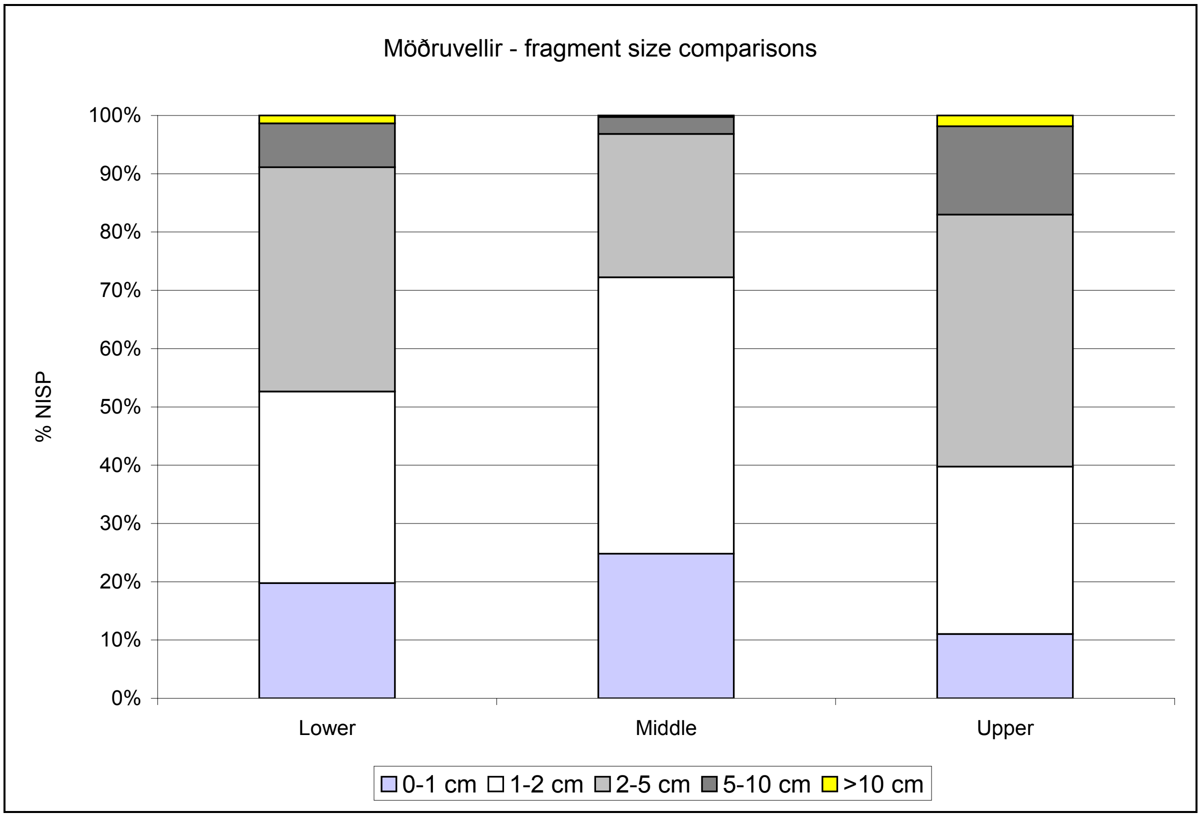


Figure 5.24. Möðruvellir fragment size comparisons.

Figure 5.24 presents the various fragment size proportions per phase; size categories 0-1 cm and 1-2 cm are indicators of heavily modified animal bones, either through butchery, burning, trampling, and other mechanical and chemical factors (Lyman 1994).

Although the medieval layers at Möðruvellir had the lowest ph level, their faunal remains do not seem to be the most damaged: 52.64 % of the lower phase bone fragments were smaller than 2 cm, with almost ¾ (72.23 %) of the middle phase falling into these size categories; 60 % of the bones from the upper phase were larger than 2 cm, and 17 % thereof larger than 5 cm.

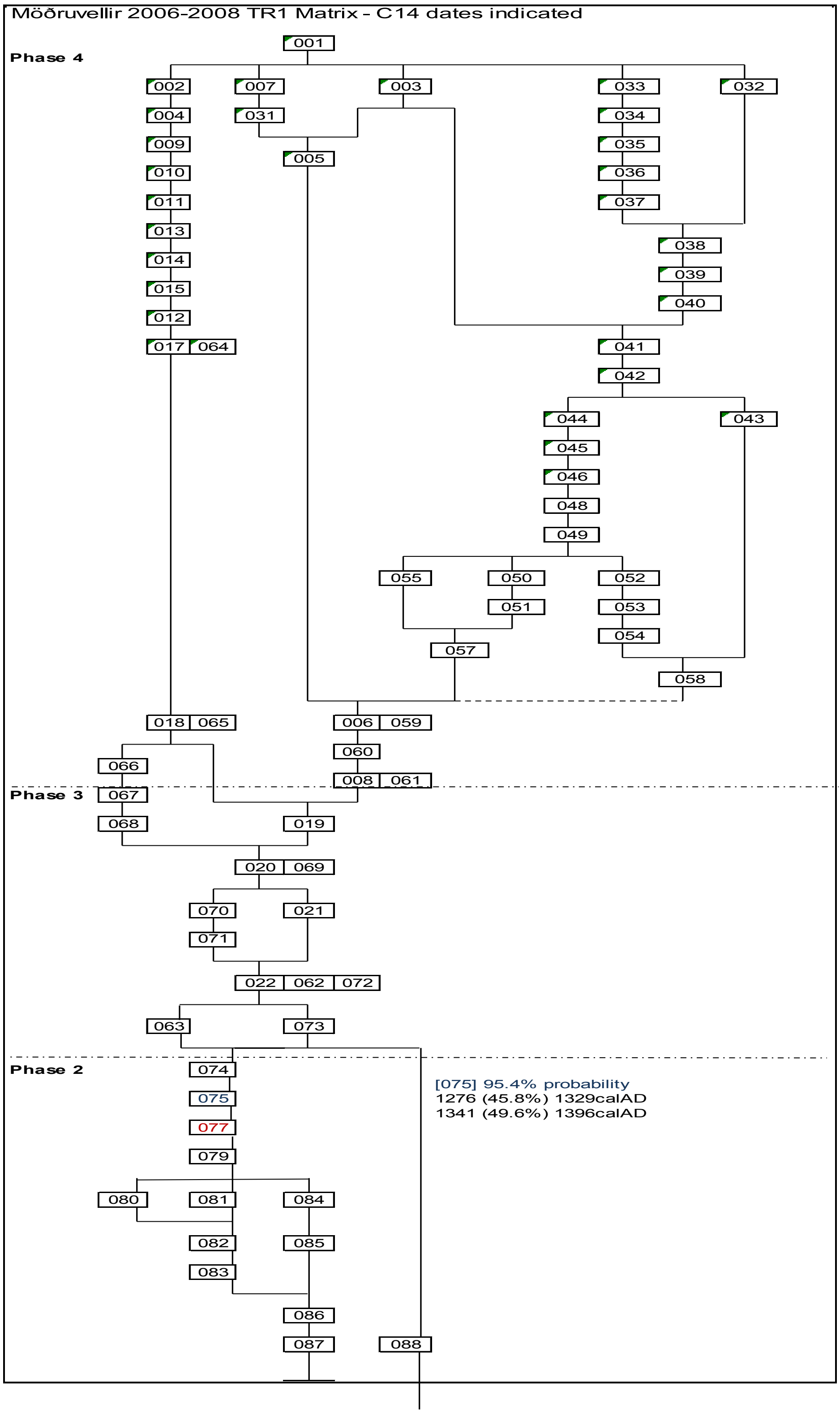
Few fish and bird, and no small terrestrial mammal remains were recovered from the lower and middle midden phases, the bone fragments less than 2 cm large were mostly fragments of larger mammal bones.

When summed up, the fragments sized 5 and below make up 91 % of the medieval butchered elements, vs. 33 % in the post-medieval/Early Modern ones, and 29 % of those from $19^{th}/20^{th}$ c. Potentially, the difference in burning degrees, butchery and fragmentation numbers, and general NISP vs. TNF ratios between the Phase 1&2 medieval archaeofauna and the Phase 3 post-medieval/Early Modern one can indicate slightly varied taphonomic factors in place:

As suggested by the cattle bone burning information (figure 5.11), the comparative burning (figure 5.23) and fragmentation graphs (figure 5.24), the Möðruvellir medieval faunal sample is less affected by taphonomic factors and to a higher degree by human decision making before deposition of meat-less bone remains as rubbish, whereas the faunal remains retrieved from the middle midden layers directly above were more heavily affected by post-depositional factors.

5.10. Möðruvellir Harris Matrices

TR1 Harris Matrix



TR1 Harris Matrix continued

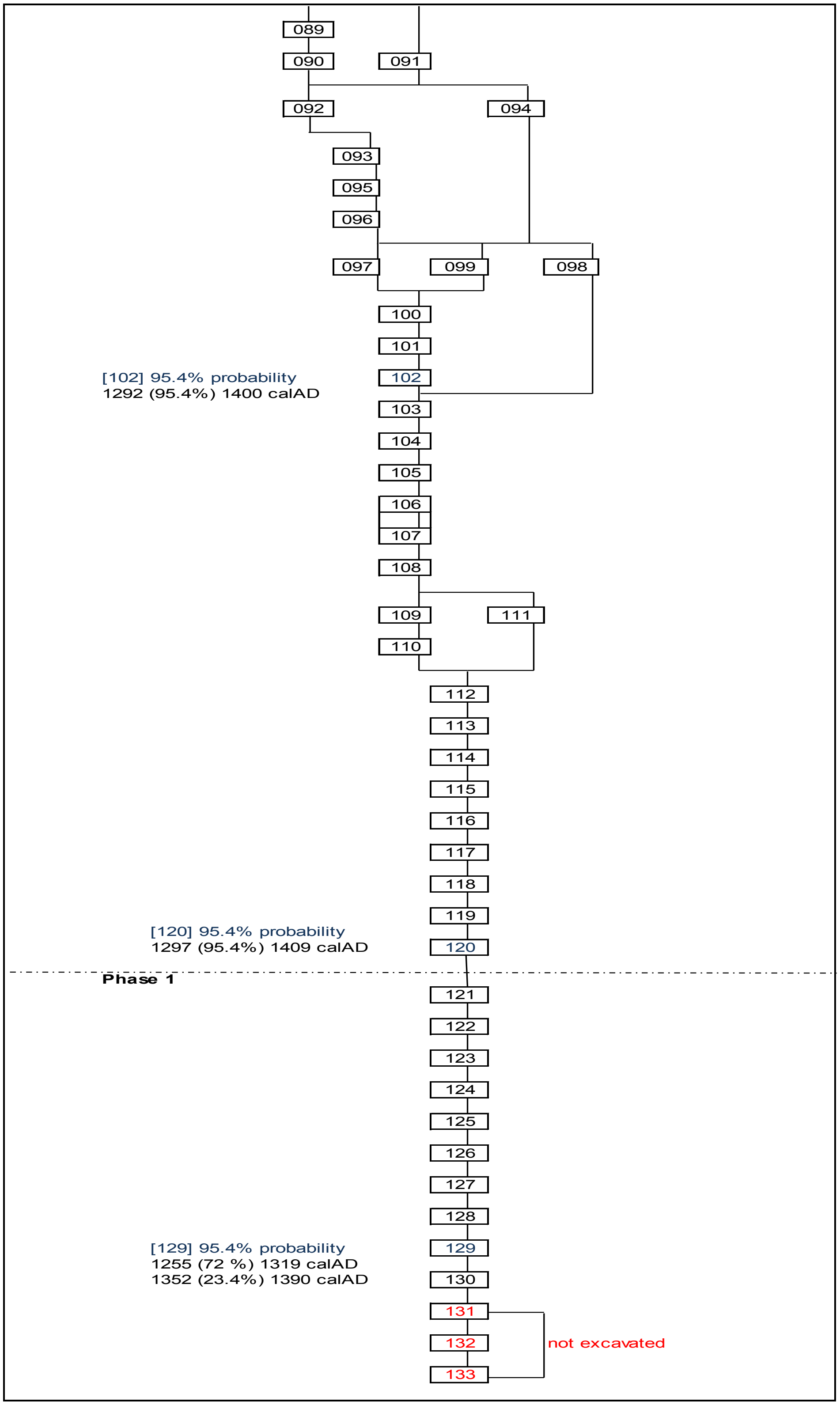


Figure 5.25. Möðruvellir, TR 1 - Harris Matrix.

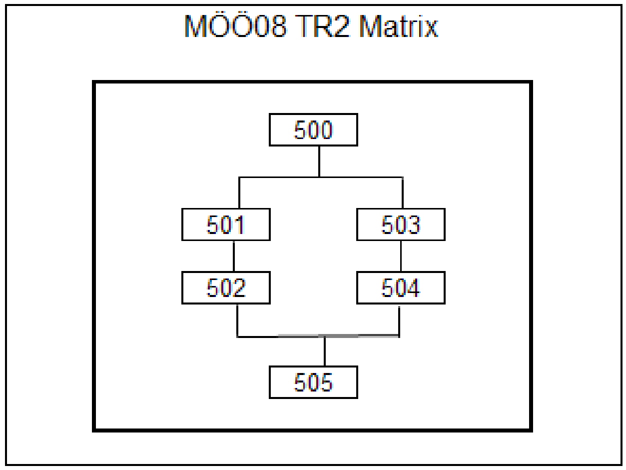


Figure 5.26. Möðruvellir TR2, Harris Matrix.

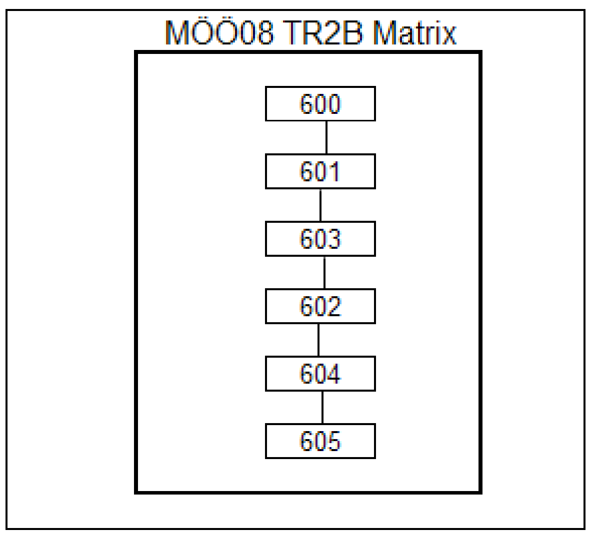


Figure 5.27. Möðruvellir TR2b, Harris Matrix.

Chapter 6. **The Skuggi Archaeofauna**

6.1. Midden Chronology

Radiocarbon analysis dates the Skuggi midden deposits to ca. AD **970 – 1208**; Tephrochronology further aids in dating this site: All midden deposits are sealed by H1300, and most of them by H1104. The turf structure under the midden contains tephra layers deposited during the volcanic landnám eruption (LNS) that coincided with Icelandic settlement in AD 871. Analysis of the Skuggi finds collection could not confirm dates beyond generally assigning the artifacts into Viking Age/Early Middle Ages. Two Viking Age style beads were found in the lowest midden phase and therefore agree with the radiocarbon dates for those midden layers (Hreiðarsdóttir 2010:44-47 , Gísladóttir et al 2010:50-57; both in Harrison et al 2010).

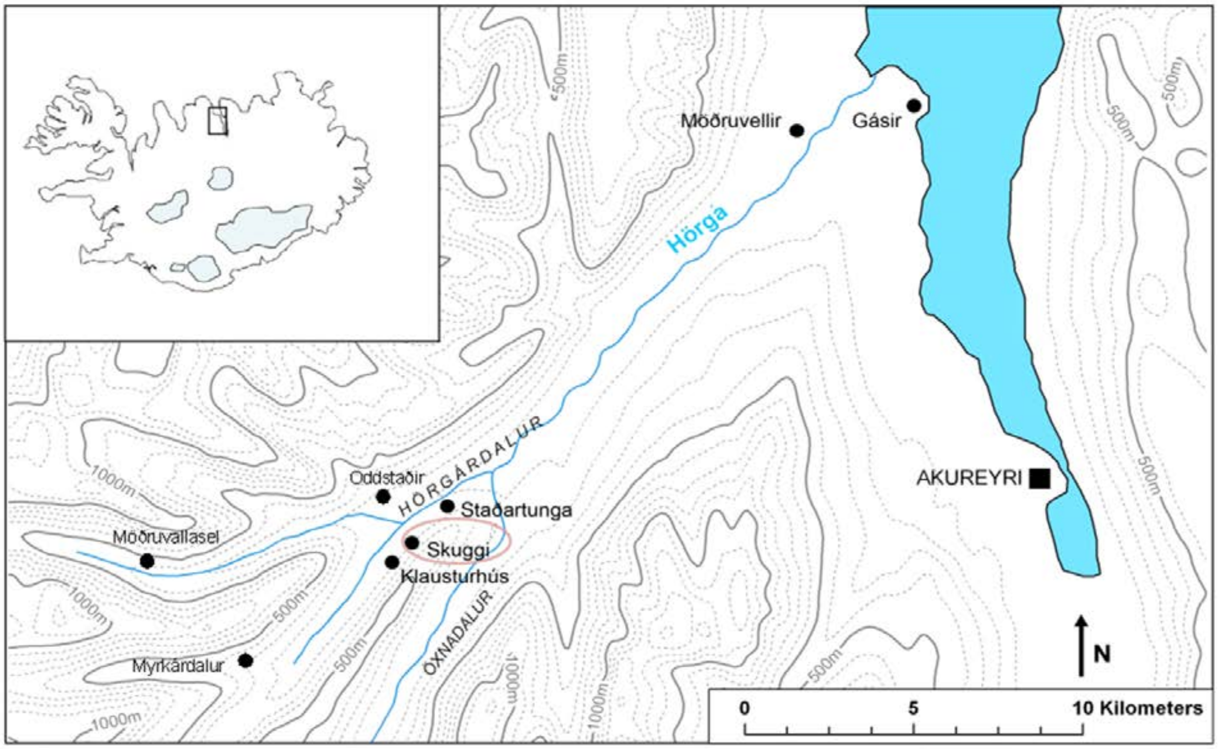


Figure 6.1 Map of Iceland, locating Skuggi and other sites investigated as part of the GHP, in Hörgárdalur, and Gásir, located at a coastal inlet in Eyjafjörður (Map after Streeter in Dugmore et al 2008; sites added by author).

6.1.1. *Radiocarbon Dates, Tephrochronology, and Phasing*

Radiocarbon and tephrochronological analysis of mammal bones from Skuggi have resulted in several main occupation/activity periods or phases that will be used for intra-site comparisons where applicable.

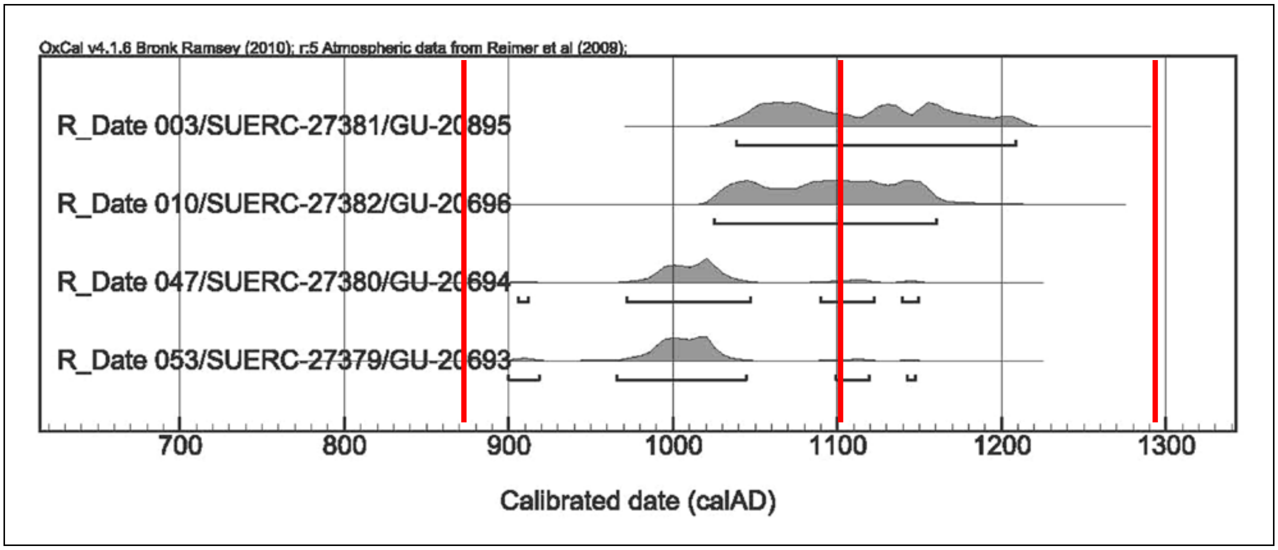


Figure 6.2. Skuggi Trench 1 Radiocarbon dates (https://c14.arch.ox.ac.uk/oxcal/OxCal.html, v. 1.6, Bronk Ramsey 2010, Atmospheric data from Reimer et al. 2009).

Figure 6.2 displays the calibrated **Radiocarbon** dates for the basal and upper layers of the midden from TR1. Context [053] is immediately overlaying structural collapse associated with the building's walls or roof and together with context [047] provides the midden basal layers. According to the calibrated C14 dates, these layers fall into the **later Viking Age period.**

Two deposits representing the upper midden layers are contexts [010], and [003], the latter one is the terminal midden layer encountered in TR1. As indicated by the calibrated C14 dates, these upper midden layers fall into the **early medieval period.**

Tephrochronology refines the dating process further, and the three different volcanic tephra layers observed at Skuggi are:

- H1300, seals all contexts in TR 1 midden.
- H1104, seals contexts below [003];
- LNS 871, in the structural remains under TR 1 midden.

The determination of the different occupational phases at Skuggi follows the various activity sequences encountered during the archaeological excavation. Absolute and relative means of dating include radiocarbon analysis, tephrochronology, and stratigraphy.

- Phase I refers to the initial site settlement after LNS 871. The structure discovered under the TR1 midden contains these landnám tephra layers (fig. 6.2) and can be dated to at least as early as the basal midden layers (Phase II), if not even earlier. Therefore this Phase is dated to the mit-10 – early 11th c. for now.
- Phase II refers to the basal midden layers from the Later Viking Age, with a calibrated one sigma range of AD966-1047. This phase can be dated to mid-10th - early 11th c.
- Phase III comprises the midden layers providing ca. mid-11th c. archaeological remains deposited during the transformation between the Later Viking Age and the Early Middle Ages.
- Phase IV refers to the upper midden deposits dated to the mid-11th – early 12th c.; it has a calibrated C14 date of AD1025-1160 (1 sigma range). These deposits are from prior to 1104.
- Phase V is the terminal occupation phase, with context [003] on above H1104 and below H1300 tephra layers. This layer has a calibrated C14 date of AD1038-1208 (1 sigma range) and provides the latest cultural deposits found at Skuggi. It is thus unlikely that the occupation at Skuggi extended into the period of the Gásir seasonal settlement.

Phase	Occupation Period	Dates	Dating evidence
I	Settlement Phase	late 9th and early 10th c	LNS 871 in structural turf
II	Later Viking Age	mid 10th - early 11th c.	cal. C14 AD966-1047 (2 sigma range)
III	Late Viking Age - Earlier medieval	mid 11th c	stratigraphy
IV	Earlier medieval	mid 11th - early12th c.	below H1104, cal. C14 AD1025-1160 (2 sigma range)
V	Terminal occupation	mid-late 12th c	below H1300 and above H1104, cal. C14 AD1038-1208 (2 sigma range)

Table 6.1. Break down of the different occupational phases at Skuggi.

Figure 6.3. Trench 1 (TR 1) at Skuggi. Left: crew members excavating (facing NNW); Right: Viking Age structural remains below midden (facing ENE).

6.2. Summary of the Skuggi Archaeofaunal Results

All faunal remains recovered from Skuggi in 2008 and 2009 were collected from Trench 1 (TR1), a 4 m (N - S) by 3 m (E - W) trench that contained midden deposits that were about 1 m to 1.30 m deep. While most of the eastern and northern extent of the midden has been determined, the midden possibly extends at least two more meters to the west, and further to the south. A future expansion of the midden trench is planned in 2013-14 through an NSF funded follow on project (Comparative Island Ecodynamics, NSF OPP ARC 1202692).

The archaeofauna excavated from Skuggi is substantial and the 2013-14 midden and structural excavations will greatly expand the sample size. All of the excavated archaeofauna pre-dates the cultural layers excavated from the Gásir trading post. A complete analysis of 100% of the excavated Skuggi collection was estimated by the CUNY Zooarchaeology staff to add at least an additional year to this thesis project, without directly addressing the key questions posed by the objectives of the Gásir Hinterlands Project that form the core of the doctoral project as funded by NSF. These factors combined suggested the need for a sampling strategy aimed at extracting a substantial sub-sample of the total collection that would reasonably characterize the overall Skuggi archaeofauna that was achievable within the time available for completion of this doctoral project. The sampling approach resulted in the complete analysis of approximately 40% of the total collection, with a sampled Number of Identified Specimens (NISP) count of 2,187 and a total fragment count (TNF) of 8189.

6.2.1. *General Patterning of the Archaeofauna*

Caprine bones were by far the most numerous domesticates in all phases. **Cattle** bone numbers made up a small percentage and their proportion of the site mammal assemblage rose slightly in Phase IV, but declined again in Phase V. There were no *horse* elements analyzed from the faunal assemblage. A total of 9 **pig** bones were found in contexts [003], [009/010], [011], [018], [021], [035], [037], and [U/S] which has not yet been excavated and is right under [053], (associated with structural remains), and contexts [003], [006], [009/010], [011], and [047] contained a total of 47 seal (Phocid sp.) bones that could not be assigned to species.

The presence of **raven** (*Corvus corax* (L.) in contexts [003], [009/010], and [011] is of interest as these birds are not regularly found in Icelandic midden deposits. Early on, the small amount of marine **fish** bone attests to the site's inland location, although it rises in the medieval deposits and together with the seal elements indicate an outside supply with marine species. As in the Mývatnssveit archaeofauna, there seems to be a clear indication of provisioning of even smaller inland farms with marine fish and sea mammals.

There were no **dog** elements in the archaeofauna, but gnawing marks left on many faunal elements are associated with presence of the species. One long bone element shows potential **rodent gnawing**, but no physical remains of rodent have been found.

The Skuggi farm depended on mostly sheep/goats during the Later Viking Age, with a change to a more diverse species utilization during the early medieval phases, including birds, marine species, and domesticates. This change in site economy profile may indicate that Skuggi was originally run as a dependent farm specializing in sheep/goat herding and possibly grew into a larger establishment with a need to supplement its own supply of domesticates with wild species to cover the needs of the inhabitants. A second explanation for the increase in marine species could be that Skuggi became more connected to the larger region and profited from an exchange network, i.e. supplying meat, dairy, or wool in return for fish and seal products, and possibly other goods being moved inland from the coast. While marine fish sample size remains limited, it may be worth noting that the focus on Atlantic Cod and (especially) Haddock is combined with a mix of other cod-family species and some Halibut. This broad species diversity again is similar to Viking Age-Early Medieval patterns in Mývatnssveit and fits the current model for the Viking-Early medieval artisanal fishery in Iceland. It differs from the strong focus on cod seen in the late medieval and early modern export-oriented archaeofauna (McGovern et al 2006). Further investigations at Skuggi and other Hörgárdalur sites are needed to better understand the dynamics of marine provisioning of these inland sites.

Table 6.2 presents the Skuggi archaeofauna as a Total Count.

Skuggi - TR 1 Element Count	Phase			
Taxon	II, mid-10th - early 11th c	IV, Mid-11th - early 12th c	V, mid-late 12th c	Total NISP
Domestic mammals				
Cow (*Bos taurus* (L.))	84	42	11	137
Pig (*Sus scrofa* (L.))	1	2	1	4
Dog (*Canis lupus familiaris* (L.))	present	present	present	present
Goat (*Capra hircus* (L.))	17	3		20
Sheep (*Ovis aries* (L.))	62	10	7	79
Unidentified caprine	725	234	132	1091
Total caprine	804	247	139	1190
Total domestic	889	291	151	1331
Wild Mammals				

Skuggi TR 1 Species Count Table continued

Small seal		2		2
Large seal		4		3
Unidentified seal species	1	32	8	42
Total seal	1	38	8	47
Unidentified whale species	1			1
Total whale	1			1
Total wild mammal	2	38	8	48
Birds				
Common Raven (*Corvus corax* (L.))		41	3	44
Small Passerines		2		2
Unidentified bird species	2	340	23	365
Total bird	2	383	26	411
Fish				
Cod (*Gadus morhua* (L.))		9	1	10
Haddock (*Melanogrammus aeglefinus* (L.))	3	14	1	18
Saithe (*Pollachius virens* (L.))		5	5	10
Cusk (*Brosme brosme* (L.))			1	1
Atlantic Halibut (*Hippoglossus hippoglossus* (L.))		2	2	4
Gadid species	5	68	3	76
Marine fish non-speciated	13	192	57	262
Total fish	21	290	70	381
Mollusca				
Clam (Mya sp.)	2	4		6

Skuggi TR 1 Species Count Table continued

Mussel (*Mytilus edulis* (L.))	8	1		9
Unidentified mollusc species	3			3
Total mollusca	13	5		18
Total Number of Identified Species	**927**	**1007**	**255**	**2189**
Large terrestrial mammal	67	35	13	115
Medium terrestrial mammal	504	564	196	1264
Small terrestrial mammal			1	1
Uni. terrestrial mammal fragments	1451	2231	877	4559
Unidentified marine mammal fragments		14		14
Unidentified fragment	1	48		49
Total number of fragments	**2950**	**3899**	**1342**	**8191**

Table 6.2. Skuggi, Total TR 1 element count, with a NISP breakdown and TNF for Phases II, IV, and V.

6.3. Major Taxa

Figure 6.4 presents the major taxa utilized at Skuggi per occupation phase. The Phase II faunal remains suggest that the people at Skuggi were consuming almost entirely domesticates, and predominantly caprines (88%). There are a few marine fish remains (2.30 % or 21 elements), and one whale and one seal element.

During Phase IV, 38 % of the total NISP were birds, followed by fish (29 %), and caprines (25 %). The faunal assemblage from this phase suggests a consumption pattern that relied almost equally on domesticates, marine species, and birds, though it is questionable that the puzzling raven remains were really used for consumption as the long bone fragmentation/butchery pattern might indicate (see birds section for further discussion).

During Phase V, the terminal occupation phase dated to the mid-late 12th c, humans were relying more on domesticated resources than in the previous phase, but were still supplementing their diet with fish, birds, and marine mammals. Caprines comprise 55 % of the total taxa assemblage from this phase, with fish at 28 %, and birds 10 %.

No horse remains were recovered from these phases.

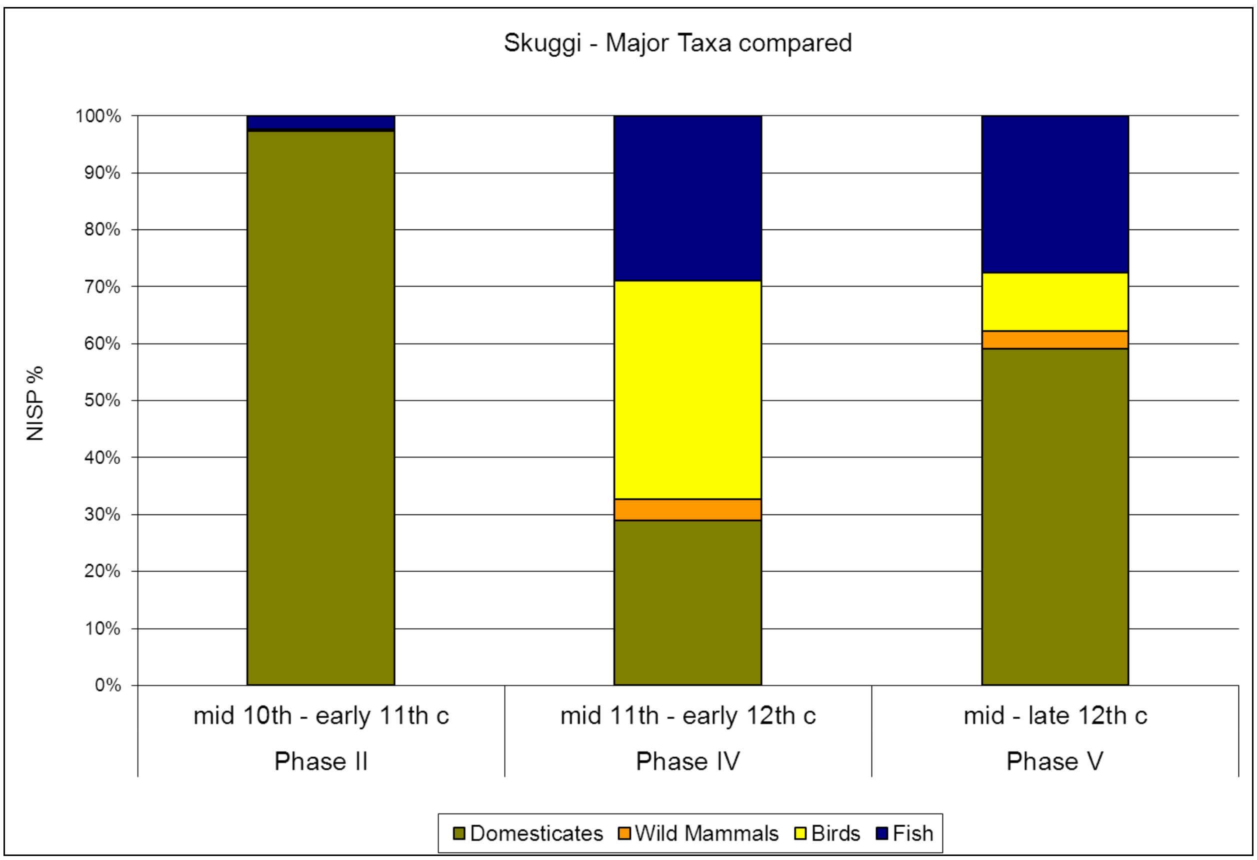


Figure 6.4. Skuggi – major taxa presented as NISP percentages per phase.

6.4. Mammals

Figure 6.5 displays the domestic and wild mammal species proportion divided into phases. Except for a very small fraction of seal and whale (0.11 % each), the Later Viking Age (Phase II) mammal assemblage consists of domestic mammals. The caprine category makes up 81 % of the total assemblage, speciated sheep (*Ovis aries*) comprise 7 %, and goats (*Capra hircus*) 2 %. The cattle proportion amounts to 9 %, the Later Viking Age cattle vs. caprine ratio is 1:10.

Medieval distributions differ from the ones from the Later Viking Age: the Phase IV mammal distribution pattern indicates the typical heavy reliance on caprines at 71 %, but sheep only account to 3 %, and goats to 1 %. At 13 %, the proportion of cattle bone is higher in this phase and the cattle vs. caprine ratio is 1:6. Seal species represent 12 % of the mammalian category and again suggest a reliance on marine species.

The terminal occupation layer (Phase V) contained a very high proportion of caprine remains. Caprines comprised 83 % of the total mammalian category, and another 4 % could be analyzed to sheep species. The cattle proportion at 7 % was lower than in the previous phases, representing a cattle vs. caprine ratio of 1:13. Although the seal percentage at 5 % is lower than in Phase VI, it still makes up a significant proportion of the total mammal category.

Pig elements were still present in this phase, as in the previous ones.

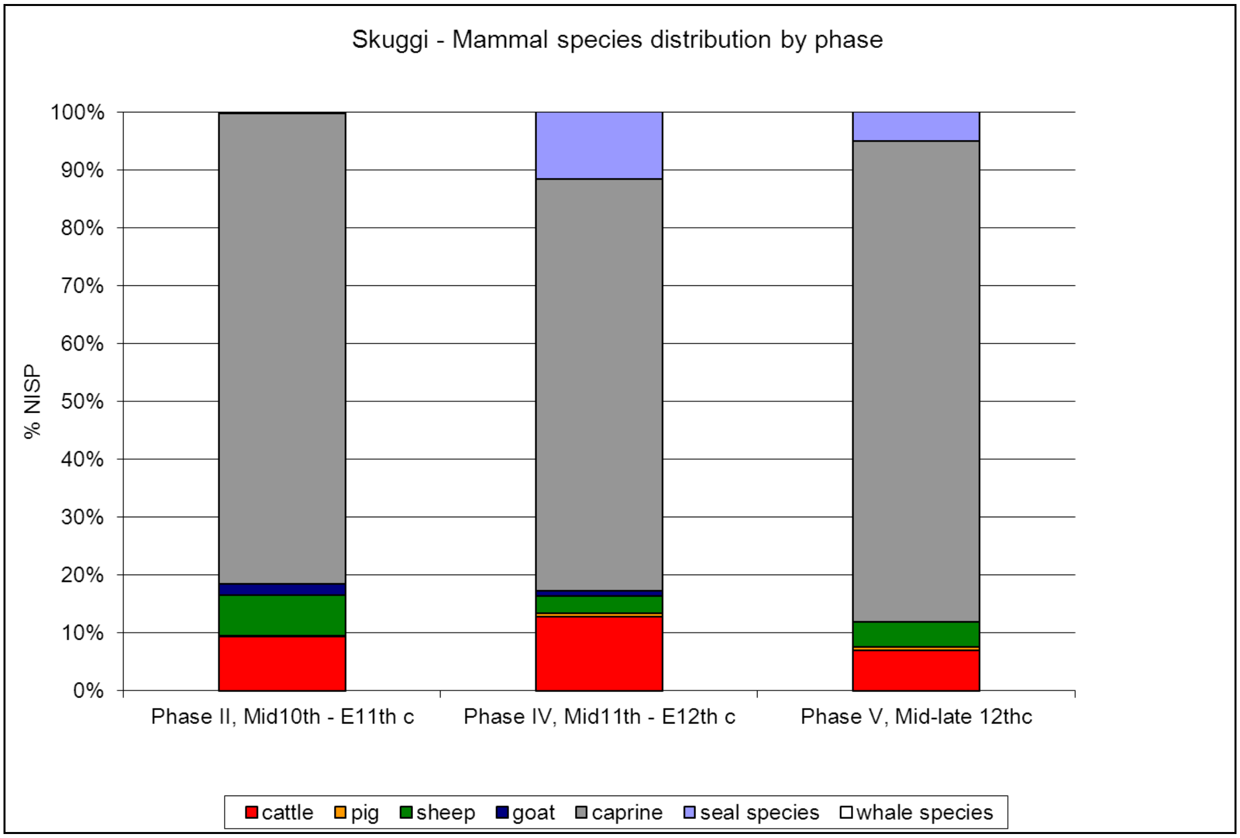


Figure 6.5. Skuggi – mammal species distribution by phase.

While there is some fluctuation in the proportions of cattle and caprines through time at Skuggi, the overall pattern makes clear that keeping caprine herds remained a key strategy for the site during the occupation. Figure 6.6 presents a broad comparison of Viking Age to Early Medieval caprine/ cattle bone ratios from available Icelandic archaeofauna. This indicator is based upon a taxonomic division that is possible on most bones of the skeleton and thus upon a majority of the bones of the domestic part of the archaeofauna, and is thus one of the more robust comparative herding indicators. Generally in Iceland farms in the south tend to have more cattle relative to caprines than in the north, and in all areas larger farms tend to have more cattle per caprine. Post AD1200, many sites in all parts of Iceland tend to show a more dramatic shift, with caprine ratios reaching the 20:1 levels recorded for much of N Iceland by the 18th c. Jarðabók records. Current data indicates that this shift is associated with the near-elimination of goats from the flocks, leaving the "caprine" category nearly all sheep (McGovern et al 2007).

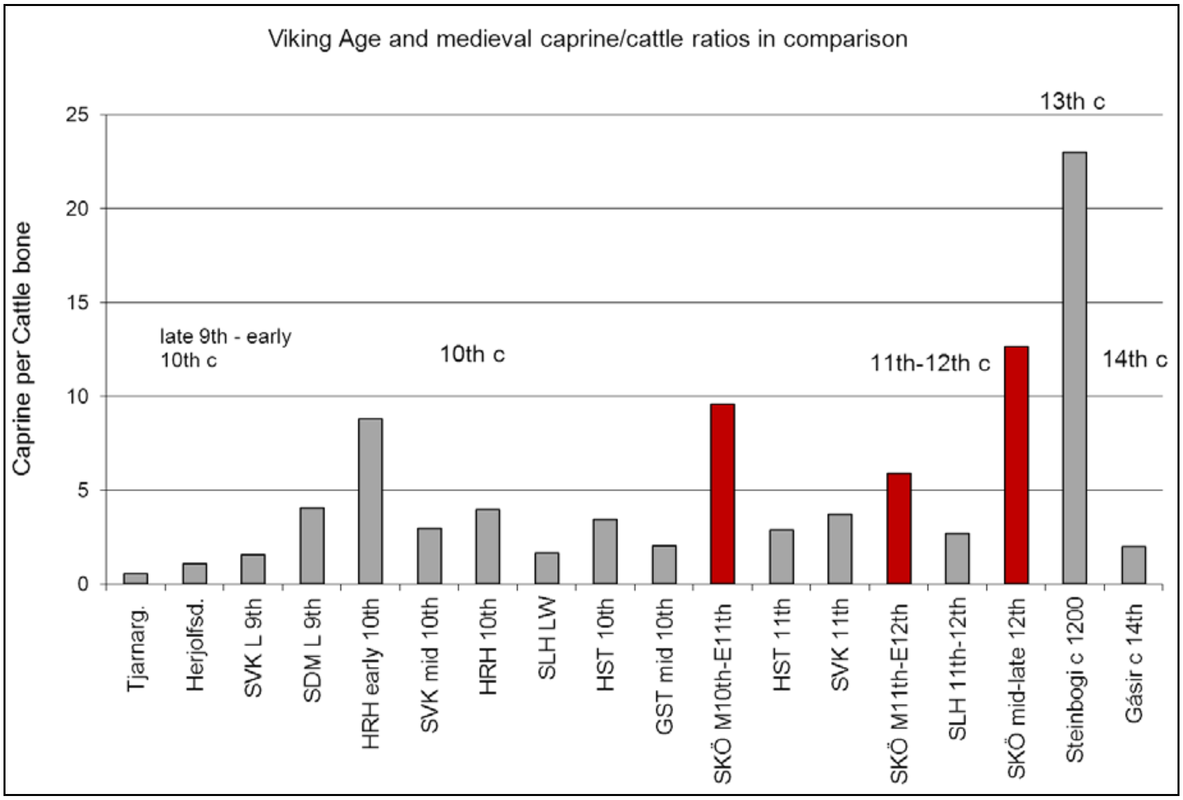


Figure 6.6. Comparison of caprine/cattle ratios from various Viking Age and medieval Icelandic sites. Sveigakot (McGovern et al 2004), Hrísheimar (McGovern & Perdikaris 2002), Selhagi (McGovern & Perdikaris 2003, Draft) and Steinbogi (Brewington et al 2004), Sandmúli (McGovern et al 2006) in Mývatnssveit; Tjarnargata (Tinsley &McGovern 2001), Hérjolfsdalur (McGovern, NABONE database), Skuggi (SKÖ), Gásir in Eyjafjörður (author).

While the Skuggi cattle vs. caprine ratios (1:6 - 1:13) throughout the three phases remained well below the 1:20 known from Icelandic small scale farms in Mývatnssveit and the far NE after AD1200 (McGovern et al 2007:41) they are notably higher in caprines than similar ratios from other small Viking Age farm archaeofauna. The site of Sveigakot near Mývatn in its phase/AU 2 (mid 10th c.) and phase/AU3 (11th c.) is directly contemporary with Skuggi in its

Phase II and IV (its basal layers AU 1 are between LNS 871 and V940 thus pre-dating the current Skuggi archaeofauna). The Sveigakot midden archaeofauna ranges in caprine/cattle ratios between 1.3:1 and 3.5:1, suggesting a significantly lower commitment to caprine raising despite the rather marginal location of this small Mývatnssveit farm (Vésteinsson 2006). The mix of sheep and goats in the flocks of these two Viking Age to early medieval small farms appear broadly similar (figure 6.7) with goats forming about 15-25% of the caprine bones that could be identified to species level in the Viking Age phases. They appear to show a similar trend in the reduction or elimination of goats from the flock in the early medieval phases.

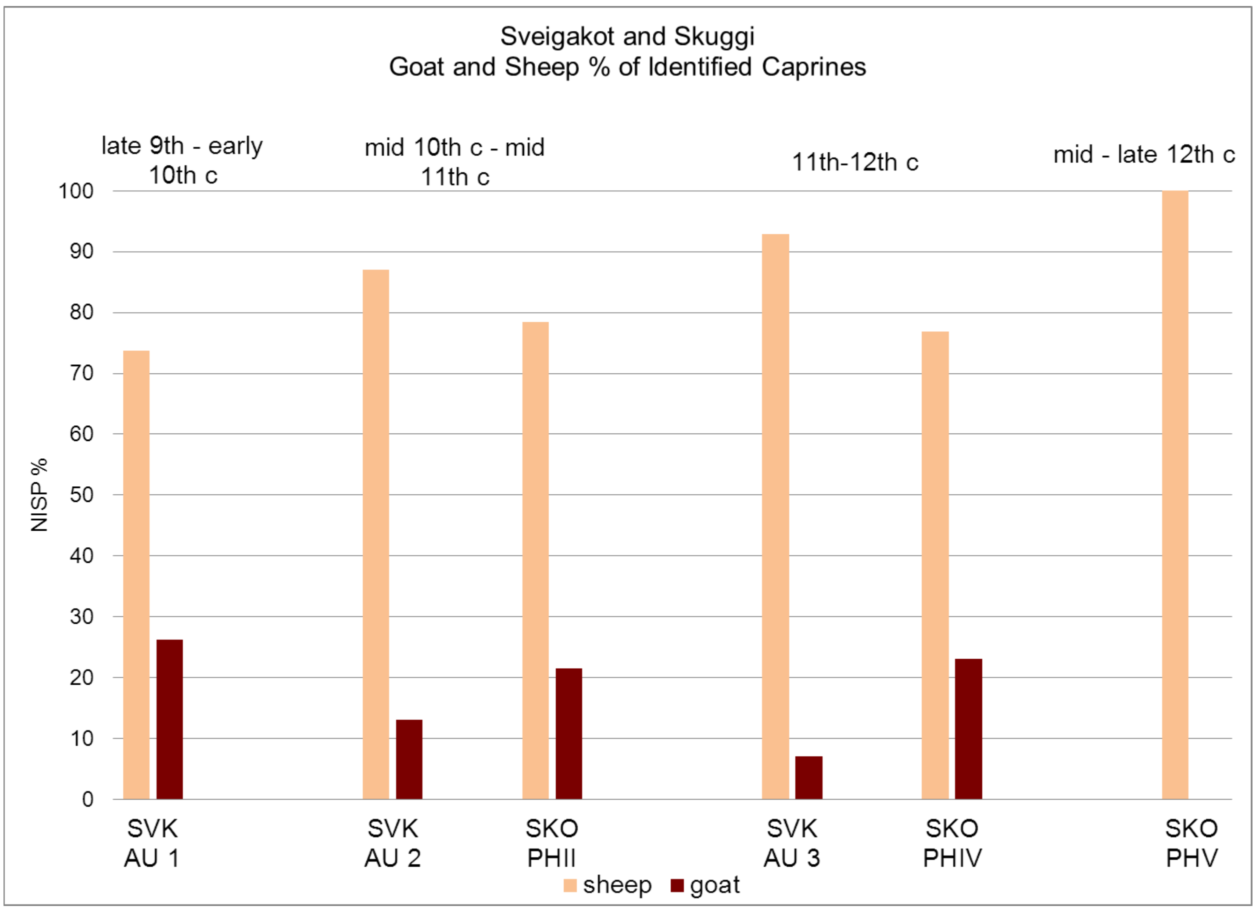


Figure 6.7. Sveigakot (SVK) and Skuggi (SKO) phased sheep vs. goat ratio comparisons.

6.4.1. *Reconstructing Domesticate Mortality Patterns*

6.4.1.1. Cattle Mortality Patterns

Zooarchaeological reconstruction of age at death consists of a combination of estimates based upon overall neonatal vs. older juvenile and adult bones, the fusion state of long bones, and tooth eruption and wear patterns.

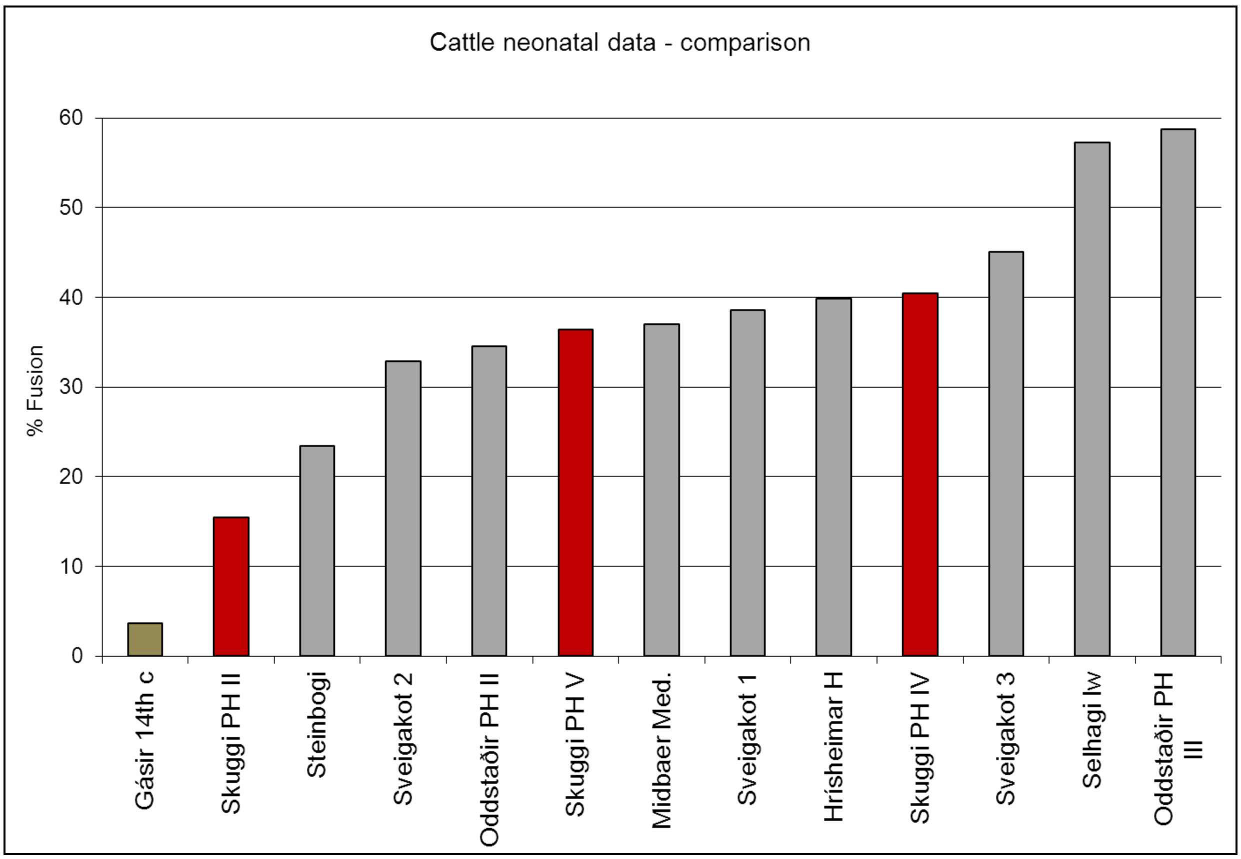


Figure 6.8. Skuggi cattle neonatal data compared to other Viking Age – Medieval sites from N Iceland (data courtesy of McGovern, NABONE database, Skuggi and Oddstaðir data are the author's).

Figure 6.8 shows a relative percentage of neonatal (newborn) calf bones in a range of Viking-Medieval sites from N Iceland (data courtesy of McGovern, NABONE database). A range of ca. 15-50 % neonates among the total cattle bone count is generally interpreted as evidence of dairy herd management, with most milk being reserved for humans (Halstead 1998). Unlike the very low percentage at Gásir attesting to the special cattle profile on that site, the Skuggi neonatal percentage resembles the one of a more typical farmstead and may indicate that at least a portion of the Skuggi cattle were used for dairying purposes. Analysis of more cattle elements is necessary to provide a better idea on cattle use at Skuggi, especially because the lack of long bone fusion data may bias the age at death data towards a younger age. In Phase II, the Skuggi cattle neonatal percentage is quite low, while in Phases IV and V, during the Early Middle Ages, the percentages increase to about 35-40 % of neonatal cows culled at Skuggi. The cattle neonatal data for Phase II at Oddstaðir which is contemporaneous with Skuggi Phase II, the neonatal cattle proportion is ca. 35 %. The Oddstaðir Viking Age assemblage shows thus a much higher relative presence of neonatal elements than its neighbor to the SW and up on the slope of Staðartunguháls. Oddstaðir Phase III, contemporaneous with Skuggi Phase IV, shows the highest neonatal cattle proportions of any of the sites´ assemblages.

The Skuggi cattle bone assemblage is too limited to allow for a long bone fusion analysis: There are a total of 7 elements available of the ends of distal long bones used in the long bone fusion and thus no coherent percentage of fused vs. non-fused long bones can be established.

There are 15 cattle mandibles from the total Skuggi archaeofauna that can be used as preliminary indicators of age at death in cows. While sample size clearly constrains interpretation in this case, the pattern does support the overall impression of cattle being culled either very early in life (newborn or less than one summer old) or later in life (mainly as adults). Both the neonatal percentage data and the available tooth eruption data from Skuggi suggest that the farm practiced the widespread dairy production strategy in cattle management.

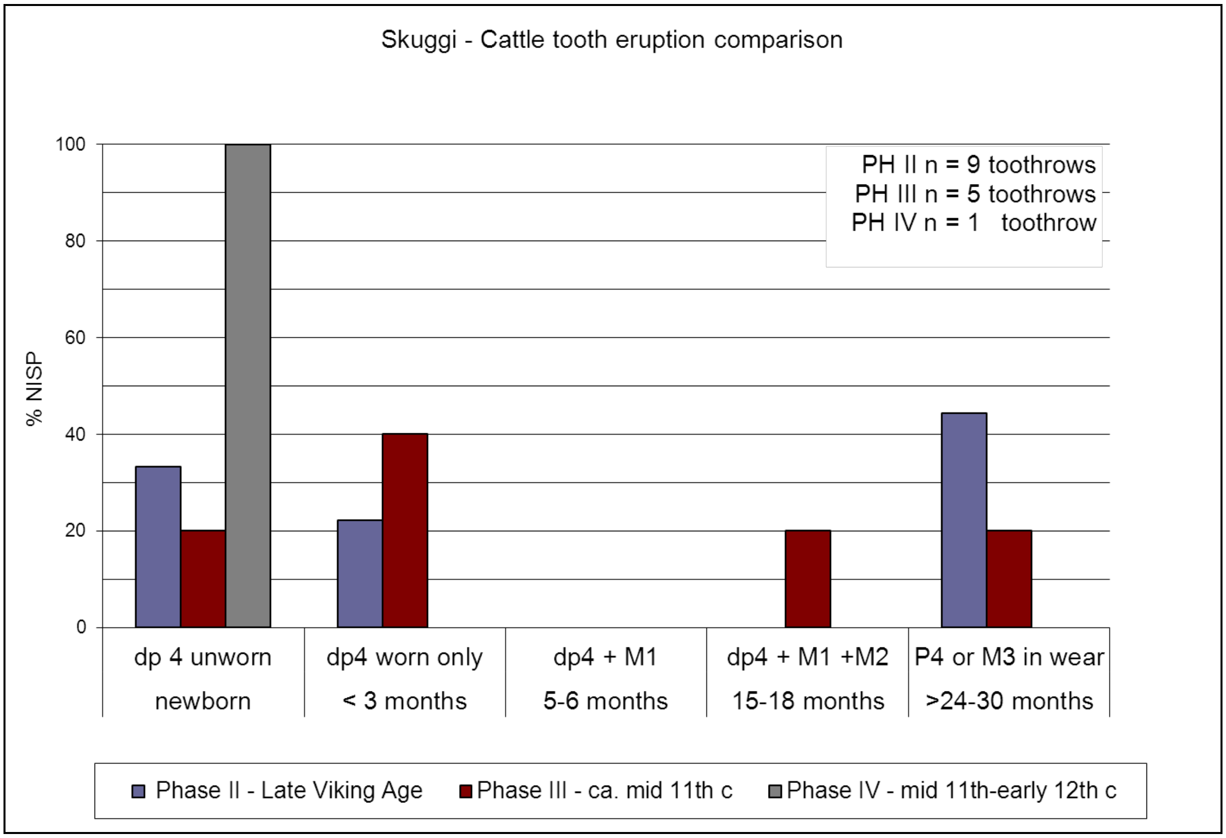


Figure 6.9. Skuggi cattle tooth eruption.

The Skuggi cattle tooth eruption analysis presents data from phases II, III, and IV. The latter phase comprise only one cattle tooth row.

6.4.1.2. Caprine Mortality Patterns

The larger Skuggi caprine collection is better suited for a phased age at death profile than the cattle collection. Although the assemblage would also profit from more elements, an initial caprine long bone fusion analysis in figure 11 suggests a difference in the caprine culling strategy from the Later Viking Age to the Early Middle Ages. As fusion studies can be strongly affected by taphonomy (differential destruction of less dense bone ends), this figure (like all those in this study) uses only element ends that are comparably robust.

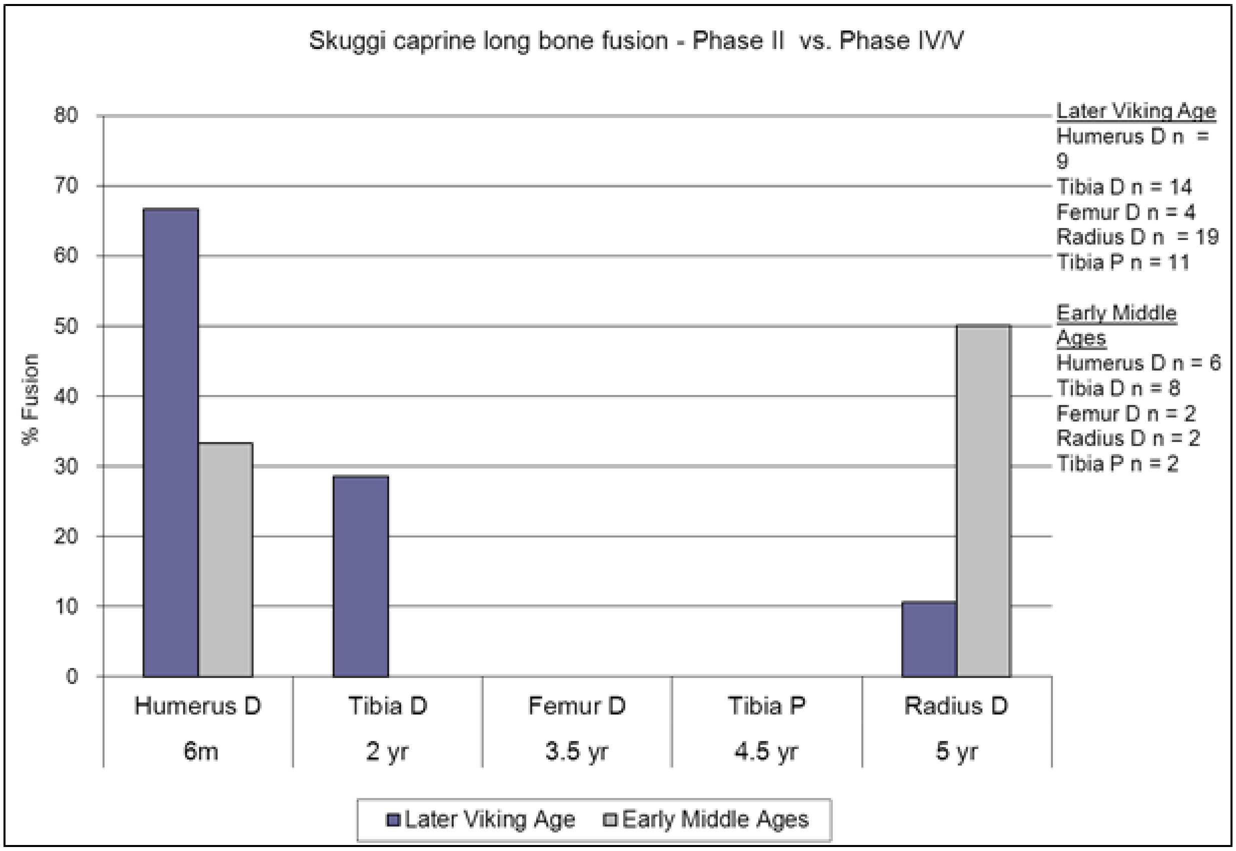


Figure 6.10. Caprine Long Bone Fusion Comparison

The Later Viking Age (Phase II) caprine long bone fusion data indicates heavy mortality in the first two years of life and limited survival to five years and above. While sample size issues constrain the conclusions we can draw, the Phase IV/V collection shows a notably higher survival of animals into their 5th year.

The intra-site caprine tooth eruption analysis illustrated in figure 6.11 makes use of mandibular and maxillary tooth rows of sheep/goats from all contexts and allows for a thorough comparison of caprine age at death during Later Viking Age (Phase II), mid 10th c (Phase III), and Early Middle Ages (Phases IV and V) at Skuggi.

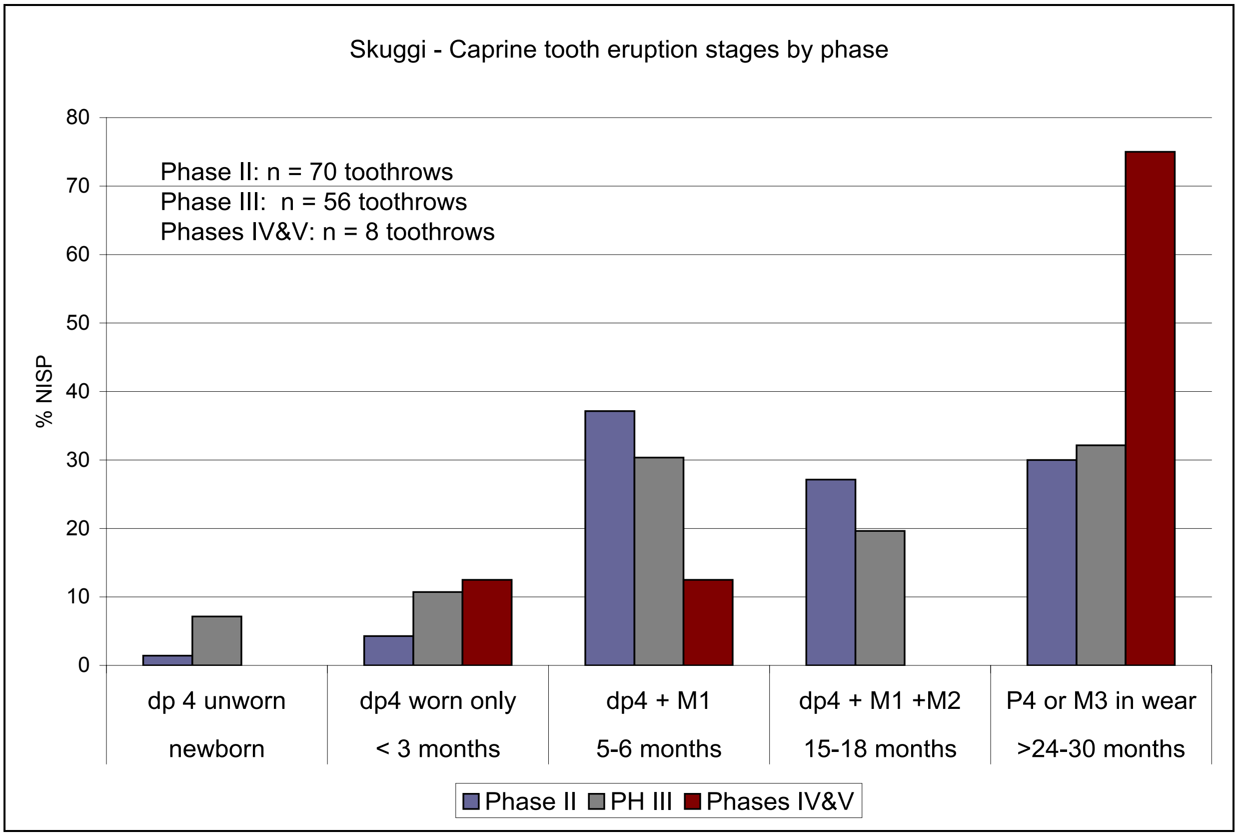


Figure 6.11. Skuggi Caprine tooth eruption comparison.

The Viking Age (Phase II) caprine age at death profile somewhat agrees with the long bone fusion study: The data suggests a culling of about 35 % of sheep/goats after their first summer, but only about 5 % being butchered at neonatal stage, with close to 60 % of the sheep/goats from phase II surviving their first winter; about 30 % lived to be older than 2 - 2 1/2 years. At around AD 1050 (Phase III), about 15 % of the newborn caprines were culled and about 30 % after their first summer. The caprine tooth eruption analysis indicates a circa 50 % first winter survival rate, and just above 30 % of the sheep/goats living beyond 2 years of age.

The data for the early medieval phases (Phases IV and V) is far less abundant, but provides a somewhat different culling pattern. About 13 % of the caprines from the upper midden layers were slaughtered before their first summer, and another 13 % after their first summer. More than 70 % survived to full adulthood vs. about 30% of the caprines in the earlier phases.

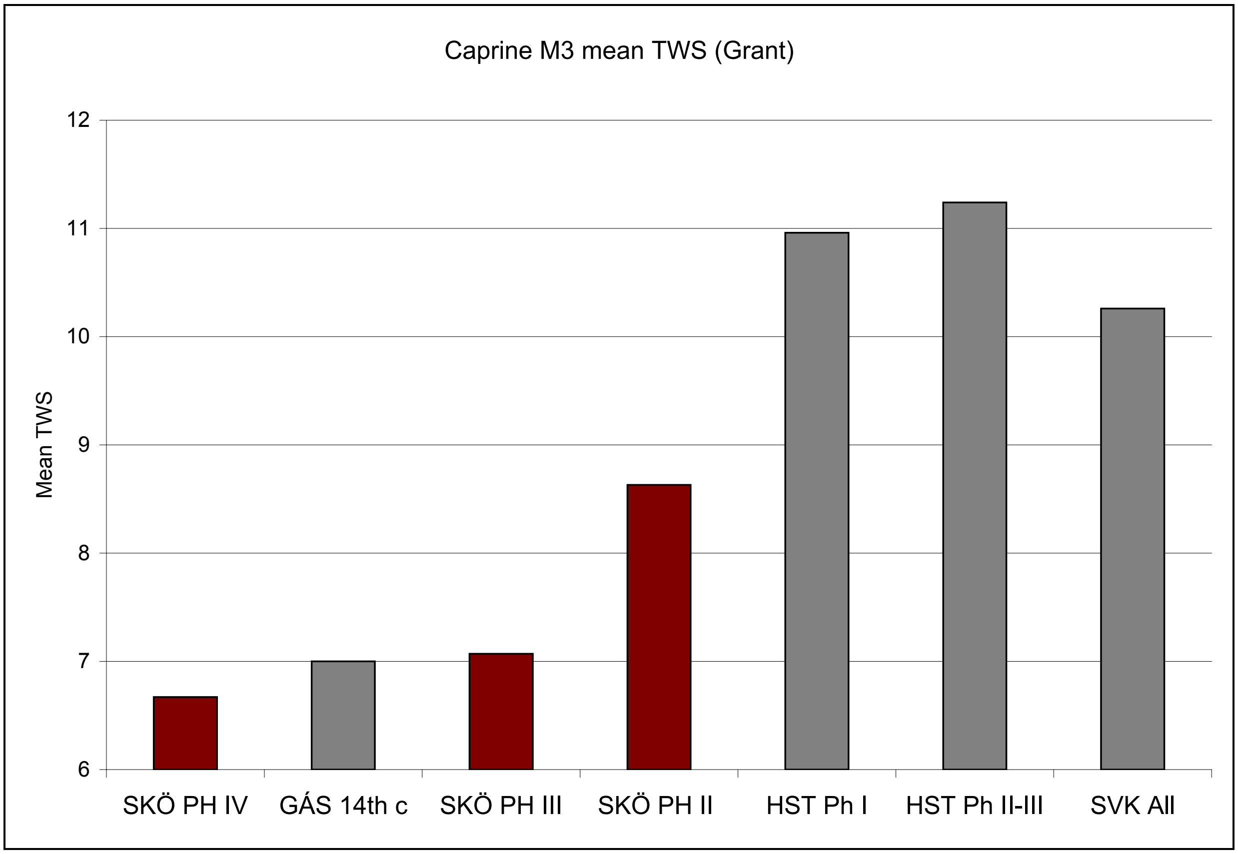


Figure 6.12. Caprine M3 mean TWS (after Grant 1982).

Figure 6.12 presents the caprine tooth wear data in a different way, with only a mean of worn mandibular M3 teeth used, an approach that ensures that only fully mature animals are included in the comparison, as the permanent M3 is the last tooth to erupt in sheep (and most other mammals). All teeth used from Skuggi show a M3 TWS mean of 7 – 9, indicating presence of mature animals, whose M3s are in wear, but not heavily worn, indicating young adults, comparable to the Gásir caprine M3 TWS (Harrison 2009). The Skuggi tooth wear data either indicate a presence of substantial numbers of young to middle aged adults in the Skuggi and Gásir archaeofauna, or a higher rate of soil grit ingestion and thus accelerated tooth wear in the

Mývatnssveit archaeofauna (McGovern et al 2009, McGovern et al 2007). The higher proportion of highly worn teeth seen in the Mývatnssveit collections at Hofstaðir and Sveigakot is associated with intake of grit (i.e. McGovern et al. 2004, McGovern and Perdikaris 2002). A fuller microwear study may be done by Mainland (personal communication January 2013) in the future. This might allow for a comparison between the Eyjafjörður and Mývatnssveit caprine and cattle adult teeth and thus might better explain this pattern.

As zooarcheologists have repeatedly noted (e.g. Mulville et al 2005, McGovern et al 2007, 2009, Mainland & Halstead 2005) sheep tend to be managed as multi-purpose animals in all periods in Iceland, generating milk, meat, wool, and tallow. As a result, culling age profiles tend to reflect multiple uses of the flock, with animals managed for meat culled in their first or second year, milk ewes culled at 3-5 years, and older ewes and castrate wethers maintained past five years. Thus harvest profiles with many animals 5 years and older are often discussed as evidence for wool production strategies. The age at death of most caprines (and their identification as sheep rather than goats) is a key element in attempting to assess the degree of investment in wool production at a given site and phase (Mainland & Halstead 2005).

In all of the midden phases, Skuggi has a higher ratio of caprines to cattle than most contemporary known Icelandic archaeofauna. The caprine age at death evidence for the Viking Age and early medieval phases and the ca. 20% proportion of goat bones within the identified caprine category however is more consistent with a multi-use strategy than a dedicated wool production strategy.

While larger sample sizes are again desirable, there does seem to be some evidence of a shift towards older flocks more entirely dominated by sheep in the post-1104 phases that is consistent with some shift towards a wool production strategy.

6.4.2. *Caprine Element Distribution*

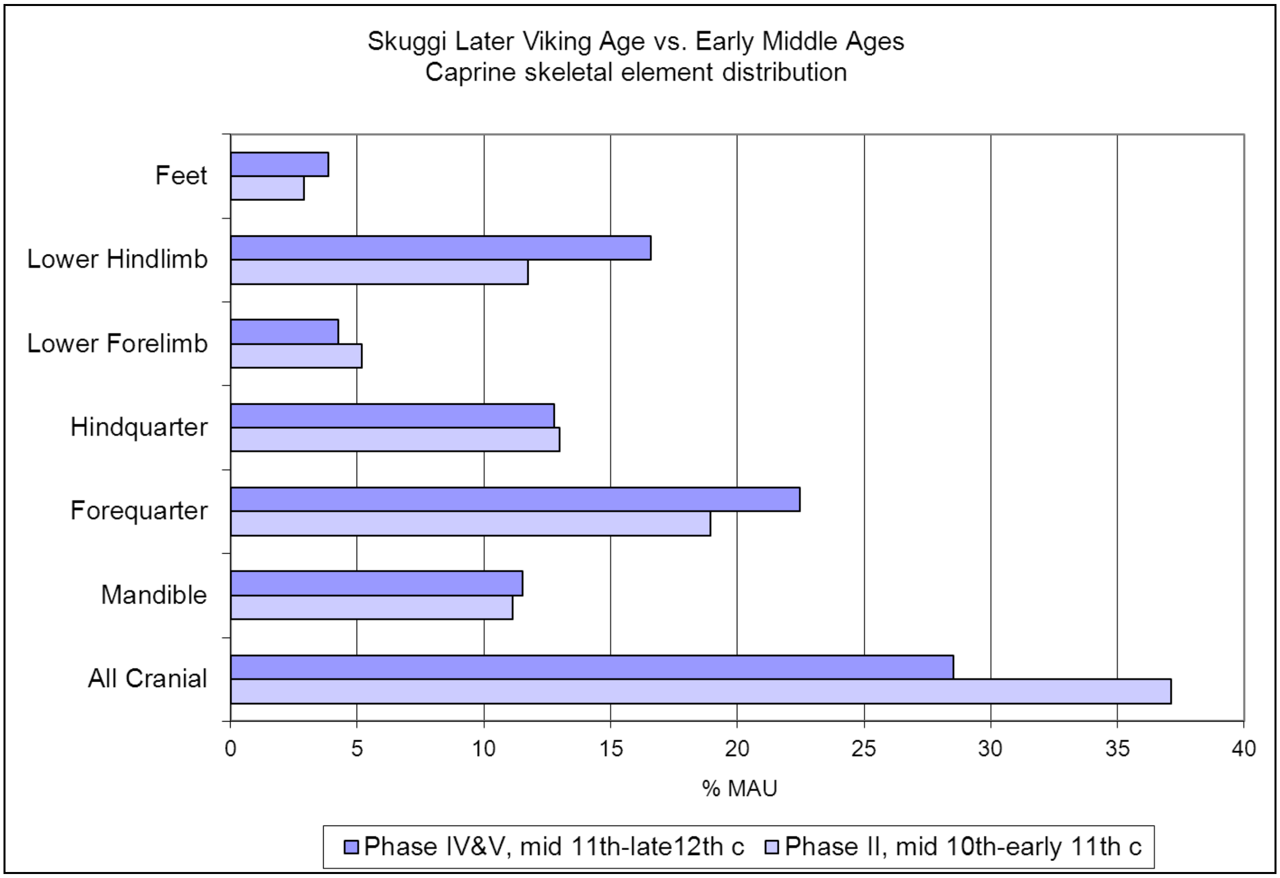


Figure 6.13. Skuggi Caprine skeletal element distribution per phase. MAU normalizes differences in number of bones in the skeleton, so in a complete and un-fragmented cattle skeleton these bars would be equal length.

Figure 6.13 illustrates the proportions of meat bearing elements present at Skuggi by phases. There is a similar caprine skeletal distribution in both time periods, although there were many more cranial elements in the Viking Age deposits than in the medieval ones. In general, the Viking Age deposits bear a higher percentage of bones that would be more sensitive to taphonomic influences than the medieval deposits. This fits within the overall observation that the upper layers show a generally poorer preservation of bone than the lower ones. The overall skeletal distributions indicate on site slaughter and consumption of caprine carcasses, especially in the Later Viking Age phase, where butchered occipital, atlas, and axis elements were recovered.

6.4.3. *Horse*

No horse bones could be identified from the contexts analyzed so far. It is possible that there were elements from this species among the archaeofauna, but none of them were well enough preserved to be placed in a more specific category than LTM.

6.4.4. *Pigs*

The Skuggi faunal collection contained 9 pig (*Sus scrofa*) elements, predominantly maxillary teeth. The 2 metapodials found in context [021] can easily be from the same individual. There was only one pig element from the Later Viking Age, and that was actually from the context associated with building collapse material under context [053].

Context	**Phase**	**Species**	**Bone**	**NISP**
003	Phase V	SUS	Mandible	1
009/010	Phase IV	SUS	Molar, maxillary	1
011	Phase IV	SUS	Incisor, mandibular	1
018	III	SUS	Molar, maxillary	1
021	III	SUS	Metapodial	2
035	III	SUS	Molar, maxillary	1
037	III	SUS	Ulna	1
U/S	Phase II	SUS	Phalanx 2	1

Table 6.3. Skuggi pigs by phases.

The presence of pig into the 12th c. is interesting and possibly suggests that their reduction belongs to a time period later than the 11th c. as indicated by Mývatnssveit faunal assemblages (McGovern et al. 2007, 2009). The reason for the earlier date of pig reduction in the Mývatn district could be because most of the region´s archaeological assemblages to not span the 11th – 13th c. time period (Vésteinsson, personal communication May 2013).

6.4.5. *Dogs*

Although there were no dog elements recovered from the Skuggi midden, dog tooth marks on numerous bones indicate the presence of the species on site.

Context	dog tooth marks	possible dog tooth marks
003	4	2
004	4	
005		1
006	2	
007		1
009/010 (group 009/010)		1
010 (group 009/010)	7	3
011	9	1
039		1
046		1
047	1	2
Total	27	13

Table 6.4. Dog tooth marks and potential dog tooth marks contexts.

Table 6.4 lists the contexts containing bones with dog gnawing marks. Phase IV clearly has the most dog gnawing marks, indicating that dogs had potentially easier access to the bone materials from this time period than in others.

6.5. Wild Mammals

6.5.1. *Cetaceans*

Only one unidentifiable chopped whale fragment from context [047] was found in the Skuggi archaeofauna. This was likely a tool rather than indicative of on-site whale consumption.

6.5.2. *Seals*

A total of 47 seal elements were collected from TR1. This number is likely to increase with further analysis. None of the elements were distinct enough to be assigned to species level. Apart from a femur of a very young seal present in context [047], the entire Skuggi phocid assemblage was found in Phases IV and V. Although none of the seals could be speciated, most of the elements are of Harbour Seal (*Phoca vitulina* (L.)) size. The four large phocid elements could be from grey seal (*Halichoerus grypus* (L.)). Both seal species give birth to their young on Iceland's sandy beaches along coastal strips.

While harbor seals were predominantly netted in spring, the grey seal was killed during the fall (Kristjánsson 1989 Vol. I:447). The element of young seal from context [047] could thus be a potential indicator for seasonal seal hunt. Many of Iceland's religious institutions had sealing beaches, i.e. Múnkaþverá monastery at the southern end of Eyjafjörður. There used to be a series of known seal hunting areas along Eyjafjörður (Kristjánsson 1989 Vol.I:315). Three seal elements found in context [011] displayed clear butchery/working marks: a proximal seal radius and one carpal (Trapezium) of a large sized seal bore butchery marks, and one skull fragment was debris from bone working; the rest of the seal bones did not bear any knife, chop, or impact marks. Figure 6.14 displays a NISP of phocid elements found in Trench 1. Context [011] with 26 elements was the most numerous in seal bones, followed by [003] with 8, group [009/010] with 6, context [006] with 3, and only one element in [047].

The majority of seal skeletal elements are represented here, indicating the site was supplied with seal meat cuts from most elements and not only flippers. Seal skin was often made into shoes, rope, outer garments and other items, and from the Middle Ages on, manuscripts were at times bound in seal skin (Kristjánsson 1989 Vol.I:446-448).

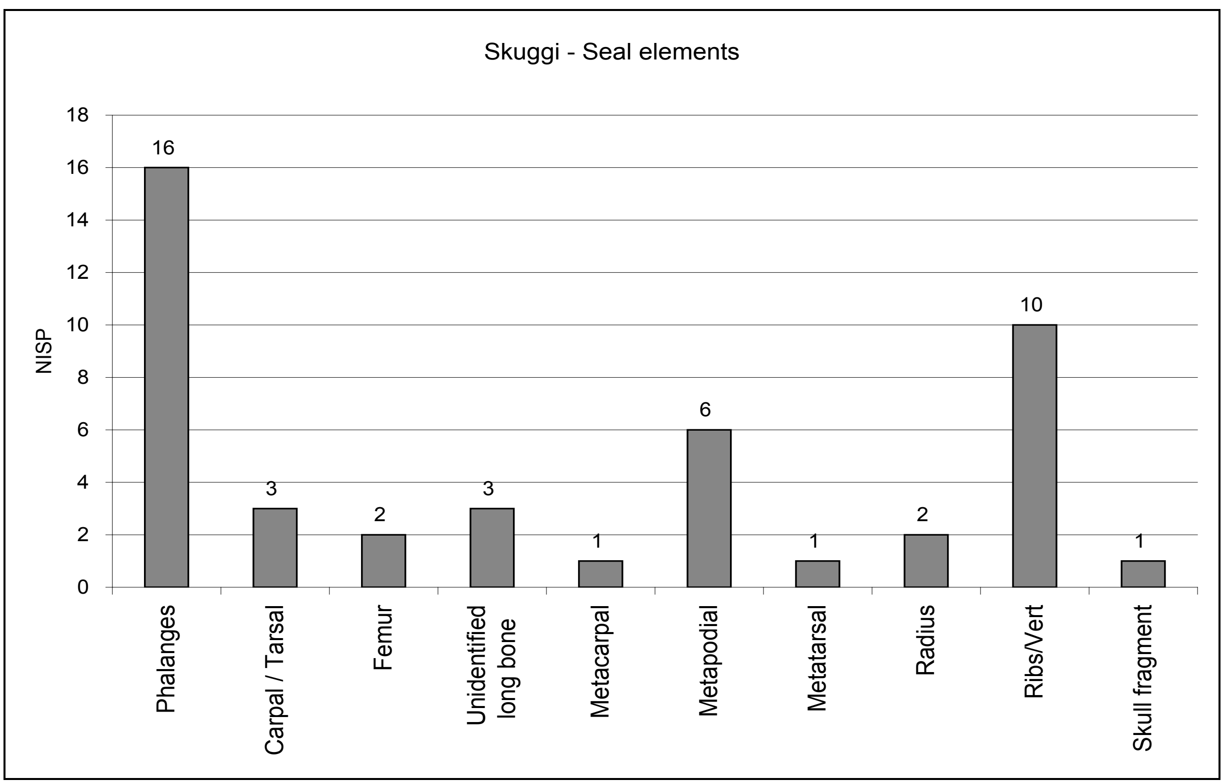


Figure 6.14. Skuggi phocid skeletal elements - NISP.

6.5.3. *Rodent (?)*

No rodent skeletal elements were found in the Skuggi archaeofauna. One long bone fragment from context [011] however displayed possible rodent gnawing.

6.6. Birds

Skuggi Bird species				
	Scientific Names	English Common Names		
Non Migratory Terrestrials			NISP count	% All Birds
	Corvus corax (L.)	Common Raven (at least 4 MNI)	44	10.71
Terrestrials				
	Passerines		2	0.49
AVSP			365	88.81
total AVSP			*411*	*100*

Table 6.5. Skuggi - Bird Species.

The only bird elements that could be analyzed to species level were those of Common raven (*Corvus corax* (L.)) (Table 6.5). Two very small ulnas belong to the very large group of

Passerines found in Island, either present year round or as seasonal guests (i.e. Hilmarsson 2000). The 365 bird elements that could not be assigned to a species or family were mainly long bone fragment shafts, but also phalanges and badly preserved ends of bird long bones.

Only two bird elements were recovered from the Later Viking Age phase.

The 44 raven elements are distributed among 3 contexts from phases VI (contexts [010] and [011]) and V (context 003]. Context [003] contained 3 elements that could be assigned to this species, context [010] from group [009/010] contained 5, and context [011] with 36 elements contained the largest number of raven bones in the assemblage. There were several other bird elements in all of these contexts that may be from this species, but their distinct skeletal landmarks are no longer present and they were thus placed in the AVSP (unidentified bird elements) category. Figure 6.15 shows one ulna shaft fragment on the bottom left, two mandibles to the right, and a proximal coracoid on the top left. A third mandible was found in context [003]. Since there are many more phalanges than long bones or other elements present in context [011], the two mandibles are probably the best indicators for a minimum number of individuals (MNI). Context [010] from group [009/010] and context [003] each contain skeletal elements of this species that may represent only one individual per context.

Figure 6.15. Various Common Raven (Corvus corax (L.)) elements from context [011].

The presence of raven elements in the medieval phase is a bit of a surprise, and surely ptarmigan (*Lagopus muta (*L.)) would have been a terrestrial Icelandic bird more likely to be expected among the food remains. Common ravens are home to this area of Iceland and live there year round (Petersen 1998). Bones of this species have been found in other Viking Age and medieval assemblages and while they were more frequently found in graves (though not in Iceland) they seem to have been occasionally consumed (Maltby 1979:73; Reichstein and Tiessen 1974:123, 144; Bond and O'Connor 1999:398, 392-93; Wigh 2001:29), killed for use of their feathers in ornaments or tools (Enghoff 2003:33, Serjeantson 2009), and at times also raised as pets, killed as pests, valued for their intelligence, but also well-known for their scavenging habits (Serjeantson 2009).

Figure 6.16. Long bone elements of Common Raven from context [010].

The Skuggi raven remains may have been the results of hunting for sport or the protection of lambs. To the author´s best knowledge, there is no evidence for consumption of ravens in Iceland, though the Skuggi long bone skeletal fragmentation pattern does not preclude this. Some of the long bones are broken/chopped in a way that could indicate disarticulation of these elements for consumption purposes. Figure 6.16 displays some raven long bone elements. The photo shows three proximal femoral and two distal tibiotarsus elements; all from context [011]. Alternatively, either taphonomic factors or potentially even ritualistic activities could have been the cause, with more research on this subject in progress.

6.7. Fish

6.7.1. *Marine Fish*

The total fish assemblage analyzed so far consists of marine species. Even though the Hörgá is known as Char and Trout fishing river, no fresh water fish were found at Skuggi so far (http://www.nat.is/nateng/angling_in_north_iceland.htm). The Later Viking Age marine fish assemblage contained 21 total fish elements, with 3 analyzed as Haddock ((*Melanogrammus aeglefinus* (L.)), and 5 elements placed in the gadid category. Presence of these elements suggests occasional consumption of marine fish at Skuggi from a very early period on.

The Skuggi medieval fish assemblages also consist of marine fish, with 360 elements present in early medieval layers (Phases IV and V). Of those, 10 could be analyzed as Atlantic Cod (*Gadus morhua* (L.*)*), another 10 as Saithe (*Pollachius virens* (L.)), 15 as Haddock, and 1 as Cusk (*Brosme brosme* (L.). A total of 71 elements were assigned to the gadid family, and four could be analyzed as Halibut (*Hippoglossus hippoglossus* (L.)).

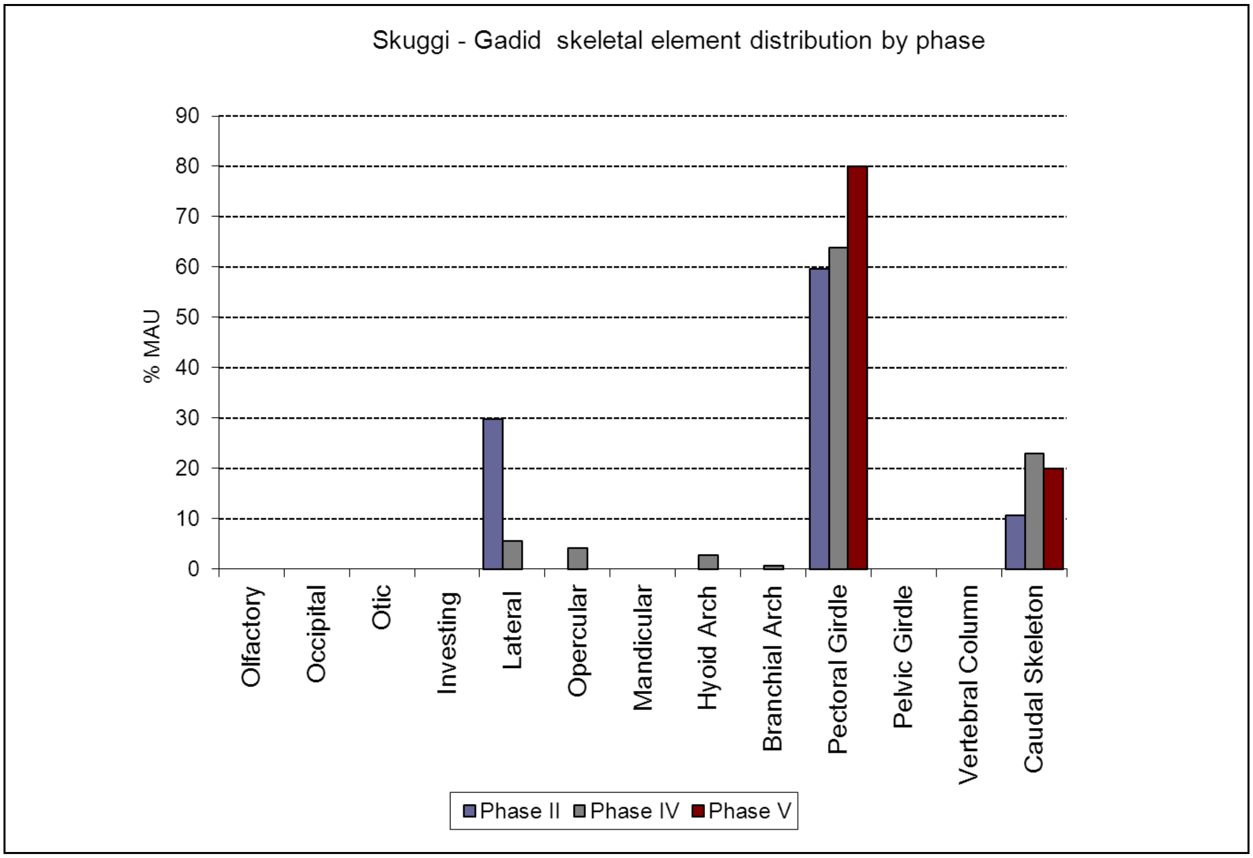


Figure 6.17. Skuggi phased gadid skeletal element distribution.

The Skuggi skeletal element distribution graph suggests, though with a few exceptions, the presence of a processed filet rather than the entire fish. Since the Skuggi gadids that were speciated were predominantly Haddock, and all the vertebral elements were part of the caudal portion of the vertebral column, the likely processed fish product would be a *flat-dried fillet* (Perdikaris & McGovern 2008:76).

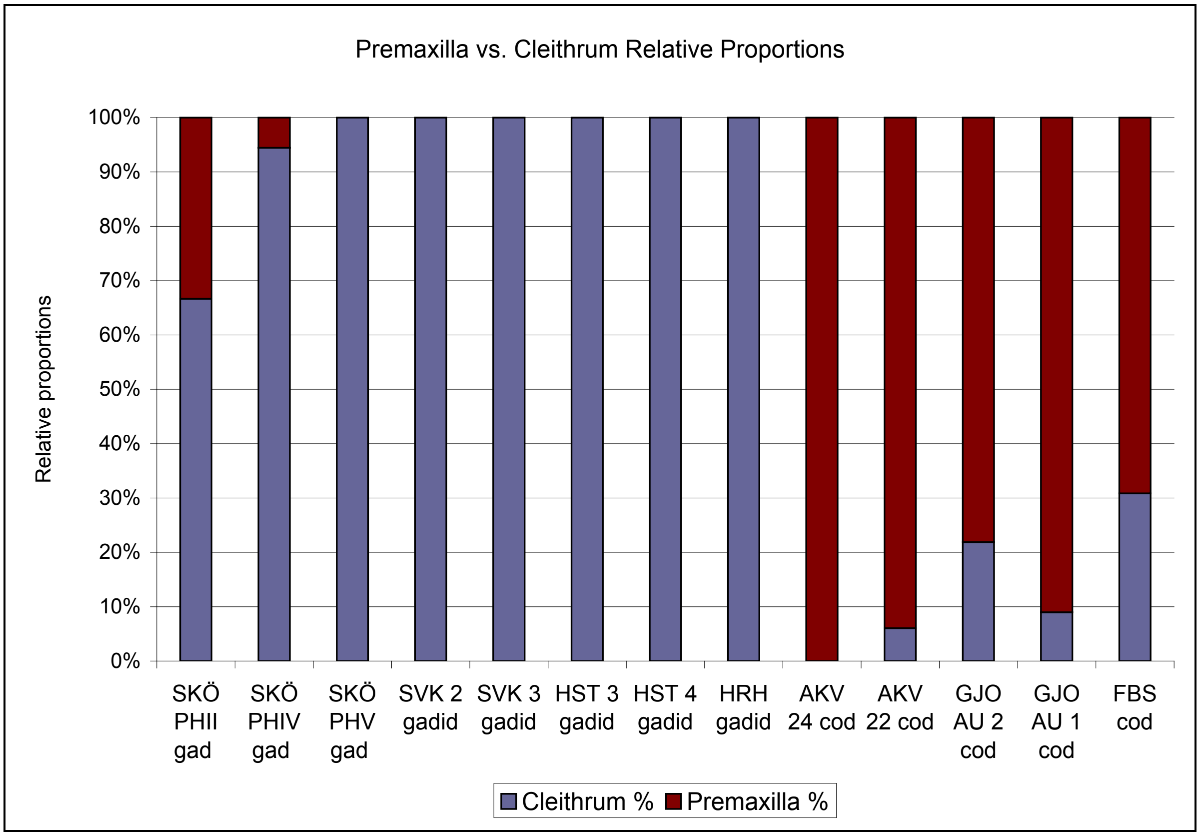


Figure 6.18. Gadid premaxilla vs. cleithrum elements; relative proportion comparisons. Hofstaðir, Sveigakot and Hrísheimar, all "consumer sites" in Mývatnssveit (McGovern et al 2007, Perdikaris & McGovern 2008) and three coastal medieval fish "producer sites in northwest Iceland (Akurvík, Gjögur and Finnbogastaðir (Krivogorskaya et al 2005, Amundsen et al 2005, Perdikaris & McGovern 2008) in comparison with Skuggi.

The graph in figure 6.18 indicates that far more gadid post-cranial bones than cranial elements were present in the Skuggi faunal collection, especially in the medieval phases (i.e. Perdikaris and McGovern 2008, McGovern et al. 2009). Premaxillae usually are found with fish skulls in processing sites such as Akurvík, Finnbogastaðir, and Gjögur in the Westfjords (Amundsen et al 2005, Krivogorskaya et al 2005). Cleithra frequently travel with a processed fish product to consumer sites such as the Mývatnssveit sites of Hofstaðir, Hrísheimar, Sveigakot (Perdikaris and McGovern 2008, McGovern et al. 2009), and also Skuggi in Hörgárdalur. The distance between Skuggi and the ocean is about 20 km, and the site's gadid skeletal profiles so far suggest the site was predominantly supplied with a processed marine fish product (gadid species and Halibut) and occasionally with fresh fish possibly caught by the farmers and brought to Skuggi to be processed there. Skuggi is an inland farm, but its distance of 20km to the sea vs. the Mývatnssveit sites´ 50–60 km distance from the ocean may partially explain the presence of the fish skull bones at Skuggi. It is also possible that in Hörgárdalur, at least as observed at this site there was not yet a fully institutionalized processed fish distribution system in place as may have been the case in Mývatnssveit (Perdikaris & McGovern 2008).

6.8. Craft working

There were several elements in the faunal assemblage that show traces of craft working. Especially long bone fragments of either MTM (sheep/goat) or LTM (cow/horse) were often used for bone tool making. Several bone fragments could be determined as bone working debris, i.e. bone pins, bone needles, bone combs, were found in the analyzed faunal materials from contexts [009/010], [011], [046], and [074]. Table 6.6 displays the different worked bone elements. All the elements listed there were either MTM or LTM long bone fragments. Several other elements are still under analysis.

Context	General finds number	Species	Bone	Count
009/010	III	MTM	Long bone	4
011	VIII	MTM	Long bone	1
046	V	Caprine	Metapodial	1
046	IX	Caprine	Metacarpal	1
046	n/a	MTM	Long bone	1
047	n/a	LTM	Long bone	1

Table 6.6. Skuggi bone working debris.

Figure 6.19. Bone artifact context [046].

The two bone pins found during excavation were from contexts [035], finds number 56; and [036], find number 74; from Phase III, or the mid-11th c. Since the faunal remains from these contexts have not yet been analyzed, it cannot be determined whether there were associated bone working debris elements in the context.

Contexts [011] and [047] contained worked fragments of what appears to be antler; both elements are still under analysis.

6.9. Butchery

The generally well preserved Skuggi faunal collection contained many elements that clearly were butchered for food consumption. Due to the better preservation conditions in the Viking Age phase, the ratio of butchered elements detected in Phase II vs. in Phases IV, V is 2 (1.73):1.

Figure 6.20. Chopped sheep atlas/axis from context [052].

The 42 (25%) of metapodials, or lower leg bones that showed butchery traces, were all split. None of the Skuggi metapodials bore the bi-perforations typical for later medieval North Atlantic faunal assemblages (not in Greenland). The practice of drilling holes into the top of a metapodial epiphysis and one right above the distal epiphysis by knife to suck out the marrow while leaving the bone intact for artifact production or children's toys started around AD 1150-1200 (Bigelow 1985).The Skuggi butchery pattern on both cattle and caprine metapodials from the Phase V archaeofauna supports this claim.

Figure 6.21. Butchered cattle and caprine elements from Skuggi. Left: Split cattle metapodials context [047]. Right: split caprine tibia, elements refitted from context [046].

6.10. Burning

Only about 12 % of the Skuggi bones showed burning. Thereof, white burnt bones whose organic materials are no longer present made up 8.5 %, black burnt bones 2.5%, and 0.6 % of the bones were scorched. Figure 6.22 presents the proportion of burnt (black), non-burnt, scorched, and calcined (white) per phase. Although only two contexts from the Later Viking Age contained burnt faunal elements, Phase II displays a higher amount of burning than do Phases IV and V where burnt bone proportion do not exceed 10 % of the total bone assemblage. The two phase II midden layers possibly contain a proportion of burnt bone and other fire place cleaning contents: context [052] was described as midden layer containing wood ash, and [047] as containing peat ash. Except for group [009/010] from Phase IV that was described as midden layers containing a combination of peat ash and charcoal, all the other early medieval deposits listed in the graph were described as containing only charcoal, but no peat ash or wood ash.

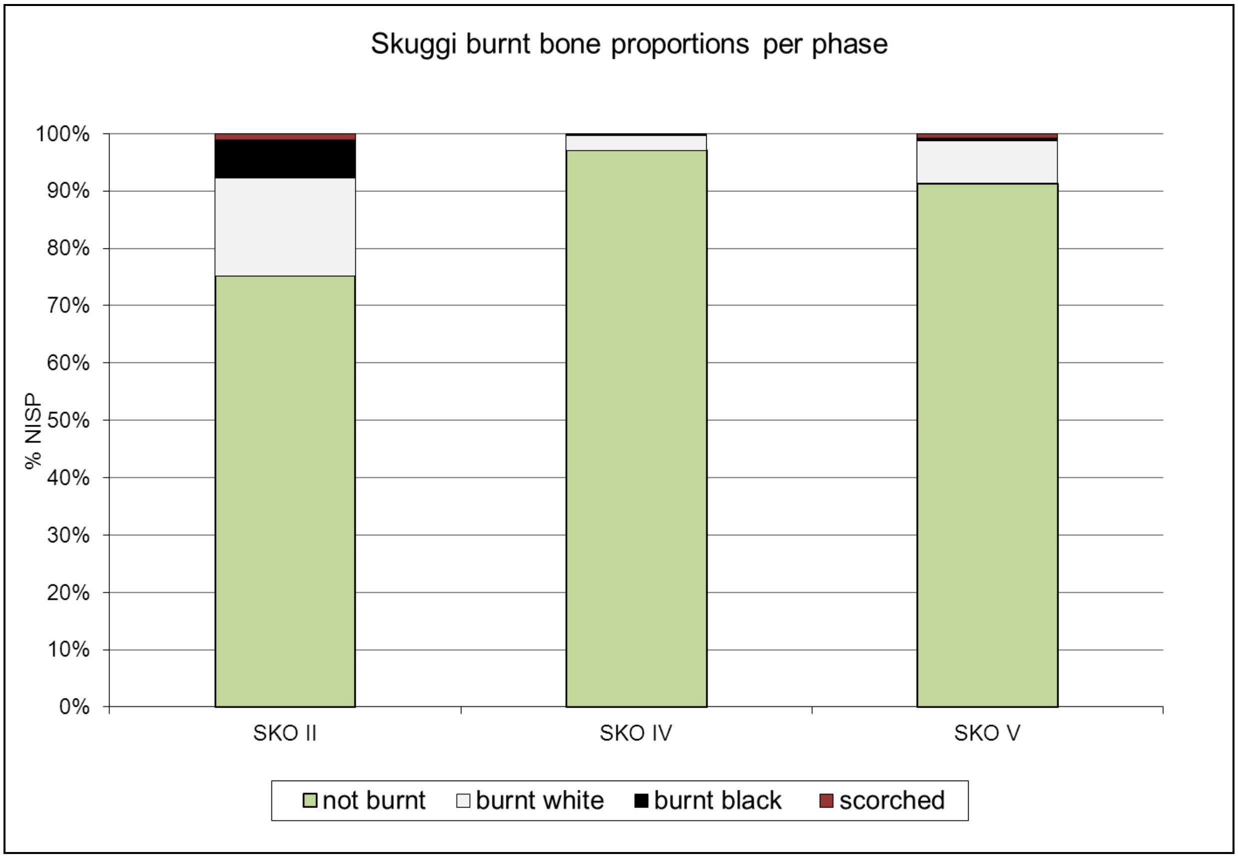


Figure 6.22. Percentage of burnt bones by phase.

6.11. Fragmentation

Phase IV and V contexts display a relatively higher fragmentation rate than Phase II contexts. This result agrees with the observation that the Viking Age bone collection at Skuggi is in better condition than the one from the Middle Ages. The upper layers and especially Phase V materials may have been exposed to repeated cycles of freeze-thaw episodes. Although the polygons typical for that occurrence were not observed during removal of topsoil, the bone fragmentation is best explained through post-depositional forces, whereas the Phase II fragmentation partially results from burning of the elements.

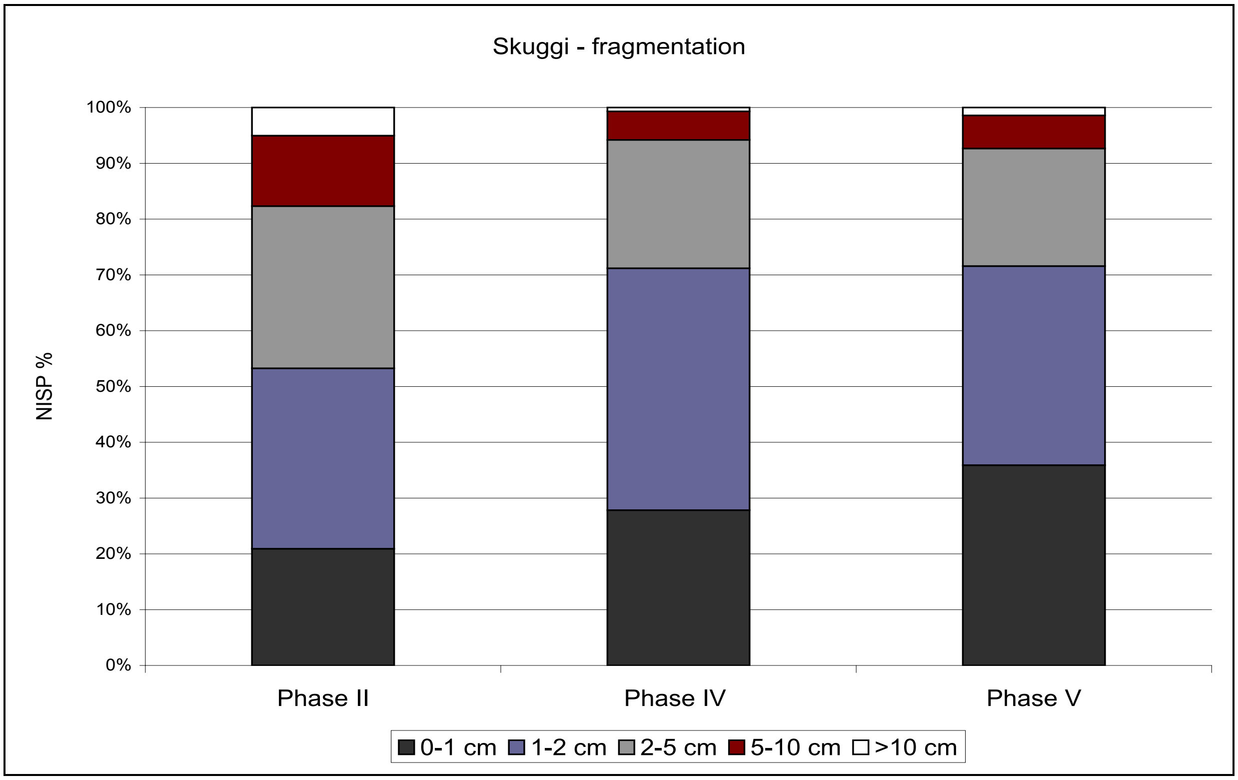
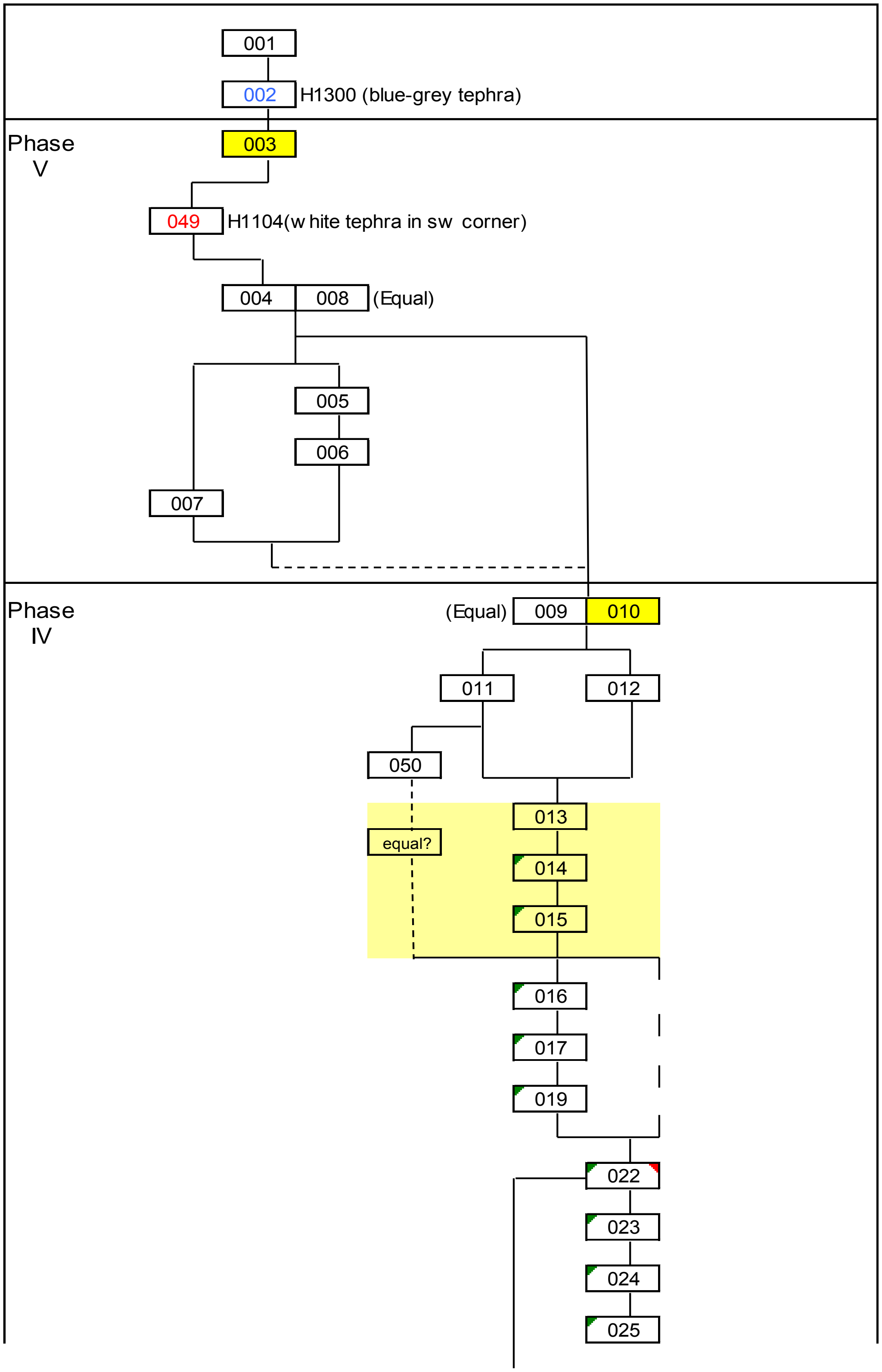


Figure 6.23. Percentage of bone fragmentation by phase.

6.12. Skuggi Harris Matrix



Skuggi TR 1 Matrix continued.

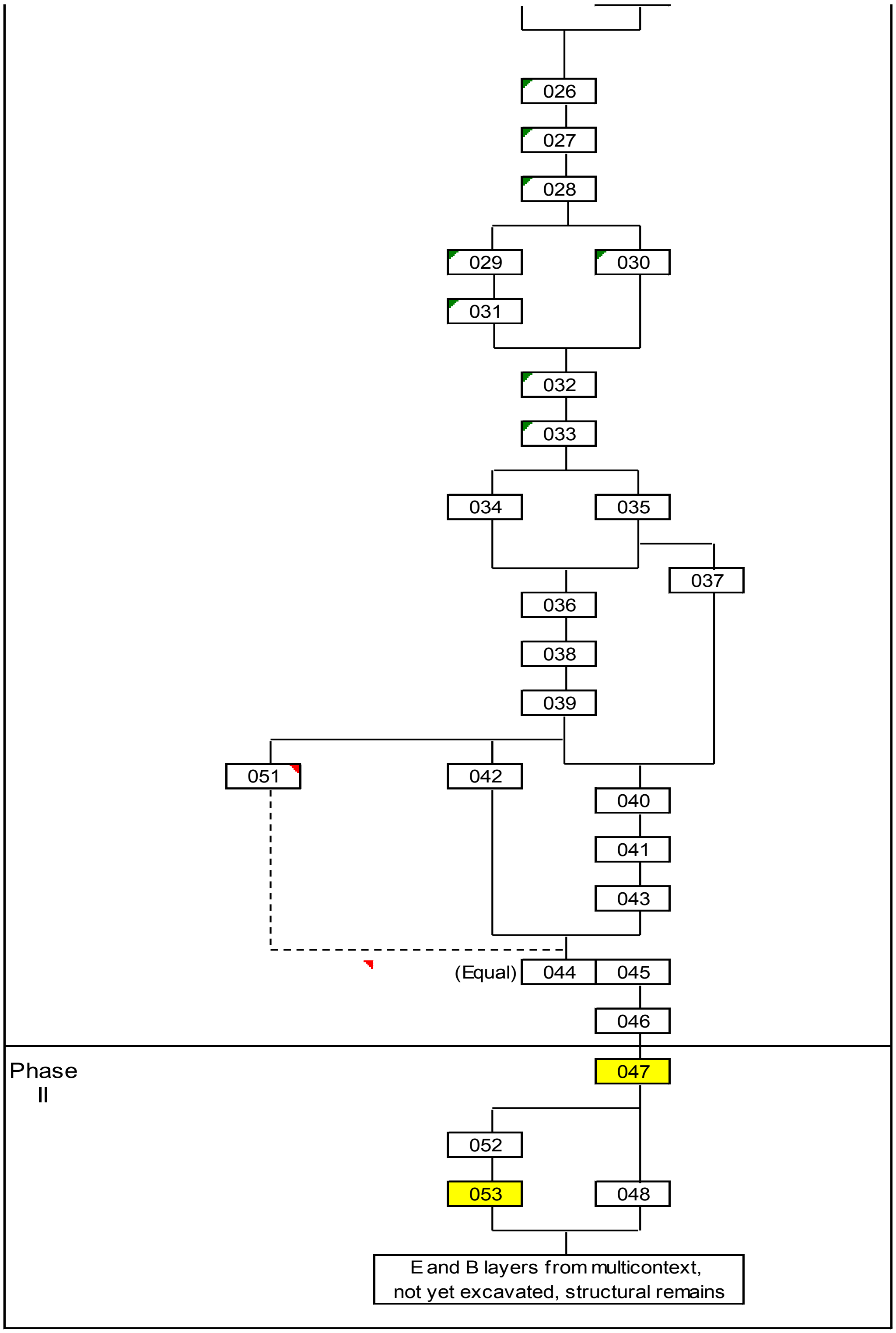


Figure 6.24. Skuggi, Trench 1, Harris Matrix. Cells highlighted in yellow indicated C14 dating.

Chapter 7. **The Oddstaðir Archaeofauna**

This chapter presents data from the Oddstaðir faunal analysis and concludes the data chapters. The Oddstaðir archaeofauna was excavated from midden trench 1 and was excavated according to stratigraphic order, providing a series of discrete deposits that allow for a coherent midden chronology and is supported by radiocarbon dates. Artifact analysis was not conclusive on the deposit dates, except for two Viking Age beads that were collected from Phase II, the occupation deposits dated between the late 9th to the mid-11th c. AD.

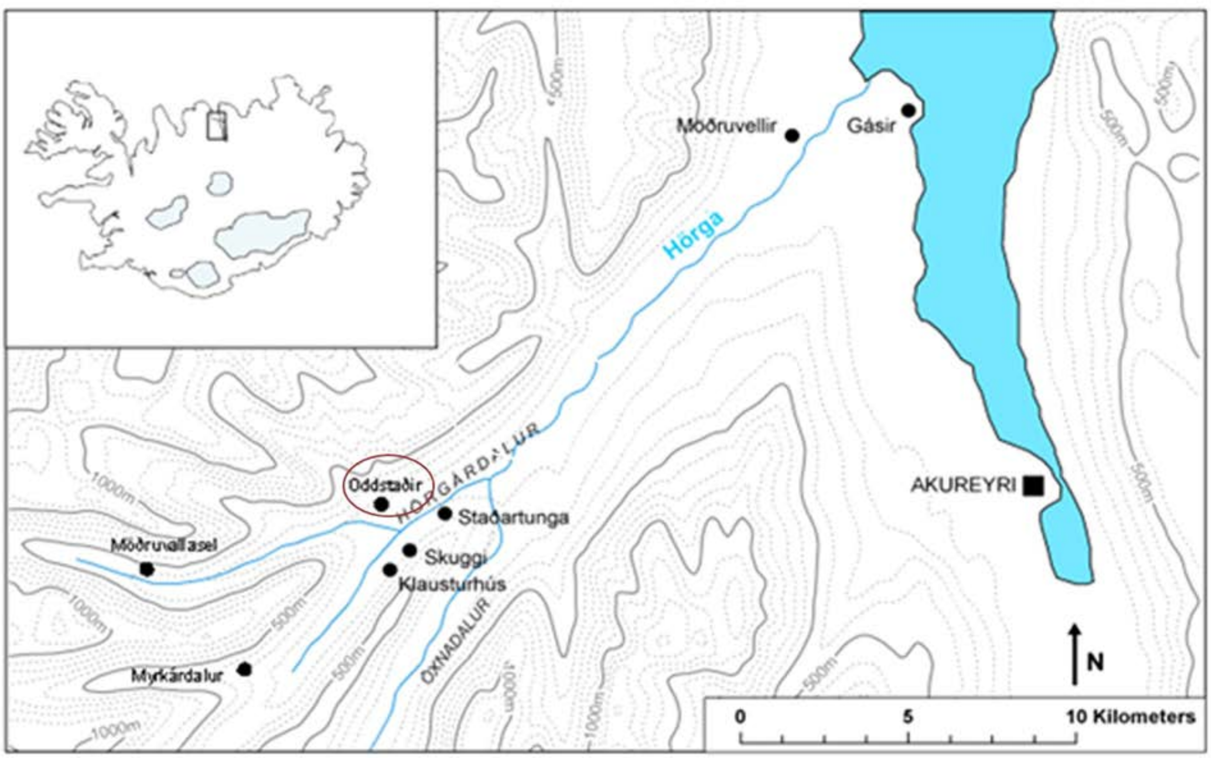


Figure 7.1. Map of Iceland, locating Oddstaðir and other sites investigated as part of the GHP, in Hörgárdalur, and Gásir, located at a coastal inlet in Eyjafjörður (Map after Streeter in Dugmore et al 2008; sites added by author).

7.1. Midden Chronology

7.1.1. *Radiocarbon Dates, Stratigraphy, and Phasing*

Radiocarbon samples on some of the Oddstaðir faunal remains have yielded six dates that allow for a phasing of the deposits excavated in stratigraphic sequence.

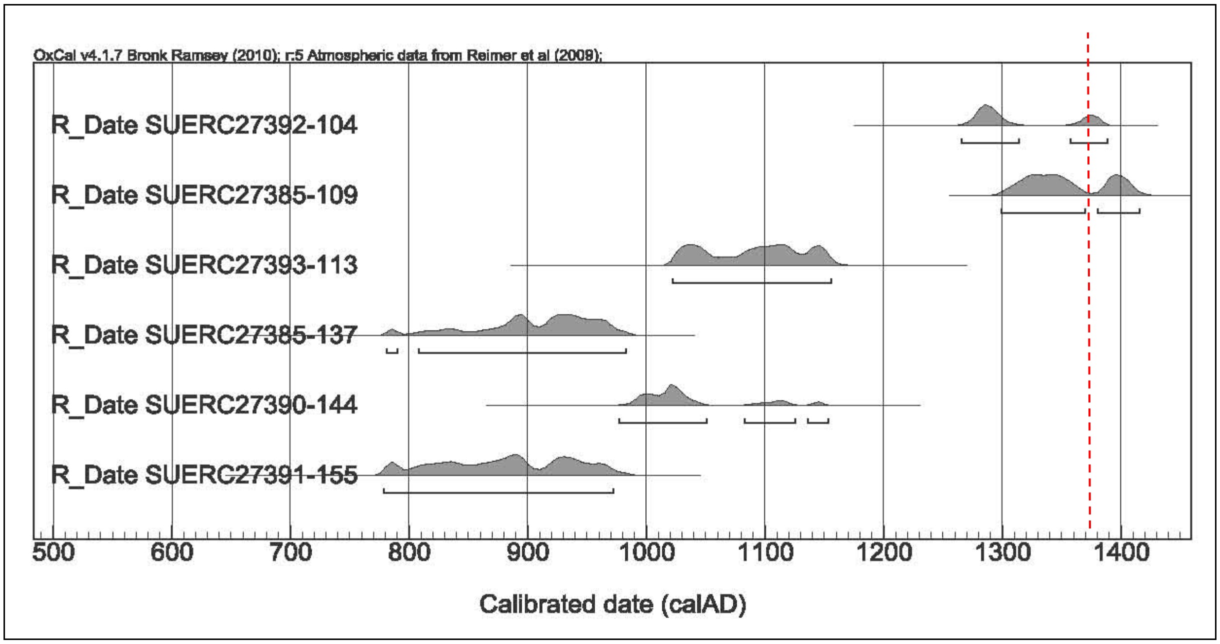


Figure 7.2. Oddstaðir Trench 1 Radiocarbon dates (https://c14.arch.ox.ac.uk/oxcal/OxCal.html, v. 1.6, Bronk Ramsey 2010, Atmospheric data from Reimer et al. 2009). Dotted line marks the still un-confirmed Grimsvötn 1354 tephra layer, context [102].

Figure 7.2 displays the calibrated **Radiocarbon** dates for the basal and upper layers of the midden from TR1. Context 155 provides the midden basal layers. According to the calibrated C14 dates, these layers fall into the **later Viking Age phase.** Although context [137] is above context [144] in the stratigraphic order (see Oddstaðir Harris Matrix), the radiocarbon analysis of a terrestrial mammal bone from this context (bovine premolar) suggests this is an element from an earlier layer, redeposited in a younger one. The residual character of this bone may be the result of a reworking of the various discrete midden layers in the late 10/11th c. Because of the discrepancy of these two dates, all the layers were lumped into a general time frame to avoid potential mixing of various layers from different time periods.

The determination of the different occupational phases at Oddstaðir follows the various activity sequences encountered during the archaeological excavation. Dates were established using radiocarbon analysis, tephra analysis where applicable, and stratigraphic excavation methods. Artifact analysis was only helpful for the earlier deposits, where glass bead finds could be associated with the Viking Age, especially find number 026 from context (140); a glass bead likely from the turn of the 10th c. (Hreiðarsdóttir 2010:48 in Harrison et al 2010). This artifact date corresponds with the radiocarbon dates, placing the contexts from this phase between the late 9th through mid-11th c. This could have been the first phase of abandonment of the structure associated with the turf wall underneath this midden layer.

None of the other artifacts were diagnostic enough in make to suggest anything other than that they were typical for Viking Age and medieval use (Gísladóttir 2010:61-64 in Harrison et al 2010). To date, analysis of the two tephra layers observed during excavation has not resulted in any concrete dating information, with one of them (previously thought to be H1300) completely inconclusive, and the other still not confirmed. This second volcanic ash layer was given context number [102] and seals the Oddstaðir midden deposits. Its chemical signature matches that of the Grimsvötn 1354 ash fall enough to suggest this as a possibility, but more work is still required to confirm this date (R. Streeter, personal communication April 2013).

Figure 7.3. Oddstaðir; left: multi-context picture: stone lined wall, post holes with a rectangular feature emerging. Picture faces west. Right: negative feature with a very regular edge forming one corner of the feature. Multicolored layers on the bottom of the feature/pit are prehistoric deposits. Picture faces east.

The phasing information available from C14 dating and stratigraphy in table 7.1 below

Phase	Occupation Period	Dates	Dating evidence
I	Viking Age	9th c.	Stratigraphy: Architectural remains below midden deposits.
II	Viking Age	late 9th - mid 11th c.	Radiocarbon dating: context [155] basal layers = cal. C14 AD770-980 (2 sigma range); upper extent: context [144] = cal. C14AD970-1050 (2 sigma range).
III	Late Viking Age - Earlier Middle Ages	mid 11th – mid 12th c.	Radiocarbon dating: lower extent = context [144], cal. C14 AD970-1050 (2 sigma range); upper extent = context [113], cal. C14 AD1020-1160.
IV	High Middle Ages	mid 12th to ca. late 13th c.	Stratigraphic dating: these are layers between Phase III context [113], cal. C14 AD1020-1160 (2 sigma range) and Phase V context [109], cal. C14AD1290-1370 (2 sigma range).
V	Later Middle Ages	late 13th – late 14th c.	Lower extent = context [109], cal. C14AD1290-1370; upper extent = context [104], cal. C14AD1260-1320 (2 sigma range). Possibly Grimsvötn 1354 – sealing the midden layers, unconfirmed date.

Table 7.1. Break-down of the different occupational phases at Oddstaðir.

7.2. Summary of the Oddstaðir Archaeofaunal Results

Table 7.2 presents the Oddstaðir archaeofauna as a Total Count. The current Total Number of Fragments (**TNF**) count is **9,055**, with a Number of Identified Specimens (**NISP**) of **2,300**. Although this is not a very large faunal collection, the numbers suffice to discuss most issues concerning long term farm management and site economy. This archaeofauna thus serves to raise issues on the larger Eyjafjörður, and especially Hörgárdalur human ecodynamics, without pretending to provide finite answers, as some data sets are subject to change.

The Oddstaðir archaeofauna is generally well preserved, the TNF indicating a relatively high level of fragmentation especially in the earlier layers (Total Number of fragments smaller than 2 cm = 4,921).

Further division of the total NISP according to phase results in a *NISP* of 836 for **Phase II,** the Viking Age deposits.

Phase III, the early medieval layers, produced a *NISP* of 650.

Phase IV, the transition phase between the high and later Middle Ages had a NISP of 356.

Phase V, the terminal midden phase from TR 1, had a **NISP** of 458.

Oddstaðir TR 1, Table of Element count.

Taxon	II, late 9th - mid 11th c.	III, Mid 11th - mid 12th c	IV, mid-12th - late 13th c.	V, late 13th to end of 14th c.	Total NISP
Domestic mammals					
Cow (*Bos taurus* (L.))	107	63	46	89	305
Horse (*Equus caballus* (L.))	3			1	4
Pig (*Sus scrofa* (L.))	23	6	1	2	32
Dog (*Canis lupus familiaris* (L.))				1	1
Goat (*Capra hircus* (L.))	6	1	3	5	15
Sheep (*Ovis aries* (L.))	28	22	16	20	86
Unidentified caprine	280	176	184	232	872
Total caprine	314	199	203	257	973
Total domestic	447	268	250	350	1,315
Wild Mammals					
Unidentified seal species	8	2			10
Total seal	8	2			10
Total wild mammal	8	2		1	11
Birds					
Common gull (*Larus canus* (L.))	1				1
Black-headed gull (*Chroicocephalus ridibundus (L.)*)		1			1
Gull species (Larus sp.)	2	2			4
Razorbill (Alca torda (L.))	1				1
Murre species (Uria sp.)	9	5			14

Oddstaðir TR 1 Table of Element count continued

Auk species (Alcid sp.)	4	2		1	7
Goose species (Anser sp.)	1	8			9
Ptarmigan (Lagopus muta (Montin))	1				1
Unidentified bird species	43	20	1	5	69
Total bird	62	38	1	6	107
Fish					0
Cod (*Gadus morhua* (L.))	14	25		1	40
Haddock (*Melanogrammus aeglefinus* (L.))	9	10		14	33
Saithe (*Pollachius virens* (L.))	6	16	3		25
Cusk (*Brosme brosme* (L.))		2			2
Atlantic Halibut (*Hippoglossus hippoglossus* (L.))	2	5			7
Gadid species	123	105	26	21	275
Fish non-speciated	230	166	75	66	537
Total fish	308	329	104	102	843
Mollusca					0
Soft-shel Clam (Mya sp.)		7			7
Hard-shell Clam (Arctica islandica (L.))	2	4	1		7
Common whelk (Buccinum undatum (L.))	1				1
Mussel (*Mytilus edulis* (L.))		1			1
Unidentified mollusc species	11	1			12

Oddstaðir TR 1 Table of Element count continued

Total mollusca	14	13	1		28
Total Number of Identified Species	**836**	**650**	**356**	**458**	**2300**
Large terrestrial mammal	141	66	57	100	364
Medium terrestrial mammal	335	303	273	318	1229
Uni. terrestrial mammal fragments	1,595	1,448	657	1,461	5161
Unidentified marine mammal fragments				1	1
Total number of fragments	**2,907**	**2,467**	**1,343**	**2,338**	**9,055**

Table 7.2. Oddstaðir, Total TR 1 element count, with a NISP breakdown by phase.

7.3. Major Taxa

The phased major taxa graph in figure 7.4 displays the proportions of various animal groups using their NISP percentages. During the entire occupation span, sampled in TR 1, the domestic mammal category never makes up less than 40 % of the site's total animal proportion profile, with 54 % in phase II, 41 % in phase III, 70 % in phase IV, and 76 % in phase V. Birds (including both local ptarmigan and goose potentially available nearby and sea birds that must have been brought from the coast) make up larger percentages during the Viking Age (7%) and Early Middle Ages (6%), whereas they are seemingly less utilized as a food resource in the upper midden deposits. The few wild mammals, mostly seals (Phocid sp.), were only recovered in the earlier midden phases, but not in the two later ones. Sea birds like seals become very rare in the later phases. The fish category made up a relatively high proportion of the total animal profile in phase II (37%), phase III (51%), but not in phases IV (22%) and V (22.22 %).

Mollusks, relatively few in number, were only found in phases II and III (2% each) and a fraction thereof in phase IV (0.28 %).

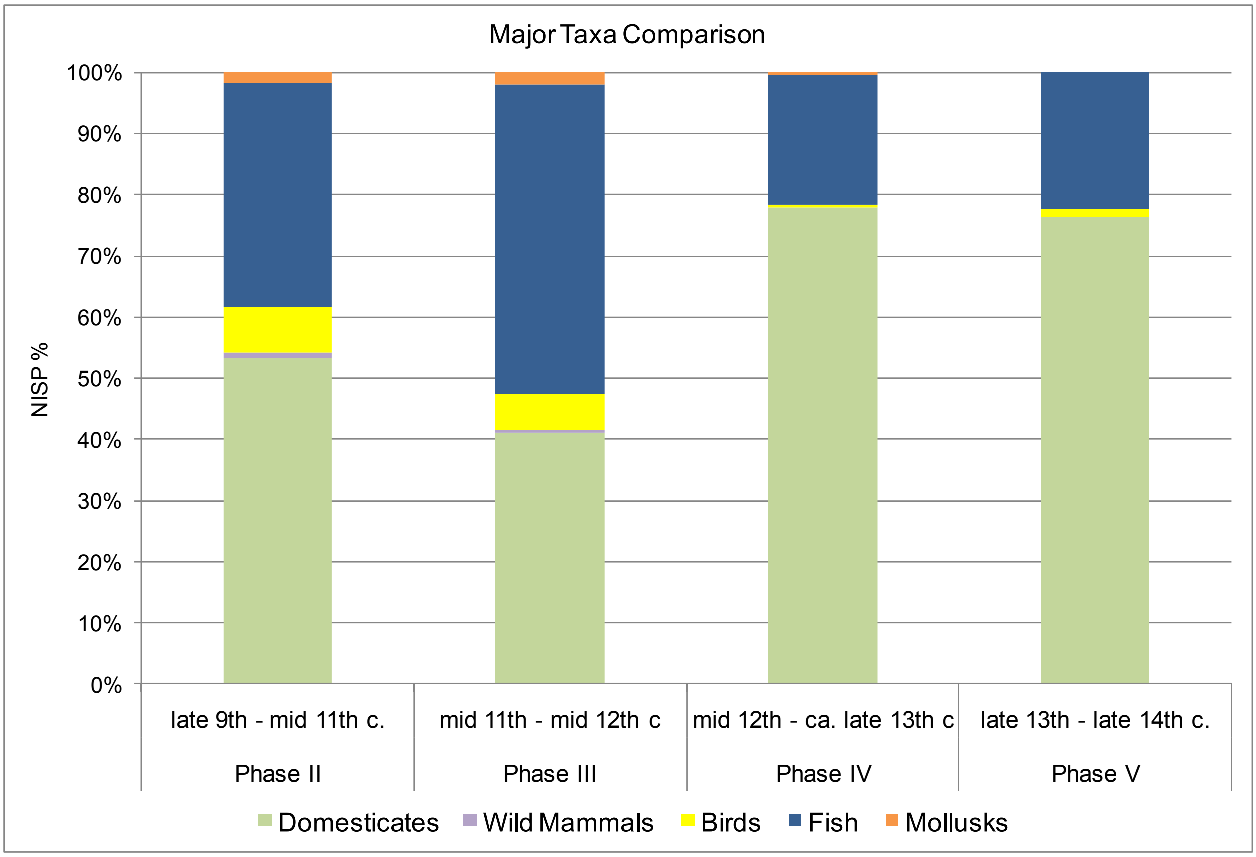


Figure 7.4. Oddstaðir Major Taxa presented as NISP percentages.

These major taxa profiles per phase suggest that generally, domestic mammals became more important from the High Middle Ages on and fish and other wild resources declined in importance as time proceeded. Overall the Oddstaðir archaeofauna indicates a decline in the use of marine resources of all types for household provisioning.

7.4. Mammals

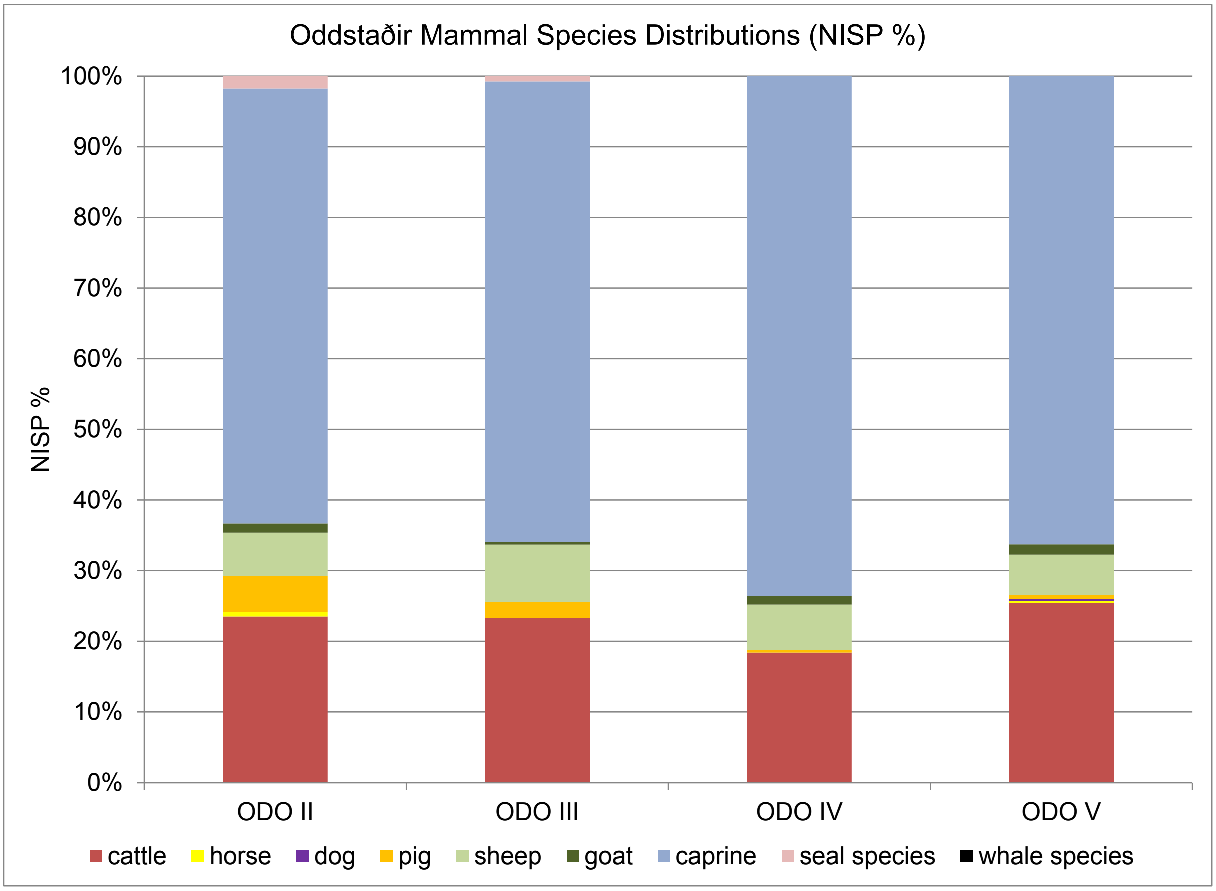


Figure 7.5. Oddstaðir phased mammal species distributions.

The phased mammal species distribution graph in figure 7.5 displays the various mammal species proportions present in the phased TR1 midden deposits. Whereas in phase IV (High Middle Ages) the cattle proportion was 18 % of the mammal species, it was 24 % in phase II (Viking Age), 23 % in phase III (Early Middle Ages), and 25 % in Phase V (Later Middle Ages). Few horse remains in phase II (0.66 %) and phase V (0.26%) and one dog remain in phase V (0.26 %) indicate the low importance as a food resource of these species throughout all the phases encountered at Oddstaðir. Pigs, however, were found in all four phases and represent 5 %

in the Viking Age phase, 2 % in the Early Middle Ages, 0.4 % in the High Middle Ages, and 0.57 % in the Later Middle Ages. A decline in this species per time period is observable, as is that of seal species, with only phase I and II contexts producing small amounts of seal. Caprines (sheep/goat indeterminable) are the most abundant category for all phases, making up 62 % of phase II, 65 % of phase III, 74 % of phase IV, and 66 % of phase V. All phases had a proportion of sheep between 6 % and 8 %. The goat percentages are very low from the beginning of the Oddstaðir activity: in phase II the goat percentage of the total mammal number was 1.3 %, in phase III it was 0.37 %, in phase IV to 1.2 %, and in phase V 1.42 %. These numbers suggest that goats were never of great importance to this site.

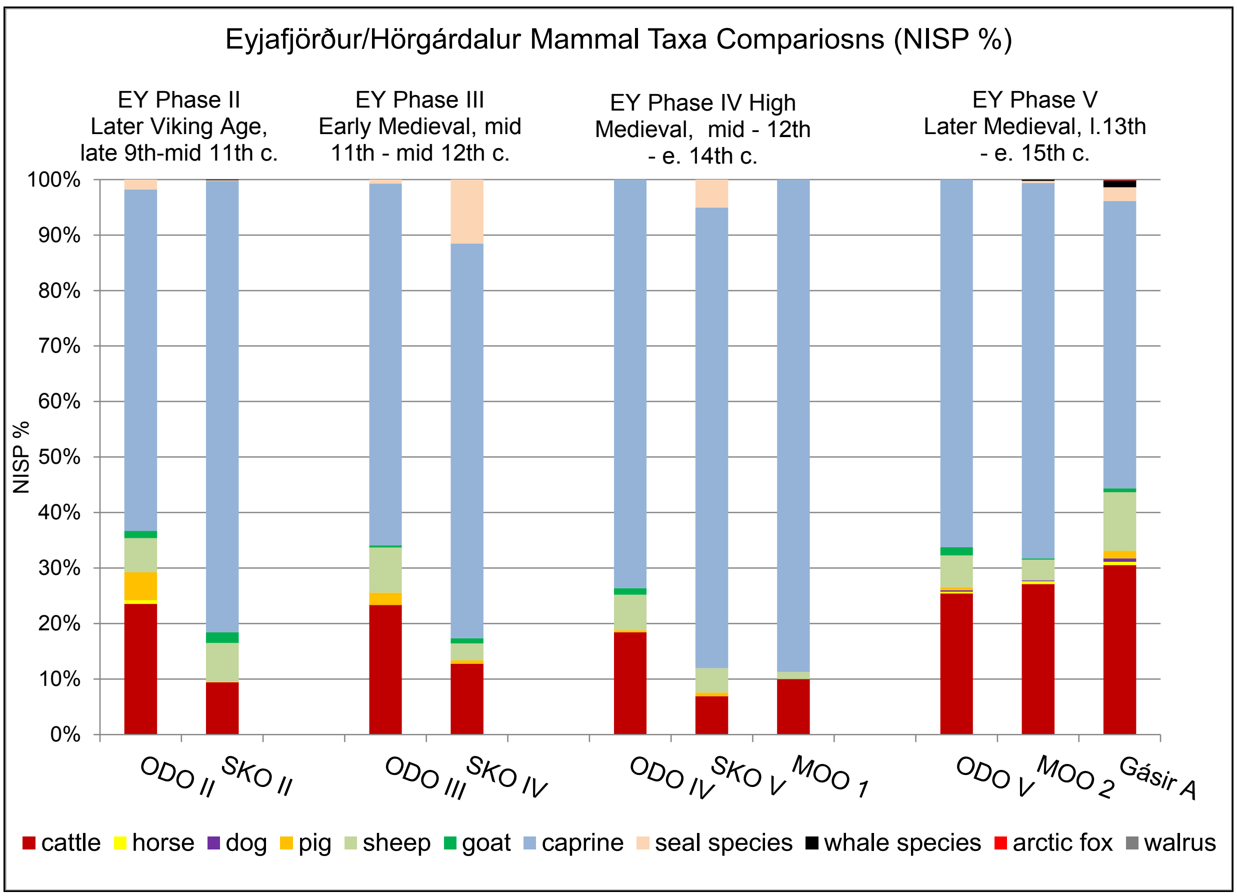


Figure 7.6. Oddstaðir phased mammal species distribution compared to other Hörgárdalur sites. ODO II and SKO II are Viking Age faunas, ODO III and SKO IV from early, ODO IV and SKO

V and MOO 1 from high, and ODO V, MOO 2, and Gásir Area A from later medieval faunal materials.

Except for a change in the few wild mammal species, the overall livestock management at Oddstaðir seems to have remained fairly stable, with cattle percentages actually highest in the latest phase encountered. This farm may have been wealthy enough to sustain a generally permanent livestock profile throughout its occupation. Whether there was a change in management of Oddstaðir sheep/goat or cattle herds may be determined better in the next section, where these animals' age at death data will be presented. There was a considerable amount of pig remains at Oddstaðir during the early times of its occupation and even during the later phases.

7.4.1. *Reconstructing Domesticate Mortality Patterns*

	Phase II - lower		Phase III - middle		Phase IV - upper L1		Phase V - upper L2	
	Late 9th - mid 11th c.		Mid-11th - mid 12th c.		Mid-12th - ca. late 13th c.		Late 13th - end of 14th c.	
Taxon	NISP	% group	NISP	% group	NISP	% group	NISP	% group
Bos taurus (L.)	107	23.94	63	14.09	46	18.40	89	25.43
Equus caballus (L.)	3	0.67					1	0.29
Sus scrofa (L.)	23	5.15	6	1.34	1	0.40	2	0.57
Canis familiaris (L.)							1	0.29
Capra hircus (L.)	6	1.34	1	0.22	3	1.20	5	1.43
Ovis aries (L.)	28	6.26	22	4.92	16	6.40	20	5.71
Ovis/Capra sp.	280	62.64	176	39.37	184	73.60	232	66.29

Table 7.3. Domestic Mammal Table.

Table 7.3 presents all the domestic animals as NISPs and also relative NISP percentages per phase. Caprines in general are the largest group in all phases, with cattle being the second largest, their proportion never falling below 18 %. Goat proportions range from 0.4 % to 1.4 %, slightly increasing in the last phase and pig percentages declining from 5 % in the earliest phase to 0.5 % in the latest. As mentioned before, the presence of pig elements in the later medieval layers seems to be indicative of the importance of these animals as status indicators, since they often disappear from low status sites' faunal collections by this period (McGovern et al 2004, 2007, 2009, Amorosi 1996). The fact that a few pig remains and goat remains were found relatively late on hints toward at least a partial meat provisioning strategy instead of one purely geared toward wool production. This very stable proportion of cattle elements throughout the occupation phases should be kept in mind.

In figure 7.7 below, except for the higher ratio of 4 caprine elements per 1 cattle element in Phase IV, the Oddstaðir caprine to cattle ratio seems to remain at a relatively constant 3 to 1 from early occupation through the latest. This pattern contrasts significantly with the one observed in the archaeofauna from neighboring Skuggi, where a ratio of ca. 9.5 caprine bones per cattle bone in the earliest phase changes to a caprine/cattle ratio of 6:1 for the mid-11th – mid-12th century collection and then rises to 12.5 caprines per cattle in the terminal phase in the later 12th c. There is no indication of a jump in caprine stocking levels into the 20:1 range after 1200 as noted at Steinbogi and Svalbard.

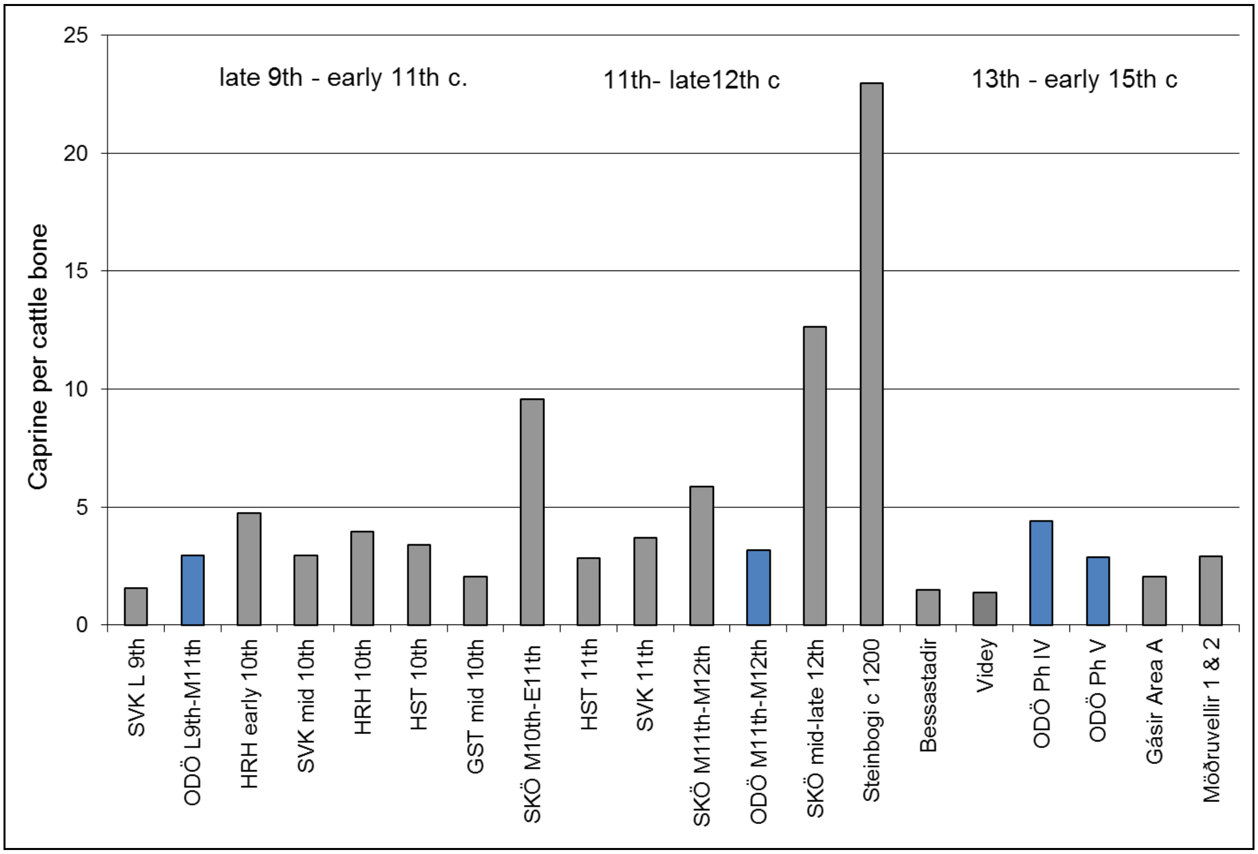


Figure 7.7. Comparison of caprine/cattle ratios from various Viking Age and medieval Icelandic sites. Sveigakot (McGovern et al 2004), Hrísheimar (McGovern & Perdikaris 2002), Selhagi (McGovern & Perdikaris 2003, Draft), Steinbogi (Brewington et al 2004) in Mývatnssveit; Viðey in Reykjavík (Amorosi 1996, 403), Stóraborg in the Southwest (Amorosi 1996, 373), Bessastaðir (Amorosi 1996, 335) close to Reykjavík,), Granastaðir (Amorosi & McGovern 1994), Skuggi, Oddstaðir, Gásir, & Möðruvellir in Eyjafjöður (SKÖ, ODÖ, Gásir, Möðruvellir data by author).

Finally, when comparing the Oddstaðir cattle/caprine ratios to other sites in early and later medieval Iceland, it appears that relatively high status farms (i.e. Hofstaðir in Mývatnssveit) display similar caprine vs. cattle proportions, with the later medieval, higher status sites at Bessastaðir and Viðey (both larger Reykjavik area) displaying a ratio of these two species even lower than Gásir's. The mid-10th c. archaeofauna from Granastaðir in neighboring Eyjafjarðardalur (McGovern & Amorosi in Einarsson 1995) indicates a caprine to cattle ratio of 2:1, and thus also has slightly higher cattle element counts per caprines than Oddstaðir. Again, when observing the above graph comparing various contemporaneous ratios from the Viking Age through the Later Middle Ages, Oddstaðir displays very little change in its caprine vs. cattle element numbers.

7.4.1.1. Cattle

7.4.1.1.1. Cattle tooth eruption analysis

Only five (5) cattle mandibles were available for eruption analysis and are thus not suitable for a cattle tooth eruption comparison discussion.

7.4.1.1.2. Cattle Long Bone Fusion Comparison

Similar to the tooth row data, only ten (10) cattle long bone elements were available for fusion analysis, and an age at death assessment from these two categories is therefore not available until more data becomes available.

7.4.1.1.3. Cattle Neonatal Data

The one data set allowing for a statement on the Oddstaðir cattle management during the four midden phases chronicling its perceived occupation time is the cattle neonatal data derived from the very well preserved elements available for a distinction between fetal, neonatal, and immature/mature skeletal elements.

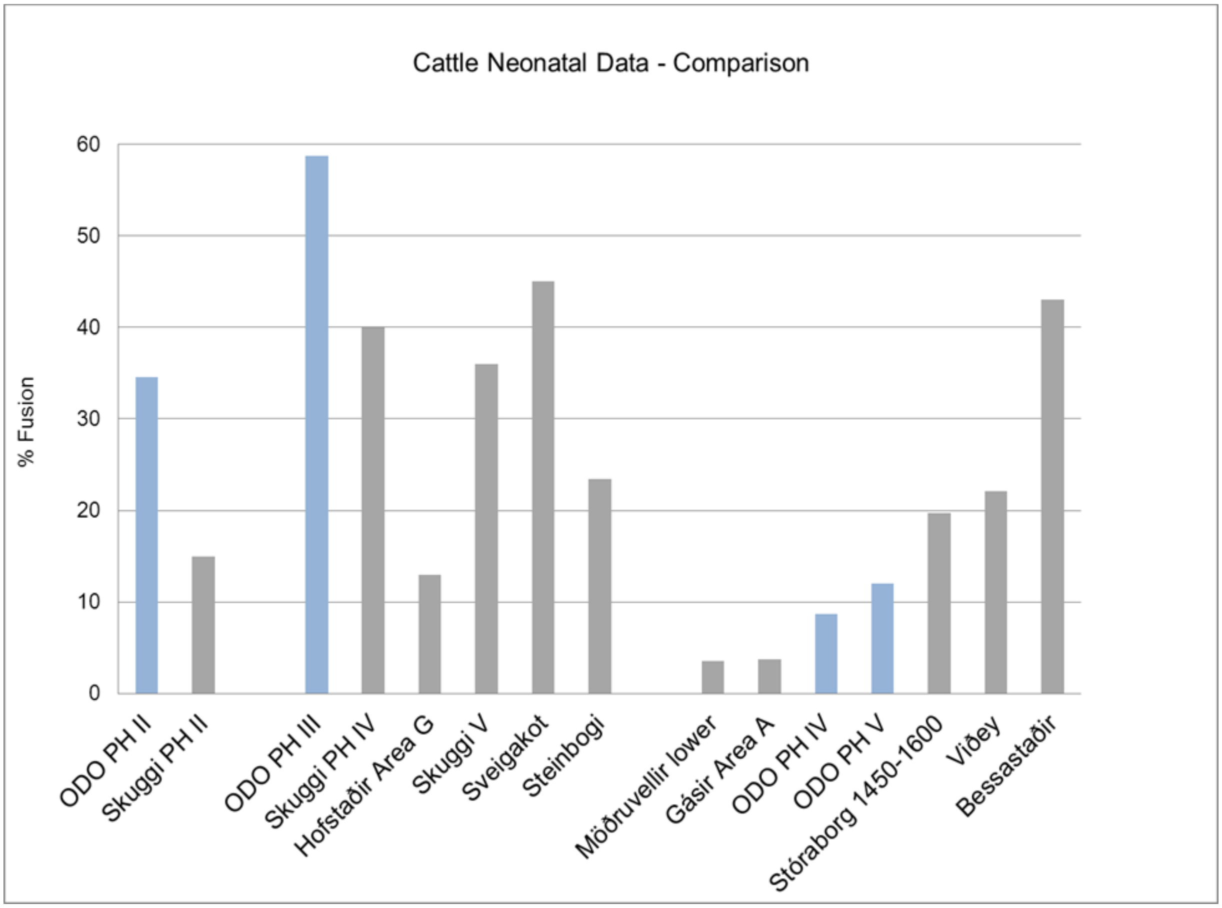


Figure 7.8. Oddstaðir cattle neonatal data compared to other Viking Age – Medieval sites from N and S Iceland. Hofstaðir (McGovern et al 2009), Sveigakot (McGovern et al 2004), and Steinbogi (Brewington et al 2004) in Mývatnssveit; Viðey in Reykjavík (Amorosi 1996, 403), Stóraborg in the Southwest (Amorosi 1996, 373), Bessastaðir (Amorosi 1996,335) close to Reykjavík,), Granastaðir (Amorosi & McGovern 1994), Skuggi, Oddstaðir, Gásir, and Möðruvellir in Eyjafjöður (SKÖ, ODÖ, Gásir, Möðruvellir data by author).

The Oddstaðir cattle neonatal graph in figure 7.8 indicates various proportions of neonatal cattle elements found in the site's four occupational phases. While the archaeofauna from Phases II and III contained neonatal elements exceeding 30 % of the total cattle elements, Phase IV and V neonatal cattle element proportions are below 15 %. It would be exceptionally useful to have a statistically meaningful number of preserved cattle tooth rows and a large number of long bones intact enough for fusion analysis from Oddstaðir, but the overall percentage of cattle neonatal bones is a robust indicator of dairy production strategies as it draws on an assessment (neonatal or not neonatal) possible on all bones of the skeleton. Except where harsh taphonomic processes differentially remove the less fully calcified bones of the young animals (as is probable in the lower layers at Möðruvellir where peat ash has increased the acidity), this proportion of adult to very young animals is one of the strongest indicators of a North Atlantic dairying economy. At the moment, no other stratified site in Iceland shows the pattern visible at Oddstaðir: A marked reduction in the deposition of very young cattle through time. A taphonomic explanation is unlikely given the fairly uniform pH readings throughout the site and the generally fine conditions of preservation evident on most of the bones (see cattle bone density discussion below).

Generally, a range of ca. 15-50 % neonates among the total cattle bone assemblage is interpreted as evidence of dairy herd management, with calves culled early on and most milk being reserved for humans (Halstead 1998). The later Oddstaðir phases coincide in time with the Gásir and lower Möðruvellir faunal collections – all from the l3th – ca. early 15th c., and potential beef production strategies at Oddstaðir require further consideration.

Age of death at time of slaughter is one indicator of a beef vs. dairy production strategy, but skeletal element distribution is another potential indicator. If parts of animals are being differentially transported from one site to another (the famous “schlepp effect”) then it is sometimes possible to identify a “kill site” vs. a “consumption site”. This is essentially the same approach as we have applied to fish skeletal elements (heads usually left at fishing sites, body parts often transported), but applied to the more complex mammalian skeleton. At W51 Sandnes in the Western Settlement in Greenland McGovern and others (McGovern et al 1996) argued for consumption of high meat value caribou butchery units at this low-altitude chieftain’s farm based on differential frequencies of meat-bearing bone elements. For detailed discussions on frequencies of skeletal parts in assessing site type and function see Lyman (1994:223-293).

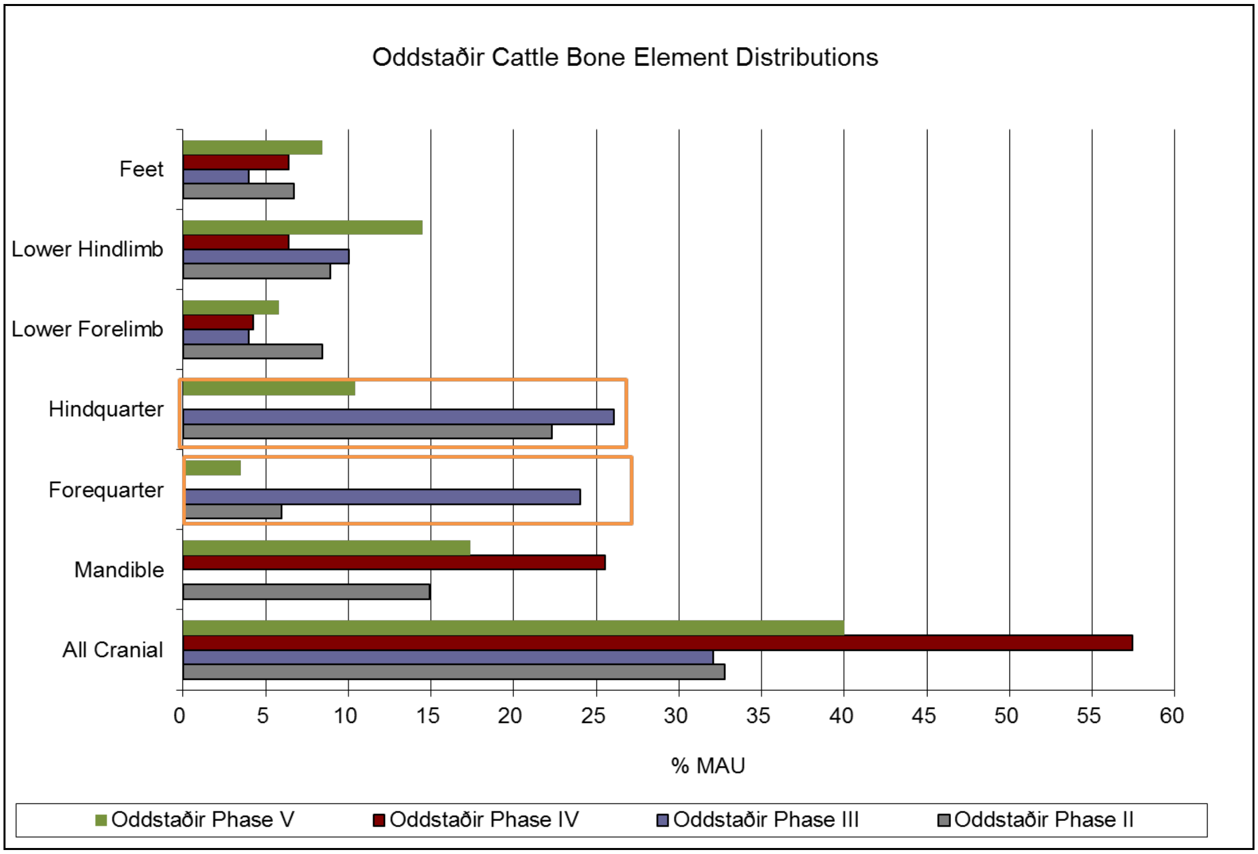


Figure 7.9. Oddstaðir cattle skeletal element distribution per phase. MAU normalizes differences in number of bones in the skeleton, so in a complete and un-fragmented cattle skeleton these bars would be equal length.

Figure 7.9 presents frequency distributions of different parts of the cattle skeleton at the four phases at Oddstaðir (normalized for skeletal element frequency to allow direct comparison of bones like toes that occur in naturally larger numbers in the skeleton than proximal humeri). Such element distribution charts combine patterns produced by taphonomy (dense bones tend to preserve better than less dense under all circumstances), but these categories deliberately combine less dense elements (like proximal humerus) with very dense elements (distal humerus, distal tibia, proximal radius) to somewhat offset these taphonomic effects. Generally feet and cranial elements tend to be discarded near the point of butchery, while meat rich hindquarter and forequarter elements are most likely to be transported for distant consumption. In most Icelandic archaeofauna of all time periods, there is much evidence of on-site butchery and most element frequency patterning can be explained by taphonomy (dogs, weathering etc. – for a thorough discussion see McGoven et al 2009).

While evidence of on-site slaughter and butchery is fully compatible with a market provisioning scenario (the animals walk to the market and are killed and dismembered there), provision of cuts of meat (that do not travel as part of whole animals) would seem to suggest intensification and perhaps some additional specialization in meat provisioning, As figure 7.9 suggests, there is a change in the Oddstaðir cattle skeletal element distribution pattern that occurs between the early and later phases. The shift appears to represent a transition from the widespread pattern of on-site household butchery of cattle and a pattern that results in an apparent deficit of major meat bearing cattle bone elements in the later phases at Oddstaðir. Besides a simple element distribution approach (as in Figure 7.9), it is possible to introduce zooarchaeological measures for the value of associated meat and marrow for individual fragments. MGUI (Modified General Utility Index (Lyman 1994:227) rankings, or portions of the animal's skeleton bearing the most food utility (i.e. muscle mass, but also marrow and sinews) are common tools applied to zooarchaeological reconstructions of differential transport of cuts of meat or kill site/ consumption site contrasts in element distribution..

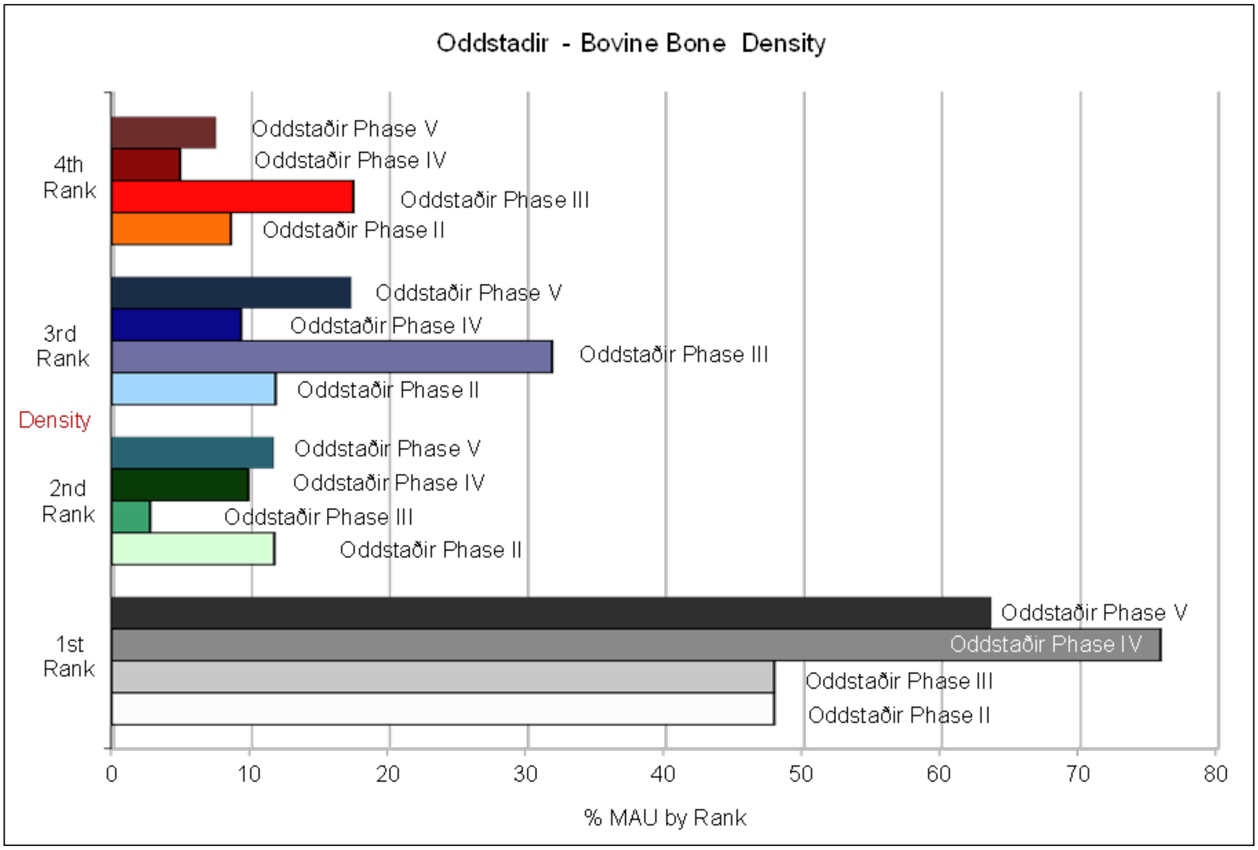


Figure 7.10. Quartile Ranked bone density distribution by phase at Oddstaðir. In all phases 1st rank density elements dominate the collections,

Figure 7.10 suggests that forces of attrition operated in broadly comparable fashion throughout the history of the site, but that the later phases show a aomewhat higher proportion of the most dense elements (which include mandibles, loose teeth, and other low-meat value elements) and lower in least dense elements (which include many upper limb bones). Overall the Oddstaðir bone density profile resembles many Icelandic archaeofauna and does not suggest the sort of radically different preservation/ attrition conditions present in lower levels at Möðruvellir or other heavily ravaged sites.

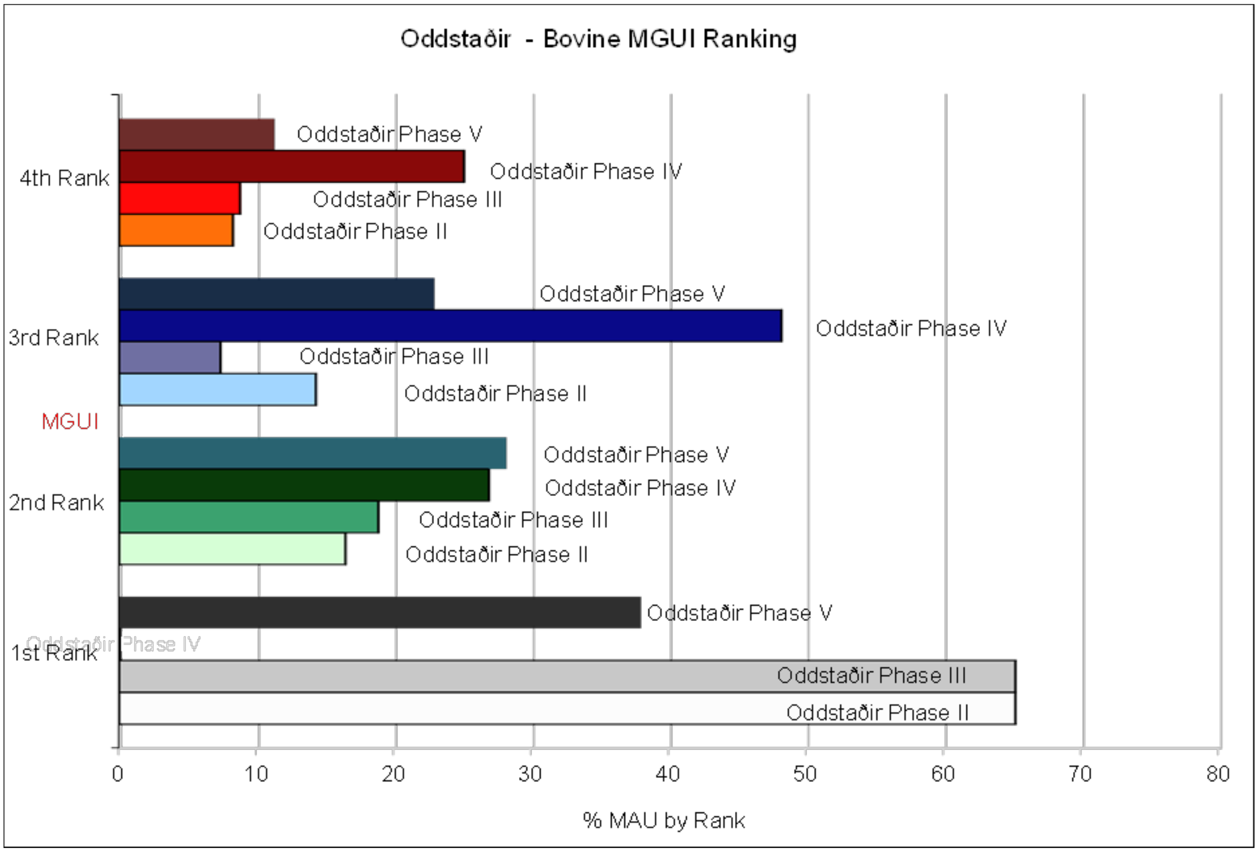


Figure 7.11. Quartile Ranked Cattle bone element MGUI scores at Oddstaðir.

Figure 7.11 presents the modified general utility index (MGUI) for the different phases at Oddstaðir. As in most cases where butchery and consumption take place in the same general area and both butchery waste and meal refuse end in the same midden deposit, there are many high MGUI values in the cattle bone assemblage from Phase 1 and II, but far fewer in the later phases. Note the different patterns in the taphonomic bone density output and the meat value MGUI output from this collection- the patterning observed is not likely to be an artifact of differential bone destruction, and is more likely to represent some actual changes in the pattern of elements deposited in the Oddstaðir site middens. This MGUI chart is effectively another (somewhat more abstracted) way of looking at the skeletal part distribution presented in figure 7.9. All three analytical approaches (element distribution, quartile rank density, quartile rank

MGUI) combine in suggesting that changes occurred in the later phases at Oddstaðir which resulted in high meat value cattle bone elements being removed from the site on a regular basis.

While there is no way to conclusively prove that these apparent cuts of beef leaving Oddstaðir match the surplus of high meat value beef bones arriving at Gásir (absent aDNA), there are a limited number of other plausible destinations in the Hörgárdalur / Eyjafjörður region given issues of transport costs for cuts of meat. At some distance it would certainly make more sense to move beef "on the hoof" as live animals to be slaughtered at the distant consumption site (and thus erasing most evidence of their presence at the production site). Möðruvellir would be the most logical other local recipient, but the patterning in the present Möðruvellir archaeofauna does not reflect the same surplus of high meat value cattle bones that is evident in the Gásir archaeofauna. Another possibility could be an outstation where animals could not be tended; and a fishing station might be such a site. At the very least, this significant change during the later Oddstaðir phases does suggest a response to something happening in the region.

7.4.1.2. Caprines

The graph in figure 7.12 below presents a caprine age-at-death assessment according to the long bone fusion data available from the various Oddstaðir occupation phases (see Reitz and Wing 1999 for information on long bone fusion during a domesticate mammal's life time). The data sets suggest 50+ % caprine survival rates until or even beyond 6 months of age for all phases, with most caprines from the Viking Age (Phase II) and early medieval times (Phase III) culled by the time they reach ca. 3.5 years of age. The distal radius data available from this collection indicate that about 50 % of the high and late medieval caprines survived until the age of 5 years and possibly beyond, suggesting the presence of relatively old animal on the farm during the later occupation phases.

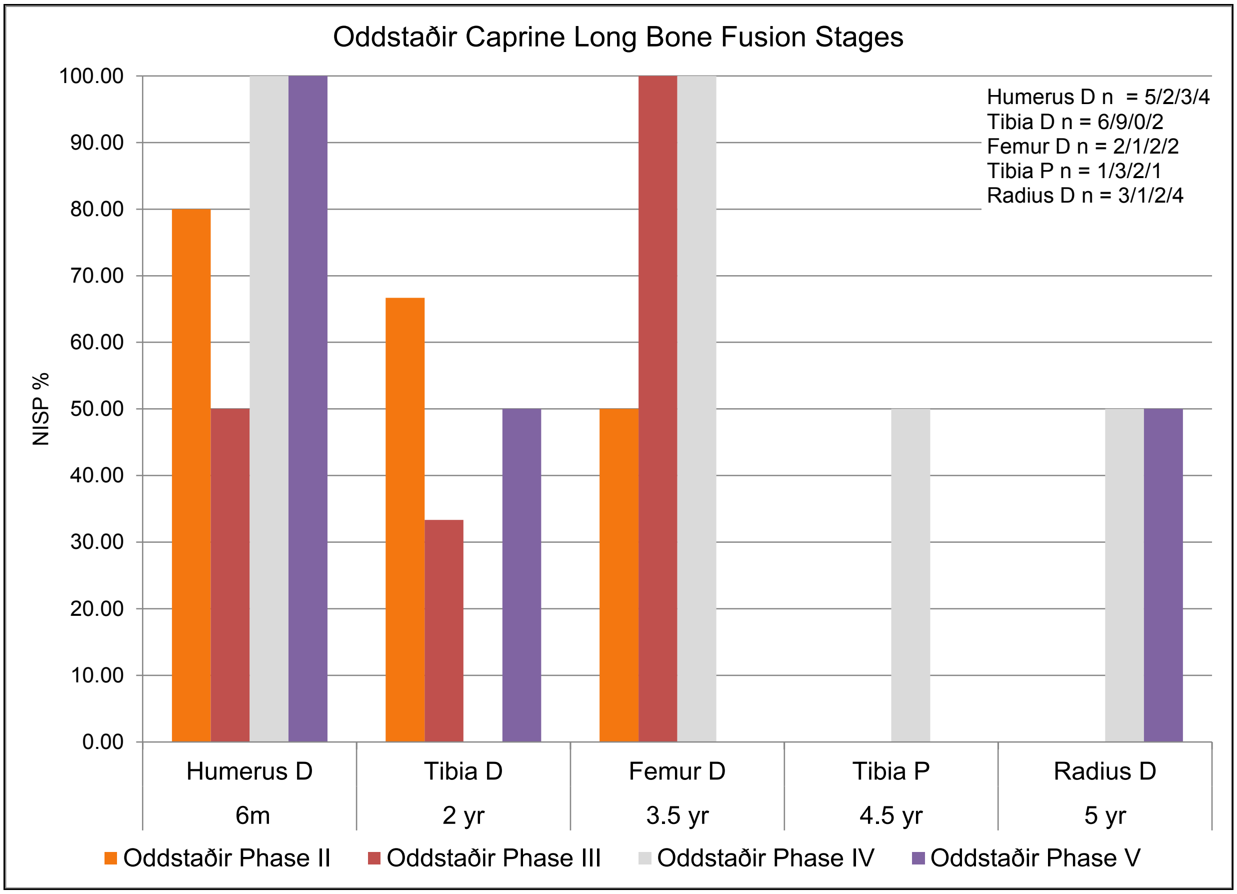


Figure 7.12. Oddstaðir Caprine Long Bone Fusion Comparison.

While interesting in itself, this data sets represent a relatively small number of individuals (the text box on the top right corner of figure 7.12 indicates the number of elements available for age assessment per element and phase), and needs to be compared to other data, i.e. the caprine tooth eruption comparison below:

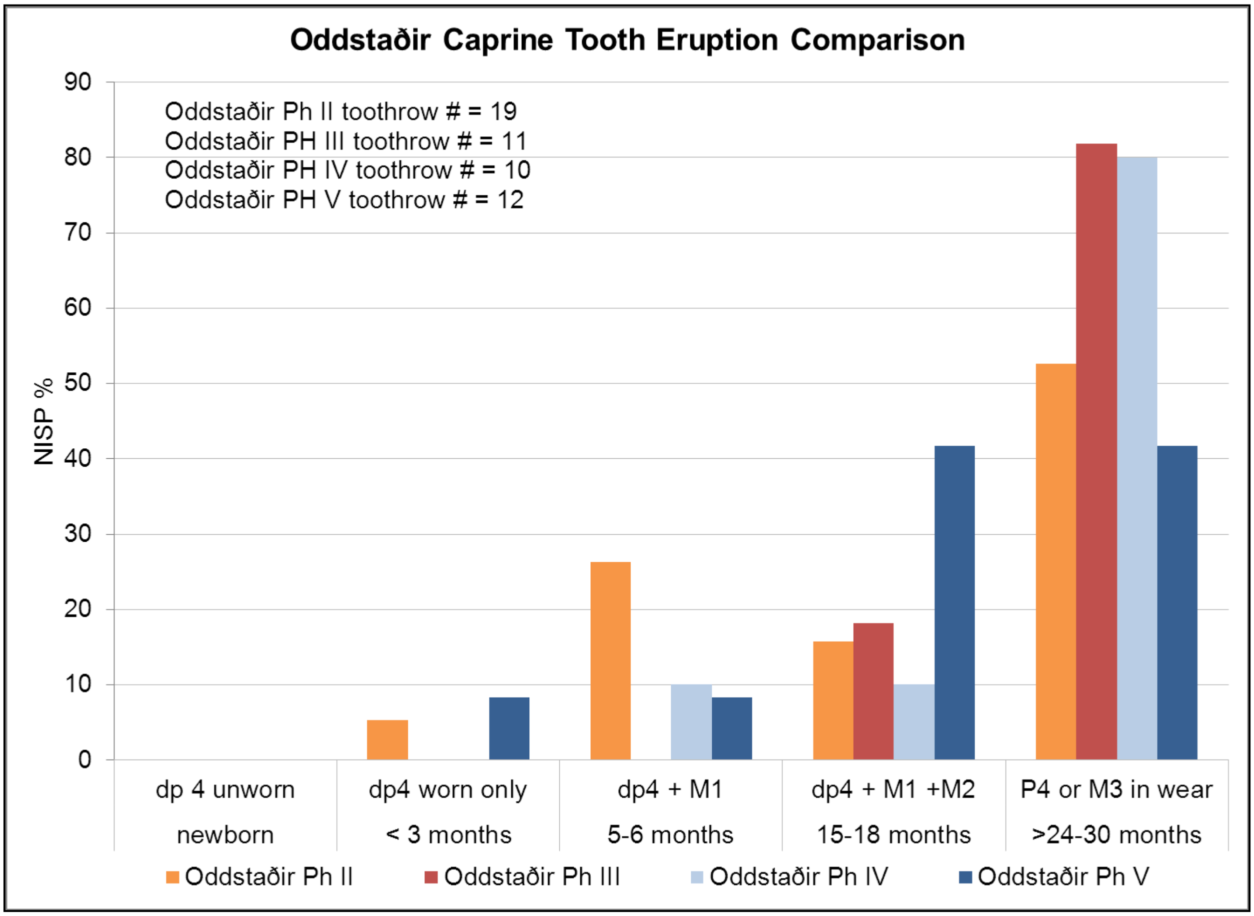


Figure 7.13. Oddstaðir caprine tooth eruption comparison.

Similar to the long bone fusion data presented in figure 7.12, the Oddstaðir caprine tooth row data in figure 7.13 indicates very few newborn sheep or goats among the Oddstaðir faunal remains, In all phases most caprines seem to have survived their first 2 - 2.5 years to full adult status, a pattern also suggested by the element fusion patterns. This is in slight contrast to the pattern at Skuggi (contemporary in its earlier phases with Oddstaðir) where the farmers more regularly culled and consumed juvenile and young adult sheep. If we assume that the Oddstaðir household in Viking to early medieval times was higher status with a larger cattle herd and more direct access to cattle milk products and beef then the relatively light caprine “prime meat” cull makes sense.

Still, the apparent difference in survivorship past the 3-4 year prime milking & reproductive period in the earlier and later phases does suggest a changing emphasis, perhaps from optimizing sheep and goat milk production towards the wool production end of the spectrum. The similarity in survivorship trends in the latest phase at Skuggi may point to a similar development near the end of that farm’s occupation and prior to its possible replacement by the nearby sheep station at Klausturhús, if that happened after Skuggi farm abandonment.

However, the pattern of sheep and goat mix in the Oddstaðir flocks as reflected in the identifiable sheep and goat bones (Figure 7.14 below) does not suggest a complete shift towards wool production. While there may have been a dip in goat relative numbers in the pre-Gásir early medieval period, in Phase IV and V goats were back to their Viking Age proportion of 15-20% of identifiable bones. Taken together the evidence for caprine herding at Oddstaðir may indicate some changes possibly associated with somewhat intensified wool production, but it is clear that Oddstaðir never became specialized in sheep wool production.

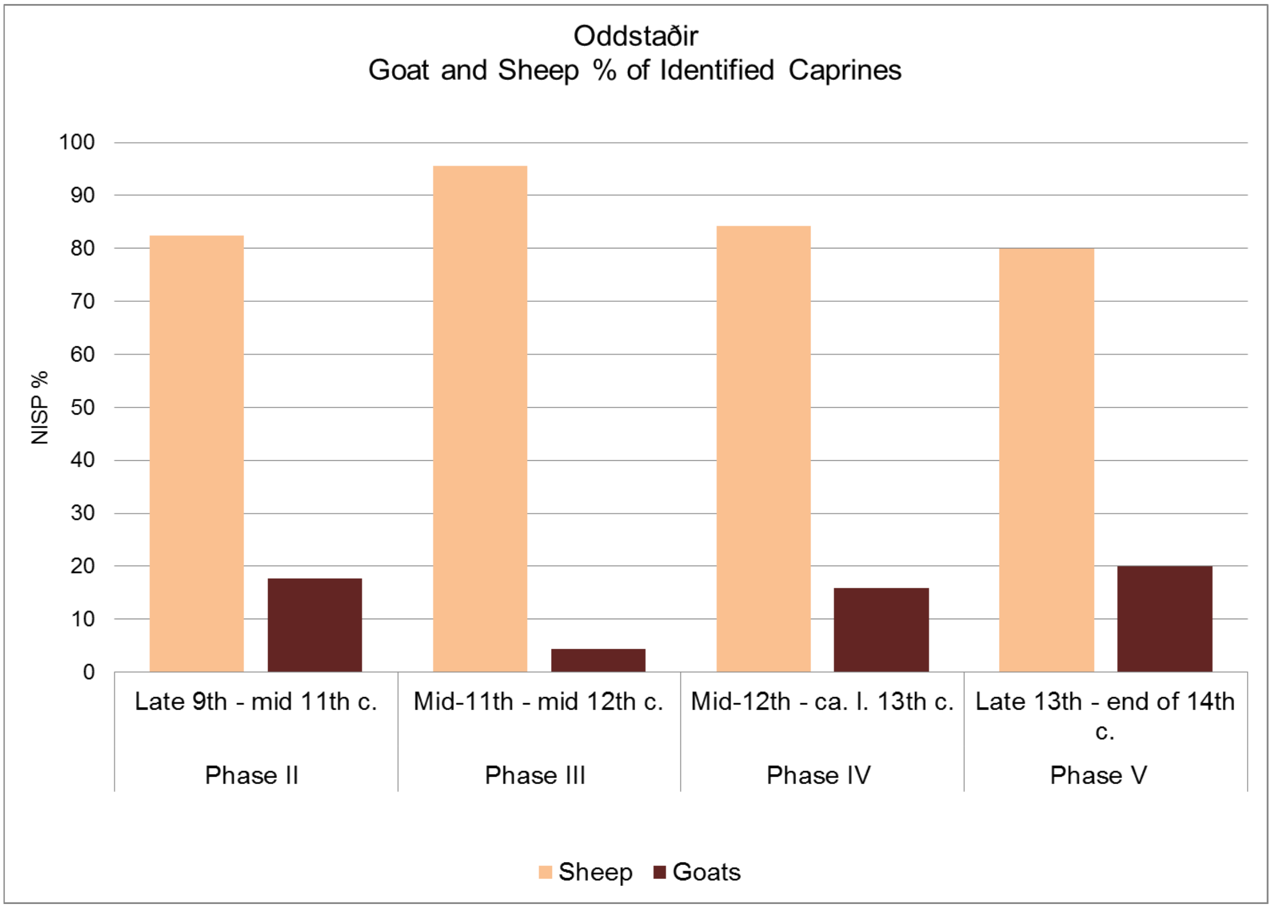


Figure 7.14. Oddstaðir identified sheep and goat bones.

Figure 7.15 below illustrates the phased Oddstaðir caprine skeletal element distributions. A relatively large amount of cranial elements (at least 30 % in all phases) is not surprising, since these elements break easily while the mandibular elements preserve very well and are thus possibly present in higher numbers than other skeletal elements.

It further indicates that the ovi/caprines whose skeletal remains were found at Oddstaðir, TR1, were probably butchered on site and likely also raised on the farm. This skeletal distribution data does not clearly indicate the lack of a significant element or series of elements correlating with a certain cut of meat. However, the fore-and hindquarter percentages from

Phases IV and V are somewhat lower when compared to the cranial elements in comparison with the Phase II and III proportions. Again, the fact that the available data sets are not very large needs to be kept in mind.

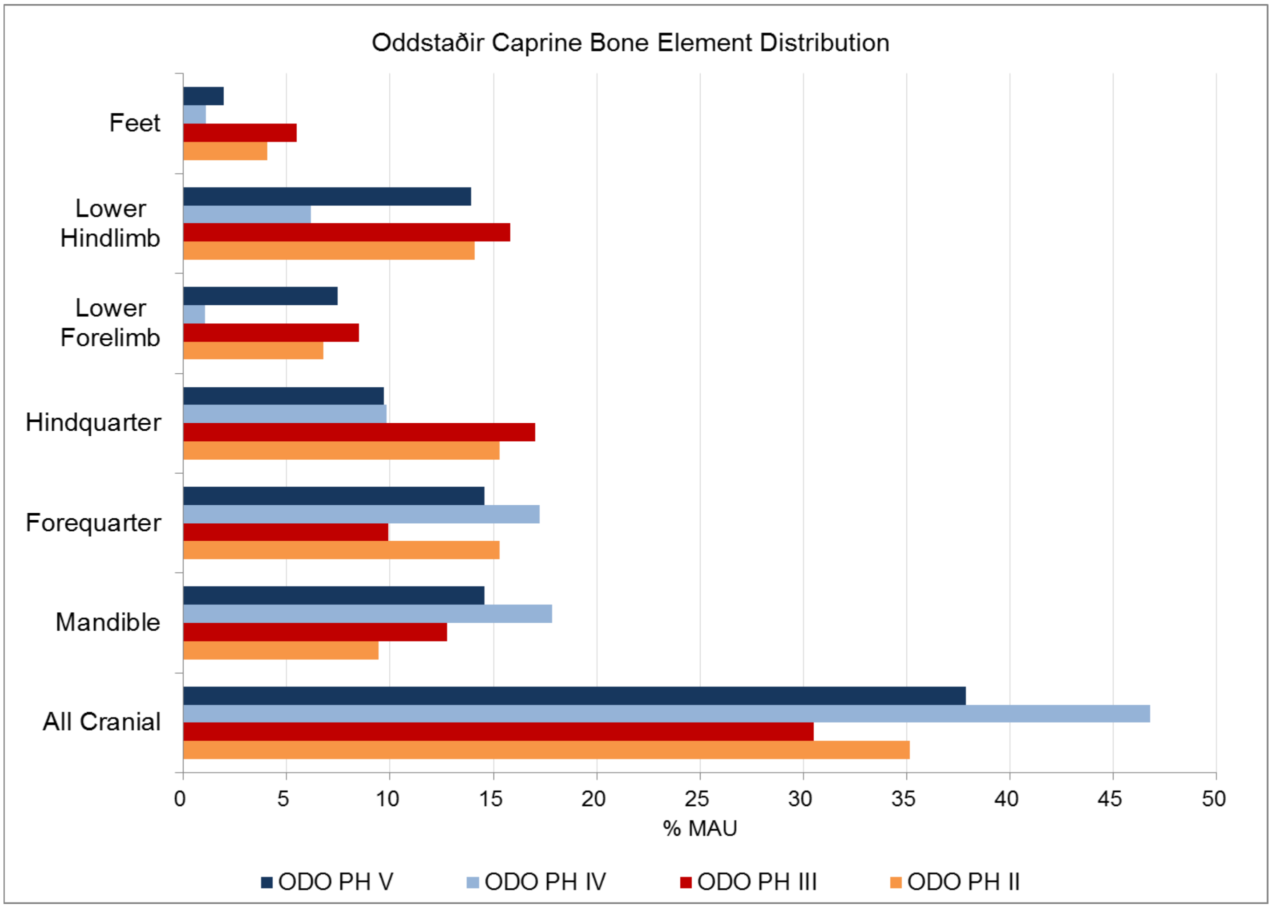


Figure 7.15. Oddstaðir caprine skeletal element distribution per phase.

7.4.1.3. Horse

Phasing	Context	Species	Skeletal element	Count
Phase V	104	Equus caballus	Maxillary fragment	1
Phase II	144	Equus caballus	Distal Phalanx	1
Phase II	158	Equus caballus	Mandibular molar	1
Phase II	160	Equus caballus	Metapodial	1

Table 7.4. Oddstaðir – contexts producing equine skeletal elements.

Three of the horse bones recovered from TR1 were from the earliest midden deposits; the fourth horse element found was retrieved from Phase V.

7.4.1.4. Pigs

The Oddstaðir midden trench produced 32 pig elements, 23 (72 %) of which were found in Phase II, and 6 (19 %) in Phase III, with an additional 1 (3 %) from Phase IV and 2 (6 %) from Phase V of the upper midden deposits.

Table listing Oddstaðir pig elements per unit and phase.

Midden_phase	Unit	Species	Bone	NISP
Phase V	107	Sus scrofa	Premolar	1
Phase V	142	Sus scrofa	Incisor	1
				2
Phase IV	119	Sus scrofa	2nd Phalanx	1
Phase III	121	Sus scrofa	Innominate	1
Phase III	121	Sus scrofa	Metapodial	1
Phase III	122	Sus scrofa	Metapodial	1
Phase III	131	Sus scrofa	3rd Phalanx	1
Phase III	131	Sus scrofa	Ulna	1
Phase III	134	Sus scrofa	Astragalus	1
Phase III				6
Phase II	137	Sus scrofa	Incisor	1
Phase II	137	Sus scrofa	Incisor	2
Phase II	139	Sus scrofa	Metapodial	1
Phase II	144	Sus scrofa	Incisor	2
Phase II	144	Sus scrofa	2nd Phalanx	1
Phase II	144	Sus scrofa	Tibia	1
Phase II	144	Sus scrofa	Tooth fragment	1
Phase II	152	Sus scrofa	Incisor	1
Phase II	152	Sus scrofa	Molar	2
Phase II	153	Sus scrofa	Incisor	1

Table listing Oddstaðir pig elements per unit and phase continued

Phase II	153	Sus scrofa	Tibia	1
Phase II	155	Sus scrofa	Incisor	2
Phase II	155	Sus scrofa	Tooth fragment	1
Phase II	157	Sus scrofa	Incisor	1
Phase II	157	Sus scrofa	Incisor	1
Phase II	157	Sus scrofa	Molar	1
Phase II	157	Sus scrofa	Ulna	1
Phase II	158	Sus scrofa	2nd Phalanx	1
Phase II	161	Sus scrofa	Mandibular fragment	1
				23

Table 7.5. Oddstaðir pigs by phases.

Table 7.5 represents the Oddstaðir pig elements by midden phase and context. Contexts listed with more than one element, especially teeth, could have contained several pig skeletons, but it is also likely that several elements of the same pig were found. The pig assemblage seems to be dominated by maxillary and mandibular elements and thus may indicate that these animals were kept at Oddstaðir and possibly culled on site.

7.4.1.5. Dogs

Only one set of elements belonging to the same individual was retrieved from TR1. A fragmentary maxilla from context [108] of Phase V (late 13th to late 14th c.) was found to articulate with left and right premaxillary fragments, part of the occipital bone, part of an innominate fragment, and one lumbar vertebra. Upon the author's closer examination, this skull closely resembles the one retrieved from the Gásir later medieval context [2812] (Harrison 2009), which most likely belongs to a small sized dog, likely a lap dog (see also Harrison et al. 2008 for discussion on the Gásir dogs). Chapter 2 discusses the potential meaning of this and lap dog sized elements retrieved from the Gásir lap dog elements at length.

Table 7.6 presents a list of contexts containing faunal elements with dog gnawing marks (n=7) and potential dog gnawing marks (n=8). Contexts from *Phase IV* contained the most bones potentially bearing dog gnawing marks, indicating that dogs may have had easier access to the bone materials from this phase than others. However, the total amount of elements with dog gnawing marks is too small to argue for a faunal collection significantly altered by dogs (see McGovern et al 2009 for a discussion on dogs´ access to certain areas in the Hofstaðir household).

Context	Midden phase	dog tooth marks	possible dog tooth marks
104	Phase V		1
108	Phase V	2	
119	Phase IV	2	6
120	Phase III	1	
144	Phase II	1	1
152	Phase II	1	
Total		7	8

Table 7.6. Contexts with faunal elements displaying confirmed and potential dog tooth marks.

7.5. Wild Mammals

The Oddstaðir archaeofauna analyzed to date only revealed 10 seal elements, none of which could be analyzed to species beyond the very general phocid category.

7.5.1. *Seals*

Phasing	Context	Species	Bone	Count
Phase III - ca. mid-11th - mid 12th c.	120	Phocid	Rib	1
Phase III - ca. mid-11th - mid 12th c.	131	Phocid	Cervical vertebrae	1
Phase II - ca. late 9th - mid 11th c.	140	Phocid	Thoracic vertebrae	2
Phase II - ca. late 9th - mid 11th c.	140	Phocid	Rib	1
Phase II - ca. late 9th - mid 11th c.	140	Phocid	Metacarpal	1
Phase II - ca. late 9th - mid 11th c.	144	Phocid	Rib	3
Phase II - ca. late 9th - mid 11th c.	157	Phocid	Vertebral fragment	1
Total				10 (5)

Table 7.7. Phocid remains by phase and context.

A total of ten unidentifiable seal elements were retrieved from Phases II and III, the Viking Age and early medieval occupation phases from TR 1. All seal elements were placed into a general phocid family category, as none of them displayed specific enough morphological signatures. The elements are of Harbor Seal (*Phoca vitulina* (L.)) size. As is true also for the gray seals (*Halichoerus grypus* (L.), harbor seals give birth to their young on Iceland's sandy beaches along coastal strips.

As mentioned in Chapters 4 and 6, harbor seals were predominantly netted in spring (Kristjánsson 1989:447), and there used to be a series of known seal hunting areas along Eyjafjörður (Kristjánsson 1989:315) where these individuals may have been caught. Although no obvious skeletal articulation was detected during excavation, the four phocid elements from context [140] may be from one individual, as may be the three phocid ribs recovered from context [144], in which case there would only be three individuals from the earliest midden phase, and two from the next one, bringing the Oddstaðir seal count to a total of five.

7.6. Birds

From a total of 109 avian skeletal elements, 38 could be analyzed to family or species level. The majority of the analyzed Oddstaðir avian elements belonged to sea birds, specifically the auk family species. Both Uria species' skeletal elements are very similar to each other and were thus placed into the Murre species category rather than labeled as either Guillemot (*Uria aalge*) or Common Murre (*Uria lomvia*). These sea birds can be found along the sandy beaches and coastal waters of Eyjafjörður (and all of Iceland) in the winter (Hilmarsson 2000:30-31). These were potentially a seasonal food species to improve the available winter diet.

Oddstaðir	Midden Phases					
Bird species count	Phase II		Phase III		Phase V	
Identified Bird Species	NISP	% NISP	NISP	% NISP	NISP	% NISP
Migratory Waterfowl						
Anser species (Goose family)	1	5	8	44		
Sea birds						
Common gull (*Larus canus*)	1	5				
Gull sp. (Larus sp.)	2	11	2	11		
Black-headed gull (*Larus ridibundum)*			1	6		
Razorbill (*Alca torda*)	1	5				
Murre species (Uria species)	9	47	5	28		
Auk family (Alcid familie)	4	21	2	11	1	100
Non Migratory Terrestrials						
(Ptarmigan/grouse (*Lagopus muta*)	1	5				

Table 7.8. Oddstaðir - Bird Species identified to family or species level.

Other sea bird elements found in the midden trench were from gull species, possibly scavengers killed on site and dumped on the garbage rather than eaten. These wild species were retrieved from Phase II and III deposits. Geese, especially during the Early Middle Ages (Phase

III) seem to have been the migratory waterfowl of choice – they could have even been domesticated birds kept on the Oddstaðir farm rather than caught while on their seasonal round.

The high medieval layers did not produce any bird elements identifiable to species or family level, and only one auk element was identified from the later medieval deposits. One ptarmigan element retrieved from the earliest deposits indicates that this terrestrial fowl was possibly available to the Oddstaðir residents, at least during the early occupation of the site. More analysis is necessary to gain a better idea on bird consumption at Oddstaðir. A distinct preference for sea birds over other species was found at Oddstaðir which is located far enough inland to suggest that the residents made trips to the coast during the winter to possibly partake in sea bird hunting exercises. Alternatively, these seabirds were part of the local food exchange and supply during the Settlement and following early medieval phases.

7.7. Fish

7.7.1. *Marine Fish*

The total Oddstaðir fish assemblage analyzed at this date consists of marine species. Even though the Hörgá is known as excellent Char and Trout fishing river, no fresh water fish bones were found in the Oddstaðir archaeofauna (http://www.angling.is/en/waters/silungsveidiar/a-nordausturlandi/6479/). This lack in freshwater fish bones among all the Hörgárdalur faunal remains (see Harrison 2009, 2011a, b) may have various reasons (see Chapter 4 and 6 for discussion). Potentially, there was no exchange / consumption of fresh water fish taking place, or, there were limited numbers available.. Another option could be that Oddstaðir land simply did not reach the Hörgá and therefore its residents could not fish there.

The Viking Age (Phase II) marine fish assemblage contained 384 total fish elements, with 14 speciated to Cod (*Gadus morhua* (L.)), 9 to Haddock ((*Melanogrammus aeglefinus* (L.)), 6 to Saithe (*Pollachius virens* (L.)), 123 to the gadid category, and 2 elements were determined as Halibut (*Hippoglossus hippoglossus* (L.)). Presence of these elements suggests occasional consumption of marine fish at Oddstaðir.

The Oddstaðir medieval fish assemblages also consisted of marine fish, with 329 elements present in the early medieval layer (Phase III). Of those, 25 could be speciated to Atlantic Cod (*Gadus morhua* (L.)), 10 to Haddock ((*Melanogrammus aeglefinus* (L.)), another 16 to Saithe (*Pollachius virens* (L.)), and 2 to Cusk (*Brosme brosme* (L.). A total of 105 elements were assigned to the gadid family, and 5 could be identified as Halibut (*Hippoglossus hippoglossus* (L.)). The upper midden phases, Phases IV and V contained lower amounts of marine fish remains, with a total of 104 and 102 fish elements counted, respectively. Phase IV, the high medieval faunal collection, contained 3 elements of Saithe (*Pollachius virens* (L.)); 26 elements placed into the gadid category. In Phase V, the later medieval faunal collection, 1 element was speciated to Cod (*Gadus morhua* (L.)) element, 14 to Haddock (*Melanogrammus aeglefinus* (L.)), and 21 to the gadid category.

From the upper midden fish collections, only gadid remains could be identified to species or family level, and species diversities were not as high as in the lower and middle midden deposits.

7.7.1.1. Gadid Species

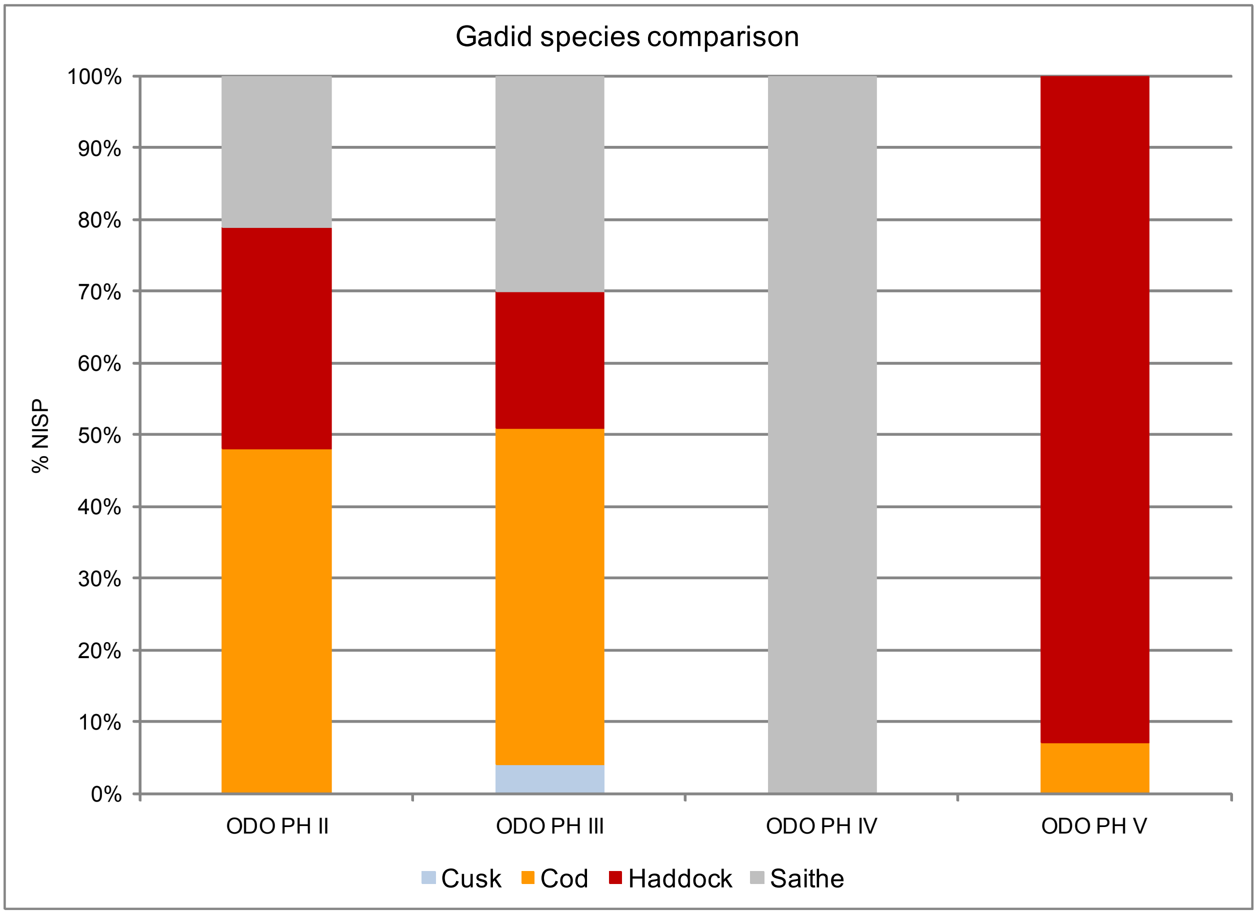


Figure 7.16. Oddstaðir gadid species comparison.

Figure 7.16 graphs the distribution of identified cod-family marine fish bones in the deposits at Oddstaðir. While sample size issues are important limitations (especially in the later phases where the total number of marine fish bones is lower), it is clear that there were a range of marine fish being consumed at Oddstaðir. This pattern (especially in the earlier phases) parallels species diversity evident in the multiple Mývatnssveit archaeofauna dating to the Viking age and early medieval periods (McGovern et al 2006, 2009). As Perdikaris (1999 et seq) has argued, such high species diversity of fish entering into the exchange networks that eventually brought them to inland sites is characteristic of pre-commercial artisanal fisheries dating back to the Early Iron Age in Northern Norway. Unlike the later fully commercialized and commoditized cod dominated export trade of the late Middle Ages and Early Modern periods, early Icelandic consumers (like their Iron Age Nordic ancestors) were clearly willing to accept a good deal of variability in the species they consumed.

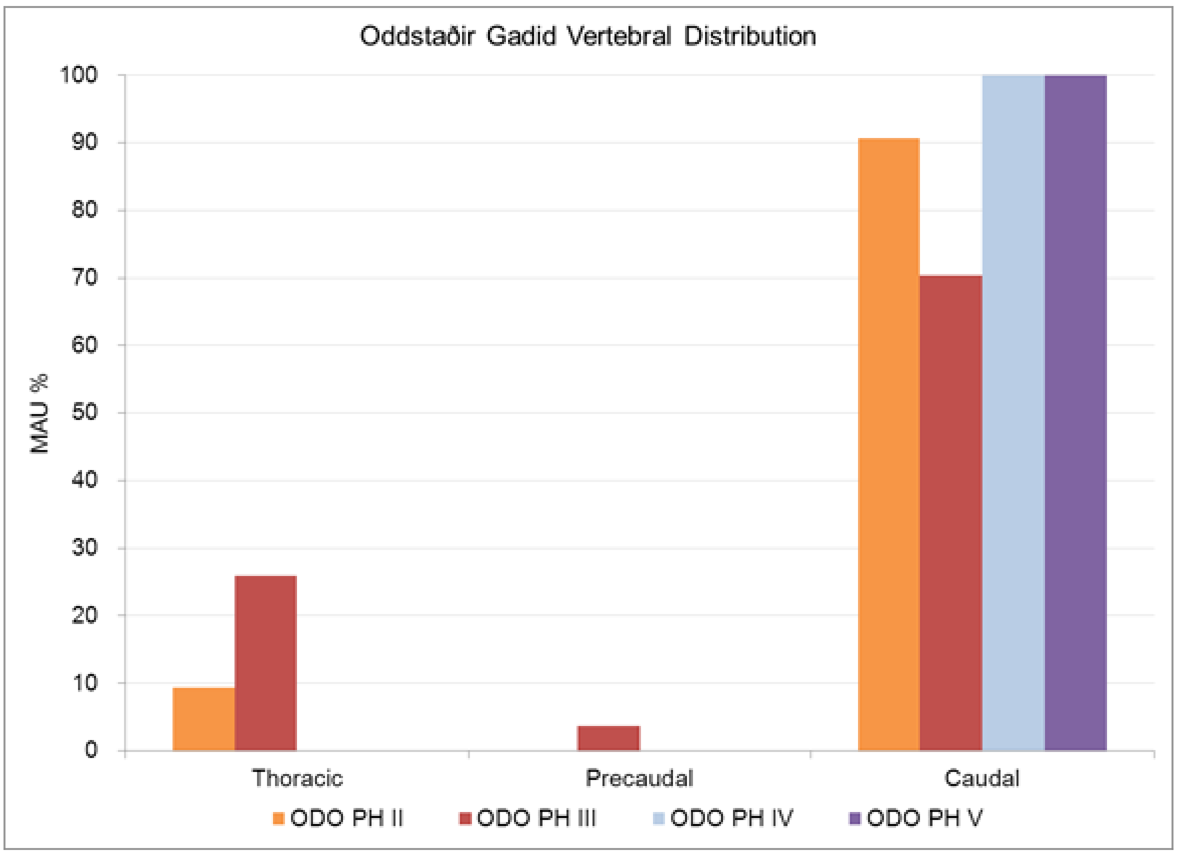


Figure 7.17. Oddstaðir gadid vertebral series distribution.

The Oddstaðir gadid vertebral series distribution analysis (adjusted here for different skeletal element numbers through MAU%) indicates that in the high and later medieval periods, only the caudal vertebrae made it to the site, while some elements of the thoracic (Phase II and III) and a few of the precaudal (Phase III) part of the vertebral column were also present in the earlier occupation deposits. Two broad patterns of fish preparation for air drying have been identified in the zooarchaeological record: a round dried product (sometimes labeled "stockfish") that contains the cleithrum and a full set of thoracic (upper body), precaudal (mid- body), and caudal (tail) vertebrae; the other a flat dried product (sometimes labeled "klipfisk") that contains the cleithrum and only the caudal and a few pre-caudal vertebrae (Perdikaris 1999, Amundsen et al, 2004, Krivogorskaya et al. 2005). While the Oddstaðir vertebral element distribution seems to reflect a clear predominance of the flat dried product (perhaps especially in the later phases), it is significant that there is also some variability (especially in the earlier phases) that suggests that multiple products were reaching the Oddstaðir household, possibly including both round dried and some fresh (un-dried) fish.

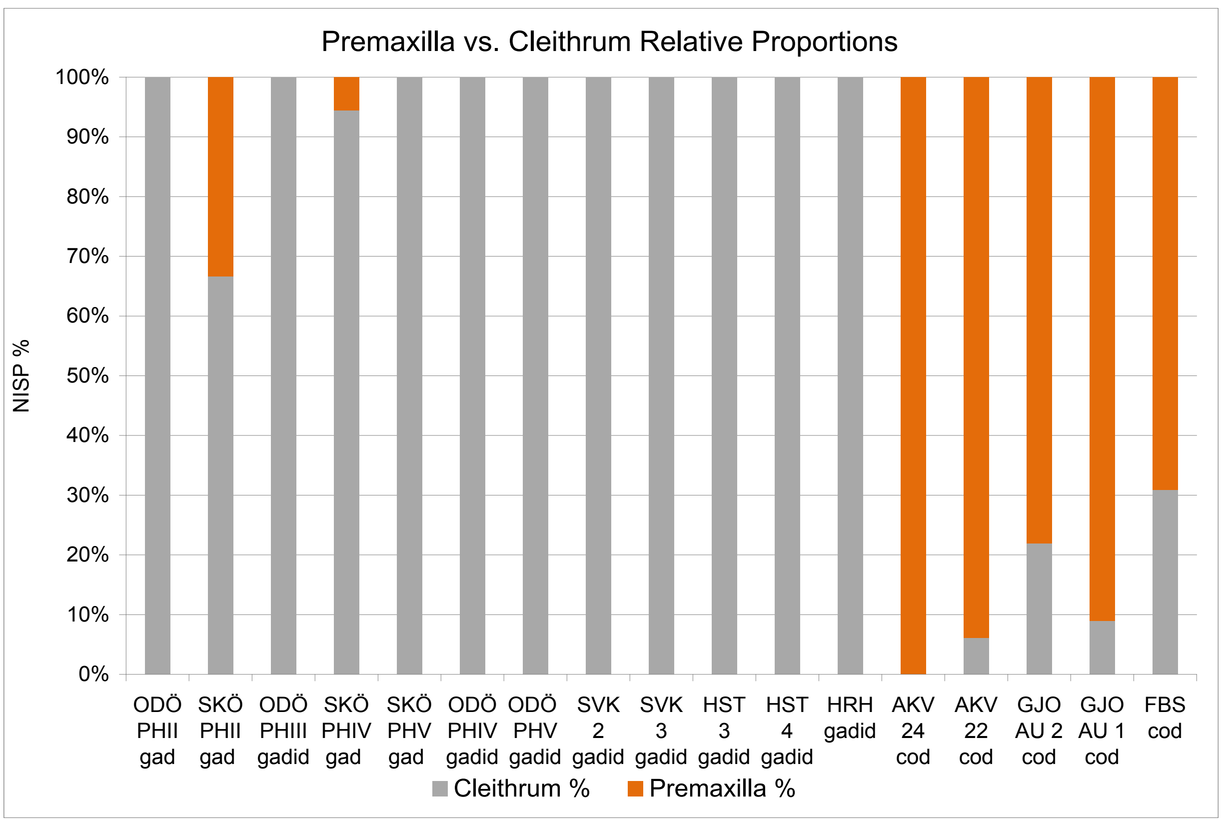


Figure 7.18. Gadid premaxilla vs. cleithrum relative proportions. Hofstaðir, Sveigakot and Hrísheimar (McGovern et al 2007, Perdikaris & McGovern 2008), all three are "consumer" sites

in Mývantssveit and three coastal medieval fish "producer" sites in northwest Iceland (Akurvík, Gjögur and Finnbogastaðir (Krivogorskaya et al 2005, Amundsen et al 2005, Perdikaris & McGovern 2008) in comparison with Skuggi and Oddstaðir (Harrison 2010, 2011).

The relative proportion of two paired and approximately equally large and dense fish skeletal elements that occur in the same number in the fish skeleton (cleithrum in the gill area and premaxilla in the upper jaw) have been extensively used to identify production and consumption sites in Iceland and elsewhere in the North Atlantic. The cleithrum is left in the exported headless dried product under all known processing techniques, while the premaxilla tends to remain with the cut off fish head at the processing point. Since these two bones appear in equal numbers in the live fish (two each) a deposit containing mainly complete fish skeletons will show a nearly even ratio of these elements (Perdikaris & McGovern 2007, 2008). The graph in figure 7.18 compares the inland Oddstaðir farm site with several other sites that exhibit a certain gadid skeletal element profile: the Sveigakot, Hofstaðir, and Hrísheimar data presented here are from Viking Age deposits of farmsteads in Mývatnssveit, containing considerable proportions of marine fish, especially gadids (Perdikaris and McGovern 2008). These inland sites are compared to others, from the coasts of the Icelandic West Fjords. Akurvík is a fishing station with medieval cultural deposits from the 12th – mid-15th c, and Gjögur is a medieval fishing farm with access to coastal areas (Krivogorskaya et al. 2005). Finnbogastaðir is an early modern coastal farmstead whose inhabitants may have mostly used a dried fish product for subsistence (Edvardsson et al. 2004).

The premaxilla/cleithrum proportion comparisons in figure 20 indicate that far more gadid post-cranial bones than cranial elements were present in the Oddstaðir faunal collection during all phases (i.e. Perdikaris and McGovern 2008, McGovern et al. 2009). Oddstaðir shows no premaxillae at all in any phase to balance the cleithrum finds, while Skuggi does show a few premaxillae as well as a strongly disproportionate number of cleithra. Oddstaðir lies about 20 km inland from the closest marine waters, and the site's gadid skeletal profiles so far suggest an occasional supply with a processed marine fish product (gadid species and a few Halibut in the earlier phases) rather than a fresh fish brought to the site and processed there.

The Skuggi archaeofauna may reflect either a mix of on-site butchery and dried product import or potentially some consumption of the dried fish heads documented from Early Modern archaeofauna and ethnography (Hicks et al *forthcoming*). The overall pattern suggests a continued participation in a somewhat variable artisanal provisioning network at Oddstaðir, though reduced somewhat in scale in the later phases.

Figure 7.19. Haddock gaming piece from context [137], Phase II (scale: 1 square = 1 cm).

This gaming piece strongly resembles a chess pieces and was made from Haddock cleithrum. It was found in the Phase II midden deposits (context [137]) and indicates that people living at Oddstaðir may have played board games during their leisure time. Six unworked Haddock cleithra were also found in these deposits; this artifact might have been saved for carving upon consumption of a fish meal either at Oddstaðir or elsewhere. Haddock cleithra were in use for carving objects until very recently (Kristjánsson V. 1989, Batey 2011:45).

7.8. Mollusks

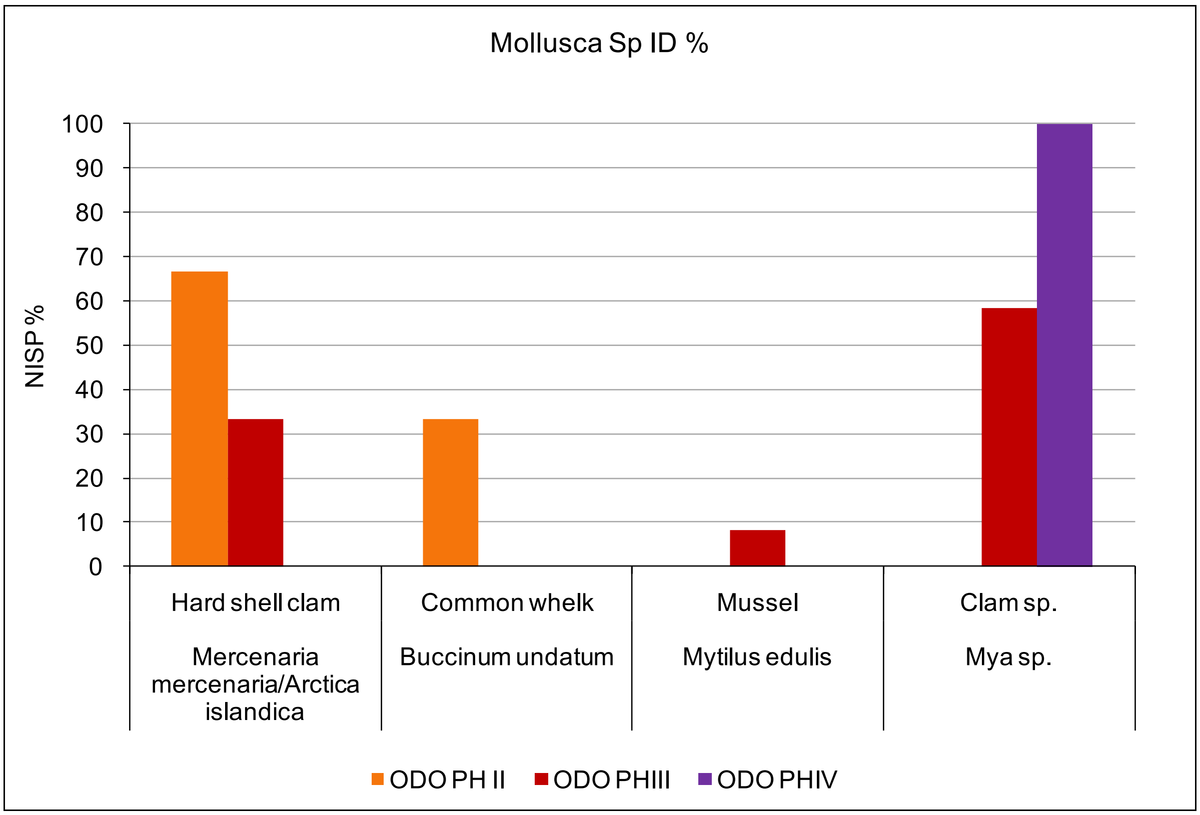


Figure 7.20. Oddstaðir Mollusks.

The mollusks identified to species/family level are all native to Icelandic waters and were all most likely consumed by humans rather than used as bait (Kristjánsson I, pp 147-151). Only one speciated mollusk was collected from the Phase IV, and none from Phase V. The lowest midden deposits (Phase II) contained three identifiable mollusks, and Phase III contained 12. The total Oddstaðir mollusk assemblage identified to family or species level therefore was very small. Considering the geographic location, the hard-shell clam remains are likely those of *Arctica islandica*, an edible, long-living, intertidal clam still used commercially in Iceland; caught also in Eyjafjörður (www.fisheries.is/ main-species/invertebrates/ocean-quahog/). Traditionally, *Arctica islandica* (Isl. *kúfskel/kúskel)* was one of the most prevalent shellfish species collected for human consumption Kristjánsson I:144-151). The shells were also used as scoops. The complete absence of shellfish in Phase V, the late 13th to earl 15th c. deposits, and the minimum amount present in Phase IV, the mid-12th to late 13th c. deposits indicates that this marine resource had become obsolete.

7.9. Burning

Throughout all occupation phases, the majority of the Oddstaðir bones were not burnt, with generally less than 20 % of elements burnt or scorched. The Phase V deposits are an exception, with close to 35 % of the faunal material exposed to fire, and almost 1/3 (31.6%) of the analyzed bones calcined, or burnt white. When a bone is exposed to high temperatures for a significant amount of time, all its organic components break down and only the inorganic ones remain.

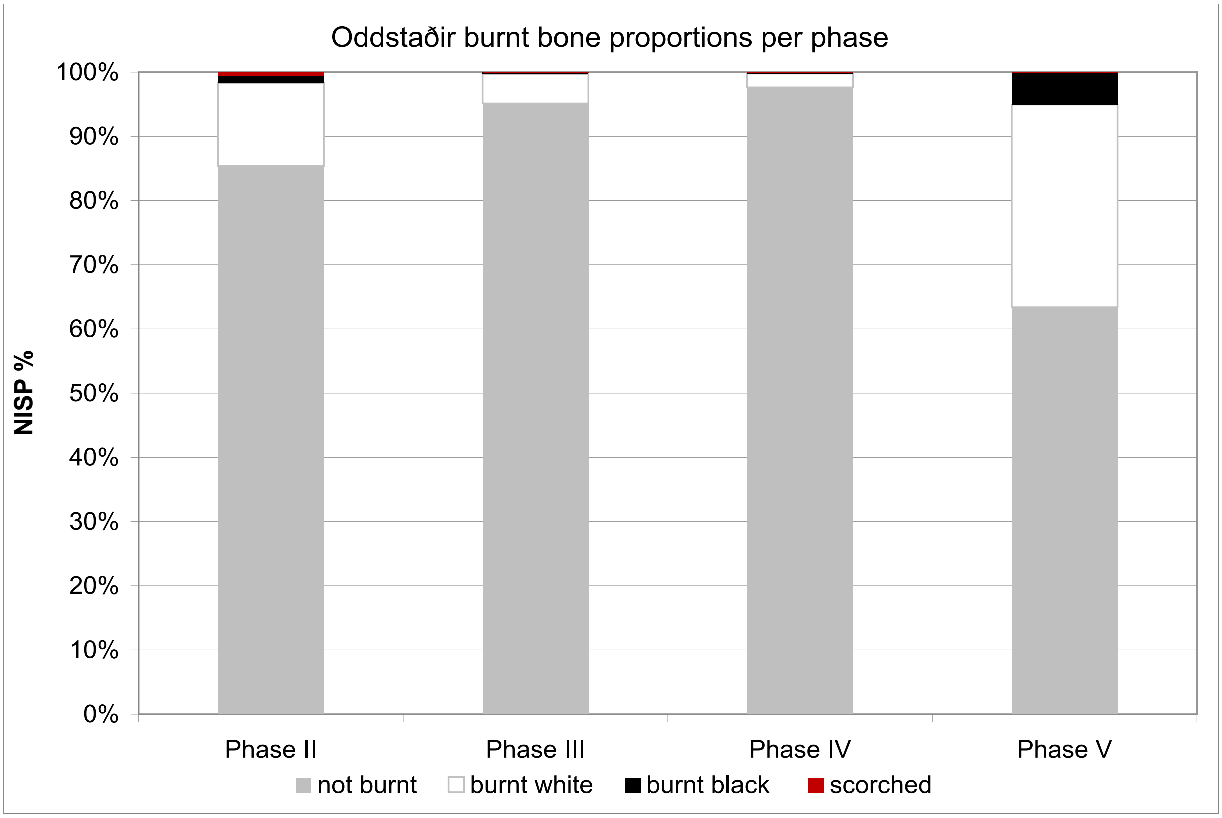


Figure 7.21. Percentage of burnt bones per context.

The overall Eyjafjörður bone burning comparison in figure 17.22 below was included to demonstrate that while both Oddstaðir and Möðruvellir had high proportions of burnt bone elements in their high medieval phases. While the Möðruvellir medieval bones were subject to post-depositional attrition, the Oddstaðir ph levels were consistent and indicative of good organic preservation at that site. Therefore, the Oddstaðir Phase V proportion of burnt bone suggests a potential change in either deposition location of burnt bone or in fuel strategy. The Möðruvellir burning profile with more than 50% of the retrieved bone fragments burnt is an indication of poor preservation conditions having affected the non-burnt portion of the collection, leaving mostly the calcined remains behind. Fuel ash data from micromorphological and soil chemistry analysis potentially helpful in explaining these patterns are still being processed.

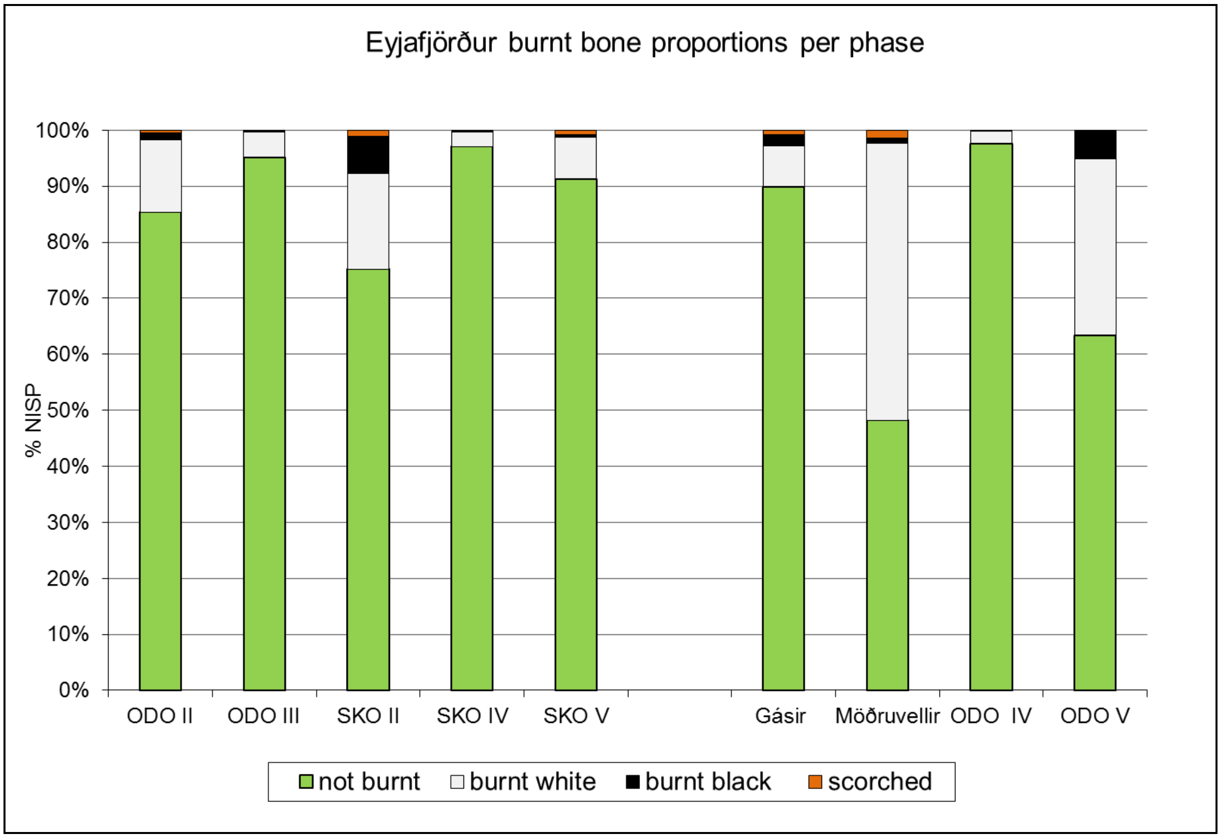


Figure 7.22. Comparison of burnt bone proportion per site and phase.

7.10. Butchery

The prevalent butchery signatures found on the Oddstaðir skeletal remains were chopping and splitting. The long bone fragments and especially caprine metapodia from this collection seem to have been split for marrow consumption rather than bi-perforated (see discussion on bi-perforation below and in Gásir data chapter 4).

Out of the current Oddstaðir TNF of 9,055, 3.27 % (296 elements) bore potential butchery marks, including chop marks, knife marks, split elements, and impact marks from tools used for splitting bone.

Only two (0.04 %) of the 49 Oddstaðir caprine lower leg bones (metapodia) had one hole drilled either on the proximal or distal end, possibly an early if likely failed attempt to facilitate marrow extraction. Both elements were whole elements with fused distal ends and were retrieved from the same context (104) from Phase V, associated with the late 13th to late 14th c. midden deposits. The rest of the site´s lower leg bone elements were all split, often displaying impact marks. None of the Oddstaðir metapodia displayed the bi-perforations typical for later medieval North Atlantic faunal assemblages (with exception of Greenland). The practice of drilling holes into the top of a metapodial epiphysis and one right above the distal epiphysis by knife to suck out the marrow while leaving the bone intact for artifact production or children's toys started around AD 1150-1200 (Bigelow 1985). The Oddstaðir metapodia with only one perforation could have also been intended for a special, if unknown use other than bone marrow extraction.

7.11. Oddstaðir Archaeofauna Summary & Discussion

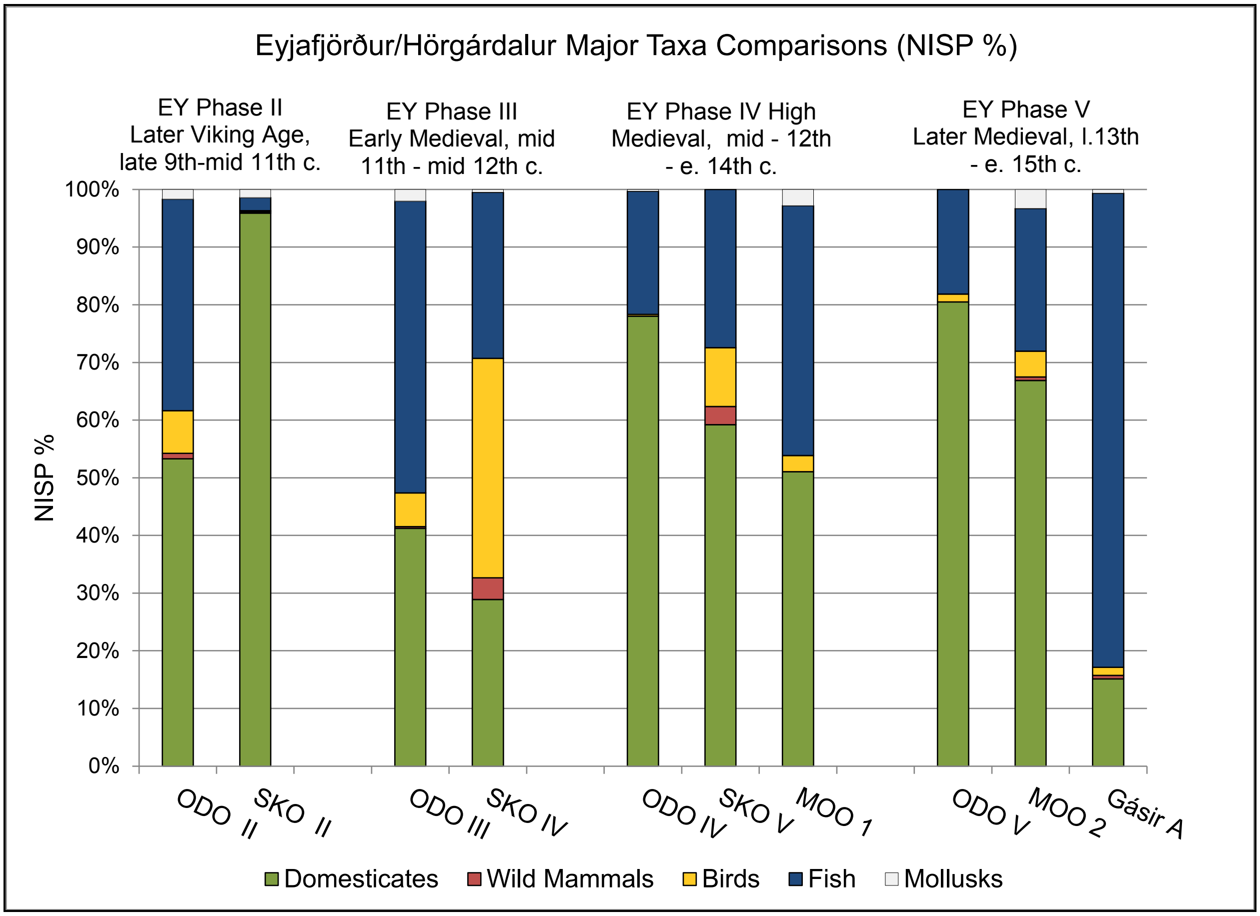


Figure 7.23. Eyjafjörður Major Taxa Comparisons by phase.

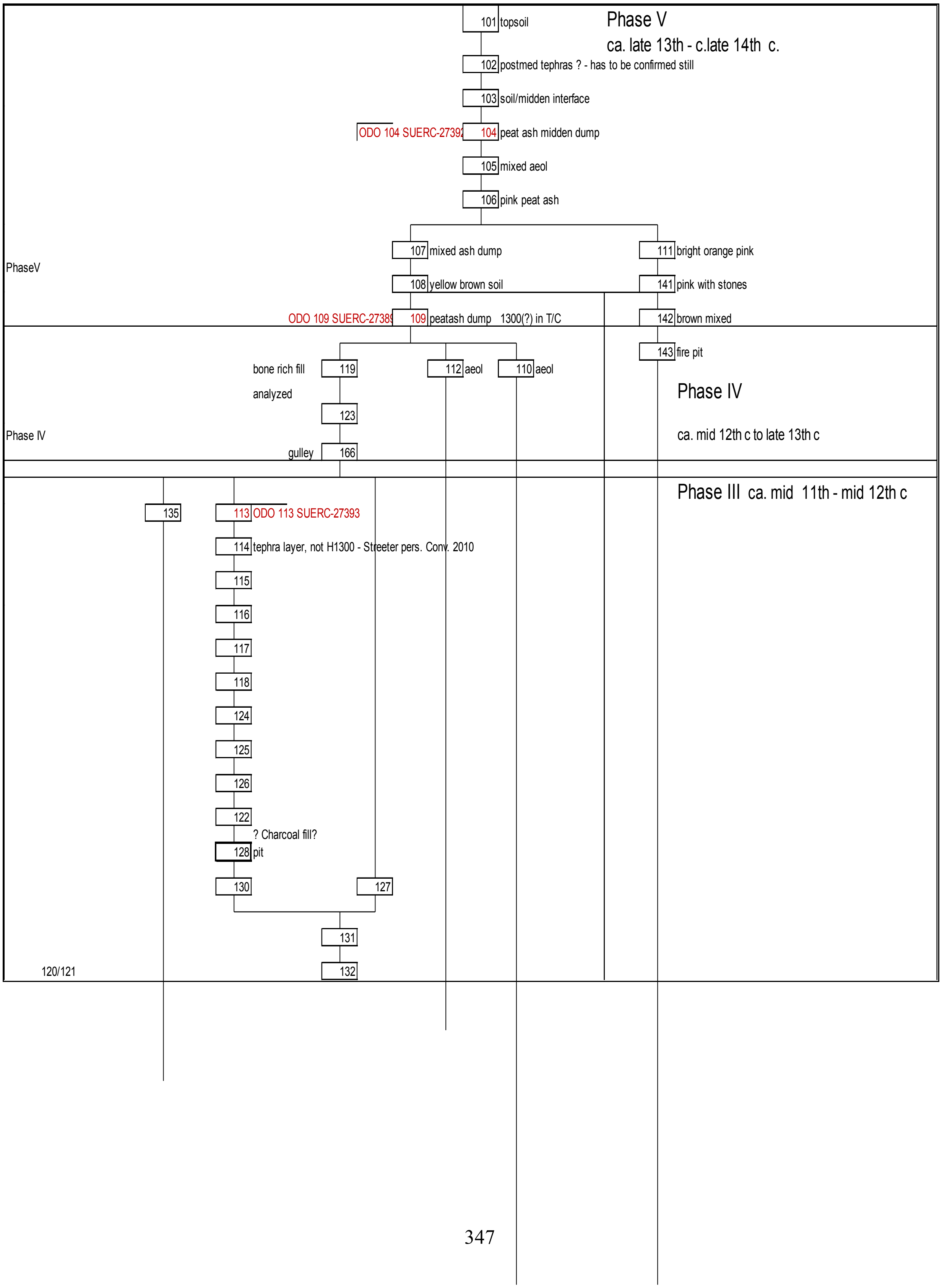
The Oddstaðir archaeofauna is in many ways typical of what might be expected of a middle-ranking moderately prosperous Viking to medieval farm. A substantial investment in cattle production is clear throughout, and the management of the caprine flocks shows little evidence for any radical intensification of wool production in the later phases.

Given that Oddstaðir was within sight of Klausturhús and within an hour's walk of the specialized sheep station at Möðruvallasel this economic niche may well have been filled by higher-ranking landscape managers by the later Middle Ages. Unlike Skuggi, this farm was not replaced as redundant during the 12th -13th century, but continued on with most farming patterns intact. However, several patterns did change markedly from the Viking age during the period of Gásir seasonal settlement.

Oddstaðir, like many other Viking Age farms (including Skuggi in later phase) initially invested significantly in provisioning the household with marine food (birds, seals, dried fish). We are far from a complete understanding of the procurement and supply networks that brought marine food to inland farms in the Viking Age and early medieval period, but it is safe to assume that such long distance transport was not free (at least in time allocated) and that the regular acquisition of such distant supplies was seen as a necessity by the participating inland households (McGovern et al 2007, 2009). The clear pattern in reduction of marine food consumption (even apparently marine fish) is so far unique in Iceland, and raises the question of alternative household provisioning strategies that could replace the earlier marine connection. Could Oddstadir be understood as a site where the farmers did not keep up with the 'general' patterns preserved from other sites´ faunal assemblages, and could this departure from the tradition have resulted in more resilience?

The change in cattle management strategy from the widespread dairy pattern and the evidence for off-site transport of select cuts of beef is also thus far unique in Iceland. While it remains speculation that Oddstaðir was one of the farms specializing in beef production to provision Gásir, a scenario seeing regular exchange of beef for grain products (or other archaeologically invisible but storable provisions that could at least partially replace marine foods) has plausibility. The presence of exotic and fashionable pet dogs (similar to those found at Gásir and Hólar) at this inland farm flags some sort of connection with the interesting strangers seasonally camped at the mouth of the Hörgá.

7.12. Oddstaðir Harris Matrix



Oddstaðir Harris Matrix continued

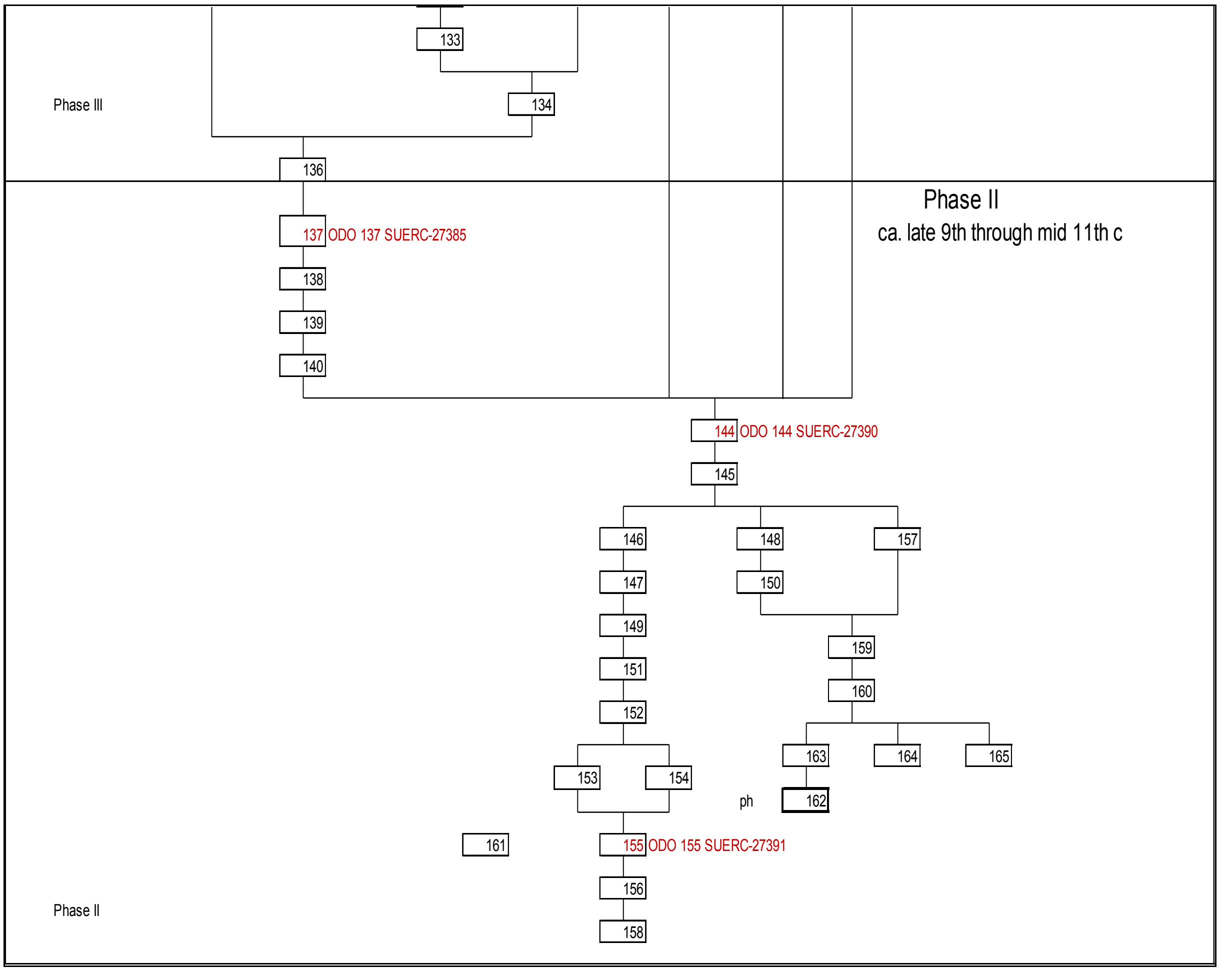


Figure 7.24. Oddstaðir Harris Matrix by Howell M. Roberts (Harrison et al 2010). C14 information in red and Phasing added by the author.

Chapter 8. **Discussion and Conclusion**

This concluding chapter seeks to combine the different data sets and project components to address the broader questions raised by this thesis and the “Gásir Hinterlands Project” funded by NSF (US National Science Foundation - OPP ARC 0809033), the core elements of this doctoral project.

8.1. Broader Questions and Research Context

This study deals with local impact brought by international exchange in the 12^{th}-14^{th} centuries in context of a proto-world system based in part on the *Pax Mongolica* of ca. 1250-1350 (Abu-Lughod 1989). Modern climatology reveals the conjuncture of the expanded trade of the mid- 13^{th} century with sudden climate change after 1258 and the initial stages of the prolonged cooling and increased inter-annual variability of the “Little Ice Age” (Dugmore et al 2012). Based on recently available data on annual temperature mean proxies for western Iceland, (Mann et al 2009, Streeter & Dugmore 2013, Ingram - see Chapter 2), this increase in inter-annual variability may have been felt even more strongly in Eyjafjörður from the 14^{th} c. and later than during the 13^{th} c. than previously thought (Harrison 2010). In Icelandic history the period 1220-1264 is traditionally the Age of the *Sturlungs*, a period of peaking conflict among great families ending in civil war and Iceland’s integration with the Norwegian realm (Byock 1986, Karlsson 2000).

It is therefore important for this thesis to consider the effects that climate change, political conflict, and economic change may have had on local level relationships between a seasonal trading center and a surrounding community. Currently, it seems that the historical Sturlung period took place during a relatively warm and stable period, while the time for when we have archaeological data as evidence for Gásir activities experienced heavy temperature flux during the later 13th c. but especially the 14th c., with a distinct drop in temperatures toward the end of that century, possibly indicating a changing climate in Eyjafjörður that could have been one of multiple factors influencing livestock management decisions.

The graph below is based on temperature means and anomalies as the one provided in Chapter 3; this time the chronological information from the Gásir open area excavation and Hörgárdalur investigated midden sites are added for a better idea of when and where these temperature anomalies may have taken effect.

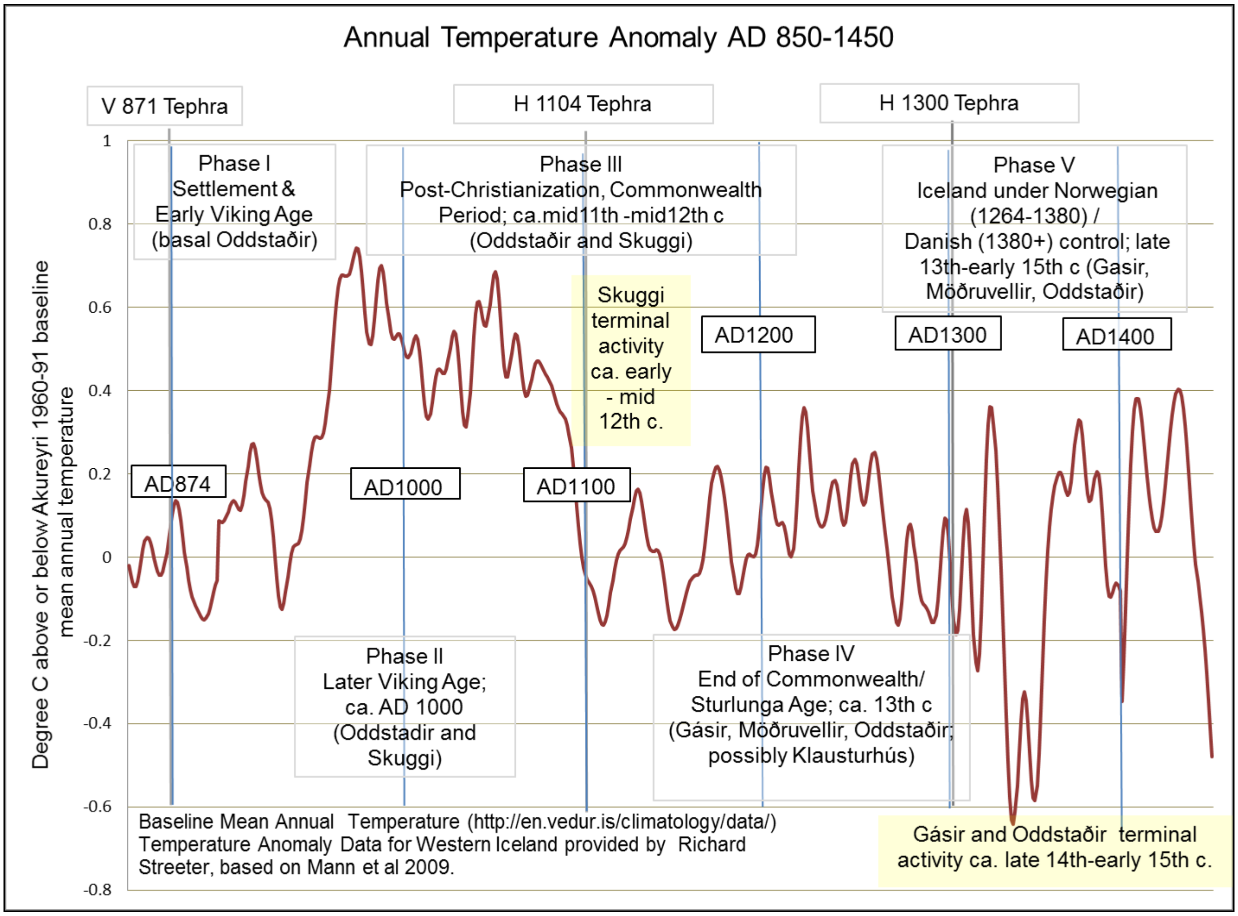


Figure 8.1. Annual Temperature Anomaly from AD850-1450 information combined with rough chronology of Gásir and Hörgárdalur sites' activity periods as presented in this doctoral thesis. Temperature Anomaly Data for Western Iceland provided by Richard Streeter, based on Mann et al 2009 (Baseline Mean Annual Temperature - http://en.vedur.is/climatology/data/) Baseline Mean Annual Temperature (http://en.vedur.is/climatology/data/).

Figure 8.1 above shows the annual temperature anomaly means from AD850-1450, with the various activity periods as available from the Gásir and Hörgárdalur faunal remains. From the 12th c. on, temperature means were lower and there was more inter-annual variety than in the 11th c. where temperatures were generally higher than later on. As mentioned, and again highlighted in the graph focusing on mean May-September temperatures used for proxy information informing on grazing-seasons below, the Age of the Sturlungs seemed to have seen relatively less extreme temperature fluctuations than previous and especially subsequent periods in Icelandic history.

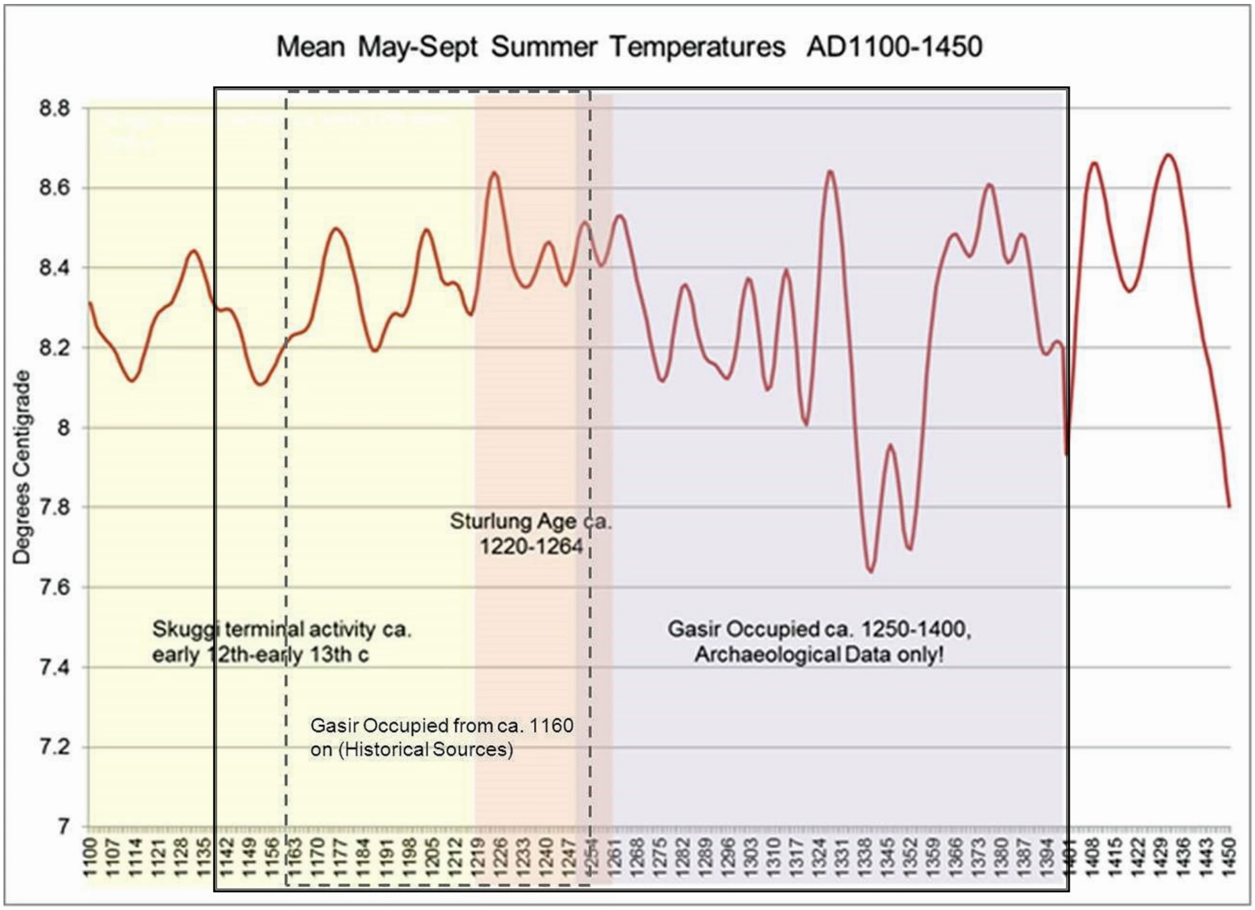


Figure 8.2. Mean May-September Temperatures AD1100 -1450. Black rectangle indicates potential span of Gasir activity. Temperature Anomaly Data for Western Iceland provided by Richard Streeter, based on Mann et al 2009. Baseline Mean Annual Temperature (http://en.vedur.is/climatology/data/).

This graph displays reconstructions of growing season temperatures from AD1100-1450. Based on these data, for the majority of the known Gásir occupation the Eyjafjörður farmers would have not only been facing overall declines in growing season temperatures compared to the early 13th c., but also considerable inter-annual variability, making it more difficult for a farmer to decide on livestock management strategy as the growing seasons may become shorter, and winter season may become longer, or the seasons may not be as regular as during more stable periods. Such inter-and intra-annual variability would make it more difficult for a farmer to predict how large of a livestock herd can be supported from the available quantities of grass and hay that may be very hard to predict under those circumstances.

This is the period of Gásir occupation for which we currently have archaeological materials. The earlier Gásir occupation as documented in historical sources falls into a time period that saw relatively more stable and warmer temperatures, as did summer temperatures for the period of Skuggi abandonment.

One inspiration for this project were the collaborative research efforts seeking a better understanding of the different historical pathways taken by North Atlantic communities after the initial colonization in the Viking Age, especially the very different fates of late medieval Iceland and Greenland. One long- cited factor in the diverging pathways of these two western Atlantic Nordic communities has been different participation in regional trade and exchange and different response to the opportunities and challenges posed by European economic development in the high Middle Ages. The Norse Greenlanders participated in a "prestige goods" hunting economy generating ivory and furs from first settlement in the 10th century down to the final extinction in mid-15th century (Dugmore et al 2007, Keller 2010, McGovern 1985, Vésteinsson et al 2002). Recent work by NABO (North Atlantic Bio-Cultural Organization) teams under the *International Polar Year* project makes clear that Greenlandic archaeofauna from contexts contemporaneous with the period of the *Pax Mongolica* proto world system show no evidence of intensification of wool production or commercial scale fishing, but instead a continuation of the Viking age pattern of walrus hunting supported by subsistence farming and intensified sealing (Ogilvie et al 2009, Smiarowski et al 2007).

By contrast, Late Medieval and Early Modern Iceland produced the "bulk goods" of fish and woolen cloth, a pattern now documented both by written sources and archaeology (Krivogorskaya et al 2005, Amundsen et al 2005, Perdikaris et al 2004, Harrison & Snæsdóttir 2012). Zooarchaeology in the past decade has developed a series of markers for the transition from an ancient Nordic pattern of artisanal fishing of deep water cod family fish and the preparation and exchange of a variety of air dried preserved fish products (in N Norway at least dating to the early Iron Age, (Perdikaris 1999) to a fully commercialized fishery producing a narrower range of standardized dried fish products that could be traded on distant futures markets as a fully commoditized product (Perdikaris & McGovern 2007). As established by Perdikaris' work, a commercialized archaeofauna signature requires 1) substantial proportion of marine fish, especially cod family (gadidae) in the archeaofauna; 2) a reconstructed live size pattern indicating peaks in catch size dictated by storage (the "stockfish window") rather than a randomly sampled natural population; 3) an element distribution pattern reflecting differential deposit of most cranial elements (dumped at landing sites) and body parts accumulating differentially at consumption points. In Northern Norway this transition is visible by ca. AD1100, and in Iceland the transition appears to be reflected as early as ca. AD1200-1250 at the sites of Akurvík and Gjögur in the West Fjords (Amundsen et al 2005, Krivogorskaya et al 2005). Perhaps especially in the NW of Iceland, a mix of commercial and subsistence fishing have been identified as key elements in local survival during the harsh "century of misery" c. 1700-1800 (Edvardsson et al 2004, Edvardsson 2010, Harrison et al 2008b).

Fully commoditized and commercialized fisheries eventually supported the eventual development of Reykjavik and modern Icelandic prosperity (Harrison & Snæsdóttir 2012). The path towards long term survival and modernity in Iceland thus is closely linked to issues of market production and local impacts of distant markets, and a key issue is when such markets began to have a significant role in local Icelandic economic strategies. This doctoral project addresses these broad questions of North Atlantic pathway divergence and the role of cross-regional, inter-scale connection in a context of rapid environmental and social change with reference to one particularly well researched portion of northern Iceland. The investigation of Gásir and its hinterland thus seeks to connect sites to their neighbors, to their environmental context, and to assess the influence of changes in the wider world beyond the valleys of Eyjafjörður.

8.1.1. *Evaluating Hinterlands: A Scenario Based Approach*

A basic issue raised in this thesis is thus the question of the nature and extent of the impact of the seasonal trading center at Gásir on surrounding valley settlements in this particular part of Eyjafjörður. Did Gásir in fact have a hinterland? Can changes in economic patterns visible in the excavated Hörgárdalur sites and at the monastic estate at Möðruvellir be plausibly linked to patterns visible in the Gásir excavations? This chapter summarizes the new evidence for regional production and consumption now available from archaeology and especially zooarchaeology presented in the body of the thesis and seeks to use these data to evaluate possible alternative scenarios for economic change from the Viking age into the period of activity at the Gásir trading center. While much new evidence has been gathered during the Gásir excavations and the Gásir Hinterlands project, major uncertainties remain in the attempt to assess the undoubtedly complex and probably changing relationships among the Gásir traders, the Möðruvellir monastic estate, and the Hörgárdalur smaller farms.

New research supported under the ongoing *Comparative Island Ecodynamics Project* will expand on the work reported here, but inevitably challenges will remain in unraveling the complex interactions of local factors, hemispheric climate change, and potential early world systems impacts. Multiple interpretations of the same evidence are certainly possible. Rather than attempting to construct a single deterministic narrative or claim realistic detailed hypothesis testing, a more productive and stimulating approach when discussing the results brought forward by this thesis may be to follow the lead of sustainability planners in building possible scenarios whose implications can be assessed as more or less likely as empirical data accumulates (Adger et al. 2004). Hence, the organization of data and explanatory arguments was built around three contrastive scenarios for Gásir and its hinterland:

8.1.1.1. "Minimalist Scenario"

Gásir has only minor effect on the local community. The number of seasonal visitors remains small, most merchants are housed with chieftain patrons and most exchange takes place on a small scale with elites. Gásir serves as a bulking point for goods awaiting export and a waiting area for a relatively small number of crewmen preparing for the journey home at the end of the summer trading season. Gásir's summer visitors number in a population total around 25-30 persons (perhaps three to five Knarr crews (Crumlin-Pedersen 1997), a population total similar to two or three moderate sized farms (Vasey 1996). In this case economic interactions between the Gásir residents and the surrounding countryside are minor and no special provisioning arrangements will be required. Archaeological evidence for trade will be minimal and imported artifacts remain rare (as in the Viking age patterns documented by Aaron Kendall 2012). In this scenario Gásir has little or no effective hinterland impact and most relations are directly with Möðruvellir and similar estates.

8.1.1.2. "Maximalist Scenario"

Gásir functions effectively as a small 13th - 14th c. town with a major regional market function, extensive craft production on site, major consumption of both local and distantly imported goods, and a wealthy and substantial population with extensive social and commercial links to the surrounding countryside (probably including marriage, property ownership, and highly structured provisioning network). Summer population numbers in the high hundreds of visitors (ca. 500-1000) who require extensive provisioning efforts during the trading season. This scenario will generate extensive archaeological evidence for trade and durable imported objects will become common in surrounding sites. The archaeological signature will resemble the 17th - 18th century pattern of highly visible increase in consumption and deposition of imports clearly evident at Skálholt in Árnessýsla (i.e. Lucas 2002) but also other early modern Icelandic contexts (i.e. Harrison & Snæsdóttir 2012). Under this (undoubtedly counter-factual) scenario, Gásir´s 13th and 14th century archaeological record will somewhat resemble 18th c. Reykjavik in hinterland impacts.

8.1.1.3. "Intermediate Scenario"

Gásir does not have the impact of a contemporary permanent medieval town (or 18th c. Reykjavik), operates within a comparatively undeveloped (and un-monetized) local economy, and fails to generate an archaeologically visible material culture imprint comparable to 17th - 18th c. patterns. However, Gásir summer residents are numerous (perhaps in the 100-300 range?) and wealthy enough that local people make a significant investment in connections to Gásir. Gásir then would be seasonally larger in temporary residents than any of the biggest contemporary manors but not actually proto-urban in scale. Gásir under this scenario is sufficiently influential to cause multiple households (not only the elite monastic farm at Möðruvellir) to revise their production strategies in an aim to provision Gásir with special food products rather than the off-take of normal subsistence production. The Gásir hinterland impact in this scenario is thus significant, but also significantly different from the highly visible post- 1500 World System impacts.

Since the artifact distribution analysis alone can be utilized to refute the Maximalist scenario (to date there is no evidence for imported medieval pottery or coins found in any of the excavated Hörgárdalur sites including Möðruvellir), it may be left to stand as a reference point at one end of a potential ball park of possibilities. The real task is to assess the relative likelihood of the remaining Minimalist and Intermediate scenarios.

8.2. Evaluating Scenarios: Evidence Beyond Bones

The major original contributions of this thesis project are in providing a zooarchaeological perspective on the Gásir occupation and its possible hinterland effects, but the scenario evaluation requires a more multi-faceted approach. While the full final site monograph for Gásir is still in process (and highly detailed locational analysis of bone deposition patterns will have to be part of this final product), the extensive preliminary reports and initial publications provide solid grounds for discussion of site scale, layout, and the character of the artifact assemblage.

8.2.1. *Site Scale*

There is no question that only a complete excavation could conclusively demonstrate the total extent of the structures at Gásir. Such a full scale excavation of the Gásir site is not feasible, however the detailed mapping of structural depressions will be used as a proxy to provide an idea of site extend and scale. The topographic map of Gásir (Roberts et al 2002) indicates as many as 120 "booth" structures divided into possibly 6 clusters (Howell Roberts, Gásir site director, personal communication 2006) present at Gásir. While excavation demonstrates superposition and considerable intersection of booth ruins, many appear to respect each other's structural boundaries, opening the possibility of simultaneous occupation. Again, only a complete excavation with demonstrated and at least weekly-scale contemporaneity could tell us for sure, but until such is available, a very educated guess that by no means claims accuracy beyond a very reasonable doubt will have to suffice in order to make some sense of the Gásir site scale.

Stratigraphic excavation of about 6 % of the booth area indicates multiple re-use of the same structure, an instance more likely in a situation of limited available structures, potentially due to an occupation close to capacity. The smallest booth structure measured about 3m^2 (1.5 m x 2 m) and the largest one about 18.5m^2 (5.8 m x 3.2 m)[7]. If we use an estimate of ca. 1.5 square meters per person this gives a low end estimate of 2 persons per structure and a high end potential for up to 12 occupants for the largest buildings (see floor area discussion in McGovern et al 1988). In a scenario in which an average of 2 persons slept in each occupied booth and 50% of the visible ruins (possibly 120) were occupied at any given summer, the total Gásir population could be 120. If we assume that 80% of the visible booths were occupied at the same density this produces a summer population estimate of 192. The church and churchyard at Gásir have been fully excavated (Vésteinsson 2009a) and represent an unusual monument in Icelandic archaeology. The church itself is one of the larger churches in contemporary Iceland, at least compared to other parish churches, and is significantly larger than the private chapels from the 11th c. (Vésteinsson, personal communication May 2013), with an interior floor area of ca. 53 m^2

[7] Thanks to Howell M. Roberts from the Institute of Archaeology, Iceland (FSÍ) for providing the various structural measurements for the booth area. Space utilization calculations are the author´s.

- using the nave (11.6 m by 5 m) and chancel (3.8 m by 3.1 m) foundation measurements[8] of the Phase 3 church, was built in the late 13th c., and functional until the late 14th c. (Vésteinsson 2009a:166), minus the wall measurements (ca. 0.75 m thickness, based on information about the measurements provided by Vésteinsson 2009a:165). If one assumes only occupation of the nave (10.85 m by 4.25 m - average church wall thickness deducted already here), an area of 46 m^2 for occupation capacity during mass remains. The churchyard outside is similar in form to the normal cemetery enclosure, but the lack of burials suggests additional spatial functions. As Vésteinsson (Vésteinsson 2009a) points out, this partly ritualized enclosure may have served multiple functions, including assembly, trade, or even sanctuary space where safe exchanges and meetings between adversaries might take place. The total area enclosed by this churchyard dyke is 468 m^2. In a relatively general assumption that medieval occupants required 1.5 m^2 of floor space each, this produces a figure of potentially 30 people standing within the church and 277 (468m^2 total churchyard interior area minus 69.75m^2 church area equal 416.25m^2 of available outdoor churchyard space) standing inside the churchyard dyke. If we provide a more generous floor space allowance of 2 m^2 per person (beyond the limits of normal conversational distance even for modern N Europeans (Hall 1966) we get an estimate of 23 people within the church and 208 within the churchyard dyke. While these area to population estimates are hardly precise, they seem to make an on-site peak population in the 200-300 person range plausible.

8.2.2. *Site Layout*

The booths at Gásir are not randomly spread, but form two straggling lines parallel to the beach, with what appears to be well-defined track-ways between. While this does not represent

[8] Phase 3 church measurements of nave length and width and chancel length and width from Vésteinsson (Vésteinsson 2009a:166).

elaborate urban planning, it does suggest the need to provide access and transit space between multiple booths apparently in operation at the same time. While only a full excavation of the entire site will confirm details of occupancy patterns, the current understanding of the site layout suggests a fairly high degree of contemporary occupation of booth depressions. The Gásir church structure's position near the top of the ridgeline above the settlement would have made it highly visible not only from the Gásir settlement, but for some distance at least across the fjord. Its function as a sea-mark and the visual statement made by such an imposing building would seem to signal at least an intention to achieve high visibility if not visual dominance over a wider area. If one goes as far as imagining bells at the Gásir timber church signaling the presence of merchants and marking time and religious celebration then another dimension is added to the presence of Gásir in its contemporary landscape. While multiple interpretations are of course possible, these features of site layout suggest that Gásir was envisaged as more than a seasonal camp-ground for a few dozen sailors. Gásir was most likely divided into plots owned by a ship-master or somebody else responsible for the ship and its journey. It seems the general layout of those plots remained unchanged through time, though there was considerable change within the plots as evidenced by the archaeology. That said, it is unlikely that all the land plots owned by the ship-master or a person of the like were always occupied at the same time, but only when the particular ship was harbored at Gásir (Vésteinsson, personal communication May 2013).

8.2.3. *Artifact Assemblage*

As discussed in Chapter 2, Iceland had gone through the transition from largely Independence during the Commonwealth period to being at least nominally integrated into the Norwegian Kingdom (Callow 2010, Jakobsson 2007) by the time archaeological evidence exists for the Gásir trading site. The various artifacts recovered from that site clearly indicate a strong international signature in places of origin of those artifacts. Be it the walrus ivory potentially from Greenland or Svalbard that was brought as an extracted tusk to Gásir in likely unfinished form to be processed and either re-circulated internationally or sent on to one of the elite Icelandic institutions, or the Spanish Albarello (Andalusian Majolica) making its way to Iceland either via original exchange with Norway, likely at Bergen, or having entered the North Atlantic exchange system somewhere further south, in either Southwestern or Northwestern Europe.

The relatively large amount of Norwegian raw materials i.e. slabs of schistose stone to be made into whetstones, or food ways, i.e. baking stones retrieved in considerable numbers from Gásir certainly indicate presence of international visitors, most likely Norwegian merchants.

Together with the archaeoentomological indication (below) suggesting presence of stored, imported grain, it is highly likely that the baking plates mentioned above were used to bake bread on site. This would be the typically Northern Scandinavian/Norwegian flat breads. These seemingly non-Icelandic food ways can also be observed from the bone marrow extractions of the lower leg bones (metapodials) from sheep and goats. At Gásir, there is a considerably lower number of bi-perforated metapodials observed than is expected for and hes been observed in other medieval Icelandic archaeofauna (McGovenr 2007, 2009).

8.2.3.1. Textiles

Nearly all the woven Möðruvellir textiles (88 %; or 71 out of 81) are vaðmál fragments (likely sewing scraps). The Möðruvellir artifact collection contains considerably more vaðmál remains than Gásir´s (Hayeur Smith, 2011b:4).

The Gásir textiles form a much more diverse assemblage than those from Möðruvellir (Hayeur Smith 2011a, b) and do not provide a clear and uniform vaðmál manufacturing signature. The Gásir assemblage contains different vaðmál pieces, possibly woven in different households. This could signify a relatively diverse catchment region employed for surplus sheep wool either in the raw or in processed form destined for the export market. One the other hand, it is entirely possible that some of the textiles recovered from Gásir could have been imported as packaging (Vésteinsson, personal communication May 2013).

Hayeur Smith notes that the standardized vaðmál does not appear in either Viking Age deposits in Iceland or in any Greenlandic collection of any period (Hayeur Smith forthcoming). Her conclusion that the standardized vaðmál represents a process of commoditization paralleling the standardization of dried fish production visible in 13th c. Icelandic archaeofauna seems reasonable, and the lack of both commercial fisheries and standardized woolen cloth production in Greenland provides a sharp contrast. The majority of the vaðmál pieces, ranging in quality and thread counts were recovered from the Gásir churchyard or Area B (Hayeur Smith 2011a:2-3).

Different from the vaðmál fragments recovered from Area B, the wool remains found in Area A turned out to be roving or strands of twisted wool, potentially serving as indicators of possible measuring standards that might have been used in place of scales or even functioning effectively as low-denomination currency (Hayeur Smith 2011a:2-3). The presence of two different kinds of wool product at Gásir could be explained by different activities taking place in the two areas. If the church in Area B was also used as a storage area, at least a proportion of the vaðmál recovered there could have been part of shipment geared for export, and as mentioned earlier, another proportion could have also been imported in form of packaging materials. The roving recovered from Area A could have been remains of an unfinished product that might have also been a standardized export staple.

While the presence of standardized cloth fragments and the contemporary development of standardized fish products suggest an increase in interest and regulation of exchange in 13th-14th c. Iceland (perhaps not paralleled in Greenland), it is important to recognize that while these factors are required to make the Intermediate Scenario plausible, they do not serve to invalidate the Minimalist Scenario.

8.2.4. *Invertebrate Record*

8.2.4.1. Wool storage indicators

Beyond the actual sheep wool fragments recovered from the site, there are also some proxy indicators suggesting storage of sheep wool at Gásir: The archaeontomological analysis indicates presence of sheep ked in form of puparia, very likely associated with sheep wool products rather than the live animals. The puparia attach to the wool and are hard to get out while adult sheep keds do not survive for long without their living host. The invertebrate specialist also confirmed the presence of several adult sheep keds in one sample, which could have been from an area where actual live animals were kept or, where new sheep wool was processed (Konráðsdóttir 2010:68 in Roberts et al 2010). The Gásir insect evidence thus seems to suggest that both storage of processed wool and some on-site processing of raw wool products were taking place. In combination with the woolen cloth evidence this could suggest the bulking of both finished cloth and unfinished wool on site. The fact that there were no spindle whorls or loom weights retrieved from the Gásir excavations, indicating a lack of cloth production tools and suggesting again a catchment zone where women are producing vaðmál to a common standard, but seemingly not at the Gásir site (see Milek 2012 for a discussion on wool cloth production).

8.2.4.2. Grain storage indicators

The archaeoentomological analysis further indicates the presence of beetles specific to environments containing stored grain. Since these invertebrates need relatively warm temperatures to breed and are not native to Iceland, it is most reasonable to suggest they came into the country with imported grain. These beetles are quite rare in Icelandic excavations, but some were found in high status sites such as Bessastaðir and Reykholt; in both sites deposits containing the grain beetles are dated to later times than the Gásir materials and are presumed to represent stores of imported grain intended for consumption by these high status households (Konráðsdóttir 2010:60 in Roberts et al 2010).

The invertebrate record then adds support to the idea of wool and grain storage taking place regularly at Gásir. The grain storage evidence combined with the baking plates may indicate the provisioning of Gásir residents only, but the archaeoentomological evidence does not contradict the idea that grain in bulk was also an import item for exchange with Icelanders. The invertebrate zooarchaeology thus (like the woolen cloth analysis) serves to support the Intermediate Scenario without in any way invalidating the Minimalist Scenario.

8.2.5. *Isotopic Information*

The Gásir project has collaborated with a large scale international geophysical/archaeological project (Ascough et al 2006) aimed at better understanding variations in Marine Reservoir Effect (MRE) which affect age estimates based on organisms wholly or partly within the marine food web (shellfish, sea weed, marine mammals, sea birds, fish). This large scale project is based at the Scottish Universities Environmental Research Center (SUERC) in East Kilbride Scotland, and is directed by Dr. Gordon Cook, who kindly provided the data and analysis. This MRE project was followed up during the International Polar

Year project by an additional expanded analysis of stable N and C isotopes carried out by Philippa Ascough at SUERC. The initial MRE project was aimed at better understanding issues affecting radiocarbon age determinations, but the IPY program was a follow up investigation attempting to better understand variability in N and C isotopes observed at Gásir by expanding analysis to the Hörgárdalur and Möðruvellir archaeofauna.

The initial MRE project provided 8 radiocarbon assays on cattle bone, seal bone, and clam shell (Mya sp.) from a single context [528]. C13/C14 assays were also carried out at the same time (delta C13%) and N15 assay was carried out on the mammal bone.

Gásir Radiocarbon Results March 7 2006 (courtesy Gordon Cook)						
SUERC #	Context	material	Radiocarbon years BP	sd	delta C13	delta N15
8635	Context 528	cattle bone	795	35	-22.5	2.8
8634	Context 528	cattle bone	595	35	-22.1	2.2
8629	Context 528	cattle bone	645	40	-21.8	7.3
8633	Context 528	seal bone	1145	35	-12.7	14.4
8638	Context 528	clam shell	1165	35	0.5	
8639	Context 528	clam shell	1305	35	1.9	
8637	Context 528	clam shell	1175	35	2.5	
8636	Context 528	clam shell	1200	35	2.8	

Table 8.1. Results from Gásir Radiocarbon and Isotopic analysis, initial MRE project (data provided by G. Cook and P. Ascough, SUERC).

As expected, the marine shell fish and the seal bone show high delta C13 values (values above -15/-16% indicate marine food web participation) and radiocarbon dates far too old for the medieval site. The single seal bone shows both a marine diet component in the lighter C13 values and a higher food web (carnivore) signature in the heavier N 15. The three cattle bones (SUERC 8635, 8634, and 8629) produce fully terrestrial delta C13 values, and radiocarbon dates that are plausible given the tephrochronological evidence, as well as that provided by documentary sources and artifacts.

The N15 values for the three cattle bones from area A indicate the animals had somewhat varied grazing histories in the years prior to their slaughter and consumption. The very low N15 values are similar to the values produced from nearby Mývatnssveit sites with highland low-arctic grazing, while the higher N15 value suggests habitual grazing on richer lowland vegetation. Both would be typical of values expected from a generalized Icelandic isotopic landscape, but are distinct from patterns from temperate zone animals. These diverse values resulting from the initial MRE study suggested that Gásir may have drawn upon a wide catchment area for its provisions. At the very least, this points to the fact that Gásir was supplied from at least more than one source.

In 2012, Dr. Philippa Ascough from SUERC carried out a follow up study under the IPY sponsorship that provided additional data for the Gásir, Möðruvellir, and Gásir Hinterlands faunal samples from terrestrial mammals used in isotopic analysis.

Table 8.2 presents a compilation of all these data, displaying the laboratory code, source material, radiocarbon years BP, one standard deviation, and the Carbon and Nitrogen isotopic assay results. The specialist's conclusion based on these results is discussed thereafter.

Table of Carbon and Nitrogen isotopic study results from Gásir and Hörgárdalur sites.

GU Number #	Site Name (site code) #	Context #	Sample Species	d13C(cf) #	d15N(cf) #	C/N(Molar)
1033	Skuggi (SKÖ)	35	BOS TAURUS	-21.50	2.96	3.28
1034	Skuggi (SKÖ)	35	OVIS ARIES	-21.18	2.37	3.34
1035	Skuggi (SKÖ)	47	OVIS ARIES	-21.60	4.24	3.34
1036	Skuggi (SKÖ)	47	BOS TAURUS	-21.23	2.84	3.35
1037	Skuggi (SKÖ)	52	OVIS ARIES	-21.12	1.05	3.30
1038	Skuggi (SKÖ)	11	BOS TAURUS	-21.11	4.38	3.36
1039	Skuggi (SKÖ)	52	OVIS ARIES	-21.56	1.33	3.36
1040	Skuggi (SKÖ)	52	OVIS ARIES	-20.91	1.19	3.34
1041	Skuggi (SKÖ)	52	OVIS ARIES	-21.53	0.78	3.36
1042	Skuggi (SKÖ)	47	BOS TAURUS	-21.39	3.97	3.32
1043	Skuggi (SKÖ)	47	BOS TAURUS	-20.75	3.99	3.32
1044	Skuggi (SKÖ)	47	OVIS ARIES	-21.35	1.24	3.40
1045	Skuggi (SKÖ)	47	OVIS ARIES	-20.97	0.91	3.35
1046	Skuggi (SKÖ)	47	CAPRA HIRCUS	-20.98	2.36	3.34
1047	Skuggi (SKÖ)	35	OVIS ARIES	-21.52	0.31	3.40
1048	Skuggi (SKÖ)	35	OVIS ARIES	-20.81	2.59	3.36
1049	Skuggi (SKÖ)	35	BOS TAURUS	-21.39	3.65	3.38
1050	Skuggi (SKÖ)	37	SUS SCROFA	-21.36	4.98	3.36
1051	Skuggi (SKÖ)	18	SUS SCROFA	-21.25	3.97	3.34
1052	Skuggi (SKÖ)	21	SUS SCROFA	-21.13	3.33	3.41
1053	Skuggi (SKÖ)	9//10	SUS SCROFA	-21.19	6.31	3.37
20695	Skuggi (SKÖ)	3	OVCA	- 20.3	4.0	3.2
20696	Skuggi (SKÖ)	10	OVIS ARIES	- 21.0	1.3	3.3
20694	Skuggi (SKÖ)	47	OVCA	- 21.0	1.2	3.3
20693	Skuggi (SKÖ)	53	OVCA	- 20.7	1.7	3.2
1054	Oddstaðir (ODÖ)	122	SUS SCROFA	-22.18	7.68	3.32
1055	Oddstaðir (ODÖ)	144	SUS SCROFA	-21.15	5.29	3.39
1056	Oddstaðir (ODÖ)	137	SUS SCROFA	-21.67	7.87	3.35
1057	Oddstaðir (ODÖ)	153	SUS SCROFA	-21.82	4.10	3.37
1058	Oddstaðir (ODÖ)	153	SUS SCROFA	-20.82	0.69	3.33
1059	Oddstaðir (ODÖ)	142	SUS SCROFA	-21.58	3.84	3.39
1060	Oddstaðir (ODÖ)	152	SUS SCROFA	-21.76	5.51	3.33
1061	Oddstaðir (ODÖ)	155	SUS SCROFA	-21.86	4.10	3.39
1062	Oddstaðir (ODÖ)	103	OVIS ARIES	-20.98	1.73	3.36
1063	Oddstaðir (ODÖ)	144	BOS TAURUS	-21.27	2.64	3.42
1064	Oddstaðir (ODÖ)	104	OVIS ARIES	-21.55	2.37	3.38
1065	Oddstaðir (ODÖ)	104	OVIS ARIES	-21.46	1.34	3.37
1066	Oddstaðir (ODÖ)	119	OVIS ARIES	-21.36	2.92	3.33
1067	Oddstaðir (ODÖ)	119	OVIS ARIES	-21.34	2.81	3.34
1068	Oddstaðir (ODÖ)	119	CAPRA HIRCUS	-21.06	1.97	3.33
1069	Oddstaðir (ODÖ)	131	OVIS ARIES	-21.43	2.11	3.35
1070	Oddstaðir (ODÖ)	137	OVIS ARIES	-21.71	1.07	3.37
1071	Oddstaðir (ODÖ)	152	OVIS ARIES	-20.83	2.70	3.35
1072	Oddstaðir (ODÖ)	144	CAPRA HIRCUS	-21.24	1.23	3.39
1073	Oddstaðir (ODÖ)	153	OVIS ARIES	-21.06	1.69	3.29
1074	Oddstaðir (ODÖ)	122	OVIS ARIES	-21.13	1.22	3.36
1075	Oddstaðir (ODÖ)	122	OVIS ARIES	-21.55	1.65	3.54
1076	Oddstaðir (ODÖ)	164	OVIS ARIES	-21.06	1.16	3.53
20700	Oddstaðir (ODÖ)	109	BOS TAURUS	-21.00	6.60	3.30
20703	Oddstaðir (ODÖ)	104	BOS TAURUS	-21.50	4.40	3.20
20704	Oddstaðir (ODÖ)	113	OVCA	-20.70	0.80	3.30
20701	Oddstaðir (ODÖ)	144	BOS TAURUS	-21.40	4.30	3.30
20699	Oddstaðir (ODÖ)	137	BOS TAURUS	-20.20	3.20	3.30
20702	Oddstaðir (ODÖ)	155	OVCA	-20.60	2.80	3.20
1087	Möðruvellir (MOO)	41	OVIS ARIES	-21.54	3.24	3.44
1088	Möðruvellir (MOO)	41	OVIS ARIES	-21.78	2.54	3.44
1089	Möðruvellir (MOO)	41	OVIS ARIES	-21.59	2.51	3.42

Table of Carbon and Nitrogen isotopic study results from Gásir and Hörgárdalur sites continued.

1090	Möðruvellir (MOO)	41	OVIS ARIES	-22.05	1.69	3.48
1091	Möðruvellir (MOO)	41	OVIS ARIES	-21.93	3.36	3.40
1092	Möðruvellir (MOO)	41	OVIS ARIES	-22.06	3.08	3.49
1093	Möðruvellir (MOO)	14	OVIS ARIES	-21.16	2.47	3.56
1094	Möðruvellir (MOO)	14	OVI/CAPRA	-21.21	3.19	3.53
1095	Möðruvellir (MOO)	14	OVIS ARIES	-20.95	1.33	3.46
1096	Möðruvellir (MOO)	102	BOS TAURUS	-21.64	7.32	3.50
1097	Möðruvellir (MOO)	102	BOS TAURUS	-21.87	5.90	3.47
1098	Möðruvellir (MOO)	102	BOS TAURUS	-22.16	3.84	3.26
1099	Möðruvellir (MOO)	102	OVI/CAPRA	-20.96	1.22	3.29
1100	Möðruvellir (MOO)	102	OVI/CAPRA	-21.20	2.10	3.60
1509	Möðruvellir (MOO)	41	OVIS	-21.92	2.04	3.23
20697	Möðruvellir (MOO)	120	BOS TAURUS	-21.60	3.50	3.30
20698	Möðruvellir (MOO)	102	BOS TAURUS	-20.30	8.10	3.20
23515	Möðruvellir (MOO)	75	BOS TAURUS	-21.90	5.60	3.20
23517	Möðruvellir (MOO)	129	OVI/CAPRA	-21.10	4.00	3.80
23516	Möðruvellir (MOO)	77	BOS TAURUS	-22.00	5.80	3.20
1101	Gásir (GAS)	2237	SUS SCROFA	-22.00	10.90	3.44
1102	Gásir (GAS)	1138	SUS SCROFA	-21.90	10.20	3.50
1103	Gásir (GAS)	655	BOS TAURUS	-22.80	2.60	3.40
1104	Gásir (GAS)	1856	OVI/CAPRA	-21.32	4.07	3.60
1105	Gásir (GAS)	1856	OVIS ARIES	-21.53	1.59	3.50
1106	Gásir (GAS)	655	BOS TAURUS	-22.47	1.73	3.28
1107	Gásir (GAS)	655	OVIS ARIES	-21.54	3.09	3.40
1108	Gásir (GAS)	655	BOS TAURUS	-22.38	4.19	3.37
20151	Gásir (GAS)	2414	OVI/CAPRA	-20.90	5.40	3.32
G152	Gásir (GAS)	537	BOS TAURUS	-21.70	0.44	3.36
20153	Gásir (GAS)	1557	OVI/CAPRA	-21.10	3.57	3.37
20154	Gásir (GAS)	1978	BOS TAURUS	-21.60	4.77	3.31
20155	Gásir (GAS)	2856	OVI/CAPRA	-21.00	3.70	3.26
13632	Gásir (GAS)	528	BOS TAURUS	-21.90	7.30	3.30
13634	Gásir (GAS)	528	BOS TAURUS	-21.70	2.20	3.20
13635	Gásir (GAS)	528	BOS TAURUS	-22.50	2.80	3.30
14810	Gásir (GAS)	1245	SUS SCROFA	-19.90	10.01	3.39
14811	Gásir (GAS)	1808	SUS SCROFA	-22.77	8.09	3.30
14812	Gásir (GAS)	1932	OVI/CAPRA	-21.12	1.47	3.30
14813	Gásir (GAS)	2021	OVI/CAPRA	-21.30	1.21	3.42
14814	Gásir (GAS)	1856	OVI/CAPRA	-21.59	1.82	3.29
14815	Gásir (GAS)	1914	OVI/CAPRA	-21.48	2.04	3.32
14816	Gásir (GAS)	1948	OVI/CAPRA	-21.14	0.07	3.43
14817	Gásir (GAS)	1978	OVI/CAPRA	-21.32	0.37	3.57
14818	Gásir (GAS)	1853	OVI/CAPRA	-20.87	-0.18	3.34
14819	Gásir (GAS)	1714	OVI/CAPRA	-21.49	3.39	3.30
14820	Gásir (GAS)	1769	OVI/CAPRA	-21.59	0.85	3.48
14821	Gásir (GAS)	2187	OVI/CAPRA	-20.79	-0.20	3.26
14822	Gásir (GAS)	2076	OVI/CAPRA	-21.49	1.70	3.27
14823	Gásir (GAS)	1968	OVI/CAPRA	-21.23	1.75	3.39
14824	Gásir (GAS)	1835	BOS TAURUS	-22.09	3.87	3.41
14825	Gásir (GAS)	1273	BOS TAURUS	-22.54	3.07	3.31
14826	Gásir (GAS)	1722	BOS TAURUS	-22.48	4.67	3.40
14827	Gásir (GAS)	1808	BOS TAURUS	-22.37	4.92	3.23
14828	Gásir (GAS)	1914	BOS TAURUS	-22.26	2.22	3.43
14829	Gásir (GAS)	1848	BOS TAURUS	-22.02	2.97	3.40
14830	Gásir (GAS)	1968	BOS TAURUS	-22.07	1.59	3.37
14831	Gásir (GAS)	1557	BOS TAURUS	-22.52	2.73	3.31
14832	Gásir (GAS)	1283	BOS TAURUS	-22.11	2.00	3.31
14833	Gásir (GAS)	1882	BOS TAURUS	-22.36	2.00	3.50
14834	Gásir (GAS)	1856	BOS TAURUS	-22.14	0.15	3.38

Table 8.2. Gásir and Hörgárdalur sites, Carbon and Nitrogen isotopic study results.

The data provided by SUERC and analyzed by Philippa Ascough (2012 unpublished report) provide isotopic signatures for Gásir, Möðruvellir and the Hinterlands sites that support the patterns observed from faunal analysis. According to the specialist, no significant variation in the N and C isotope values was found between animals from different sites and time periods, though there was some interesting variability between cattle, sheep/goat, and pigs.

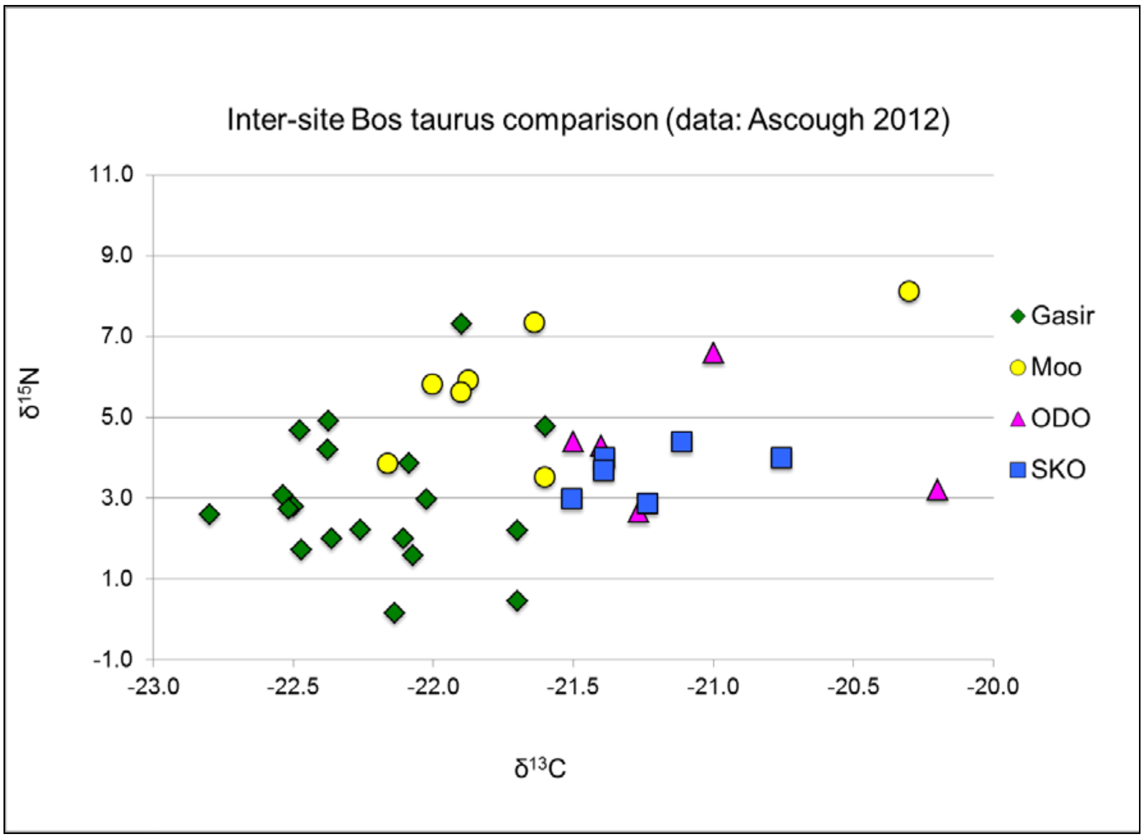


Figure 8.3. Hörgárdalur and Gásir cattle bone, delta 13C and delta 15N values (graph and data by Ascough, 2012, unpublished report).

The graph in figure 8.3 above presents the results of isotopic analysis applied to cattle bone materials from Gásir, Möðruvellir, Skuggi, and Oddstaðir. Dr. Ascough suggests that a wider isotope range in cattle at Gásir when compared to the more clustered Hörgárdalur cattle bone values could be the result of a Gásir supply with cattle grazed at various sites other than

Gásir itself. While there are cattle bones from Gásir showing isotopic values lower than those from others presented here, this does not rule out that these specimens could be brought to Gásir from elsewhere in the Eyjafjörður region. The variation could result from climatic variables reflecting topography, elevation, rainfall, etc. with specimens likely originating from sites other than those discussed here (Ascough 2012, Ascough (SUERC), personal communication, December 2012).

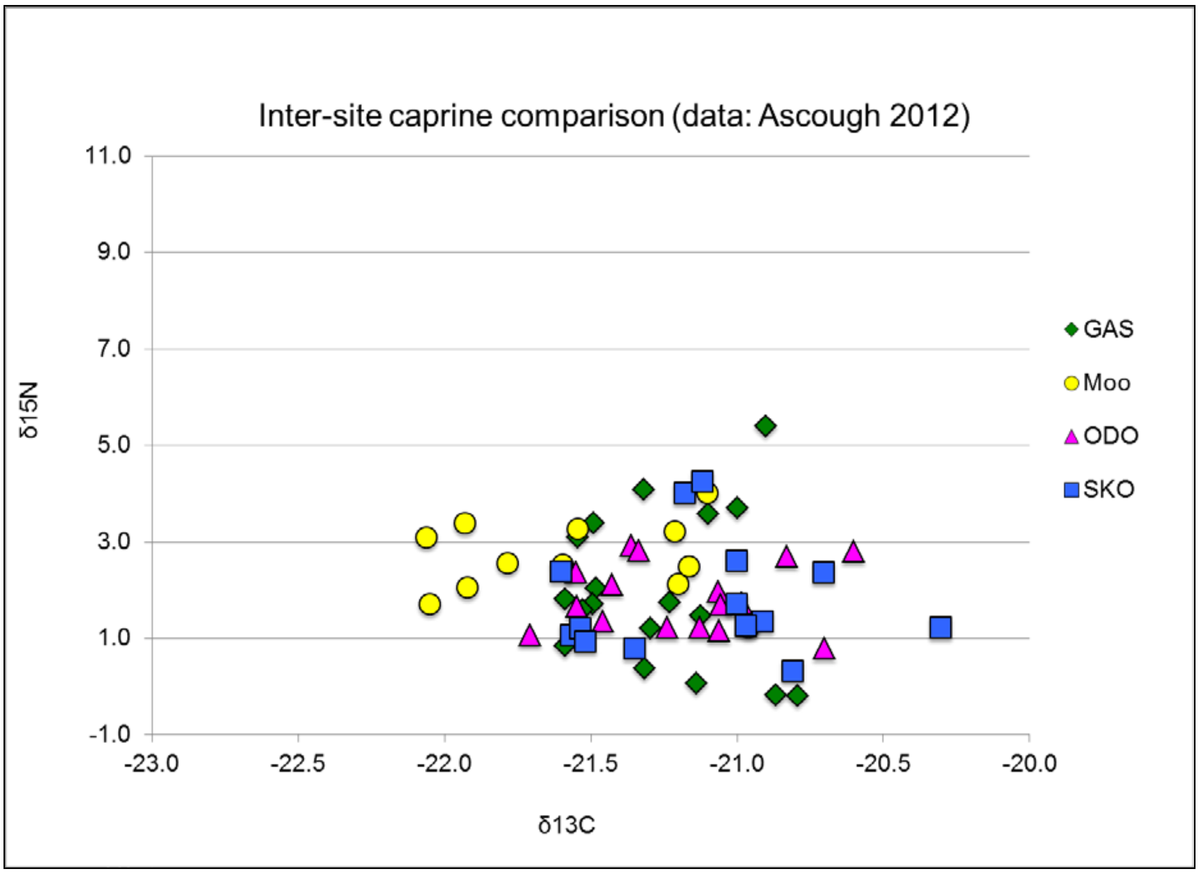


Figure 8.4. Hörgárdalur and Gásir sheep/goat (caprine) bone, delta 13C and delta 15N values (graph and data by Ascough, 2012).

There is a good match of caprine isotopic values from the Hörgárdalur sites and the Gásir ones. Based on the isotopic signatures available for Skuggi SKÖ, Oddstaðir ODÖ and

Möðruvellir MÖÖ, a Gásir site supply with at least some animal products transported from the Hörgárdalur sites cannot be ruled out, given the degree of overlap in values.

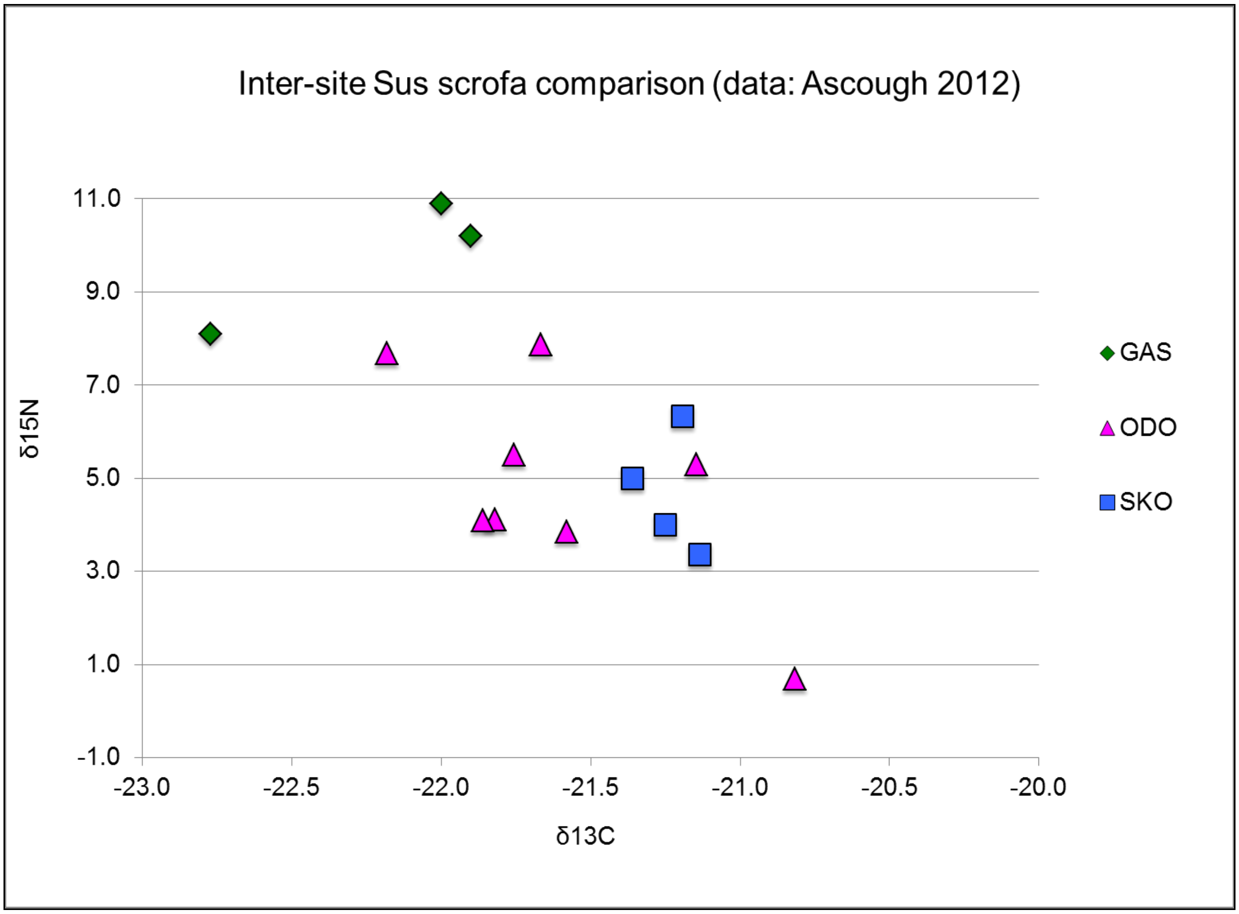


Figure 8.5. Hörgárdalur and Gásir sheep/goat (caprine) bone, delta 13C and delta 15N values (graph and data by Ascough, 2012).

Contrasting with the cattle and caprine data discussed above, the Gásir delta 13C and delta 15N values on pigs are clearly different from the Oddstaðir and especially the Skuggi values from pigs dating to the Viking age/ early medieval phases. Ascough suggests that the Gásir pigs may have been fed animal products at much higher degrees than the Hörgárdalur Viking Age pigs, if the latter had been fed animal waste remains at all. The lack in freshwater fish remains observed in the valley sites' faunal collections are also reflected in the Skuggi and

Oddstaðir pigs isotopic signatures in contrast to some values on Viking Age pigs from the Mývatn/ Laxárdalar region (Ascough 2012, unpublished report). The Gásir medieval pig isotope values are too varied from those at Oddstaðir and Skuggi to suggest a feeding patter similar to the earlier Icelandic pigs, and might suggest foreign were pigs either brought to site alive to be consumed there, or cuts of salted pork were brought on boats for consumption at the destination.

The initial MRE and larger follow up IPY stable isotope study thus indicates that Gásir *could* have been provisioned on locally raised Icelandic sheep and cattle, and does not support a pattern of extensive beef or mutton provisioning via salted provisions or imported live animals. The spread of cattle N and C values is consistent with a pattern of consumption of animals coming from a range of home pastures (perhaps at varied altitudes), but due to issues of equifinality in N and C stable isotope patterns it is not possible to further localize cattle home ranges. The tighter and more homogeneous cluster of sheep N and C isotopic values may reflect a more uniform lifetime grazing pattern that included both upland and lowland vegetation rather than the more localized feeding pattern of the cattle. A new unpublished SUERC study by Sayle et al (2013) on the stratified archaeofauna from the site of Skútustaðir in Mývatnssveit making use of a combination of N, C, S values shows great promise in resolving many of the problems of equifinality in the patterns generated by the N and C values alone, and offers real promise of being able to identify non-local animals from their isotopic signatures.

The pig values provide a useful contrast in signaling a feeding pattern very different from the earlier Icelandic Viking Age and early medieval patterns in Hörgárdalur. By the time Gásir was in full operation, pigs seem to have become rare in the Icelandic landscape, and the presence of pig bones at Gásir would raise questions of import even without the isotopic values. It may be worth noting that the Hörgárdalur site of Oddstaðir presents a very unusual pattern in apparently maintaining local pig-raising into the high Middle Ages. If this pattern of late pig keeping at Oddstaðir is associated with any pattern of provisioning of Gásir, the isotopic patterns of the Gásir pigs that have now been studied do not reflect this.

The two sets of isotopic studies (MRE and follow up IPY) thus provide some support for the Intermediate Scenario: Gásir was provisioned by local sheep and cattle, and the cattle at least seem to have had variable feeding histories. The pig results raise many intriguing questions, but at least demonstrate that the overall Gásir provisioning effort was likely multi-stranded and perhaps more complex than would be required by the Minimalist Scenario.

8.2.6. *Vertebrate Zooarchaeological Evidence*

The largest sets of data offering new information on Icelandic Viking Age and medieval farming practices in light of historic and environmental contexts provided in this dissertation derive from the archaeofaunal collections. This discussion summarizes various aspects on the Gásir and Hörgárdalur human ecodynamics that can be addressed by the current faunal data. This project has been fortunate in being able to locate and at least partially excavate Hörgárdalur sites which were occupied before and during the Gásir period, and these make up a key element in an attempt to assess the Gásir Hinterland Scenarios.

8.2.6.1. Long-term Regional and Single site Chronologies through Faunal Collections from Local Farm Middens

One of the potentially greatest contributions the Gásir and Gásir Hinterlands Project’s faunal collections bring to the current body of knowledge about a Gásir impact on a possible hinterland is an idea on regional farming practices and economic decisions made through time.

The excavated faunal remains can be associated with the regional chronology that has been established through combined analysis of volcanic tephra layers, radiocarbon analysis and zooarchaeology. Thus, an initial pattern of a dynamic and yet remarkably stable system of Hörgárdalur domesticate husbandry is emerging for the first time, spanning the time of settlement through the end of the 14th c.

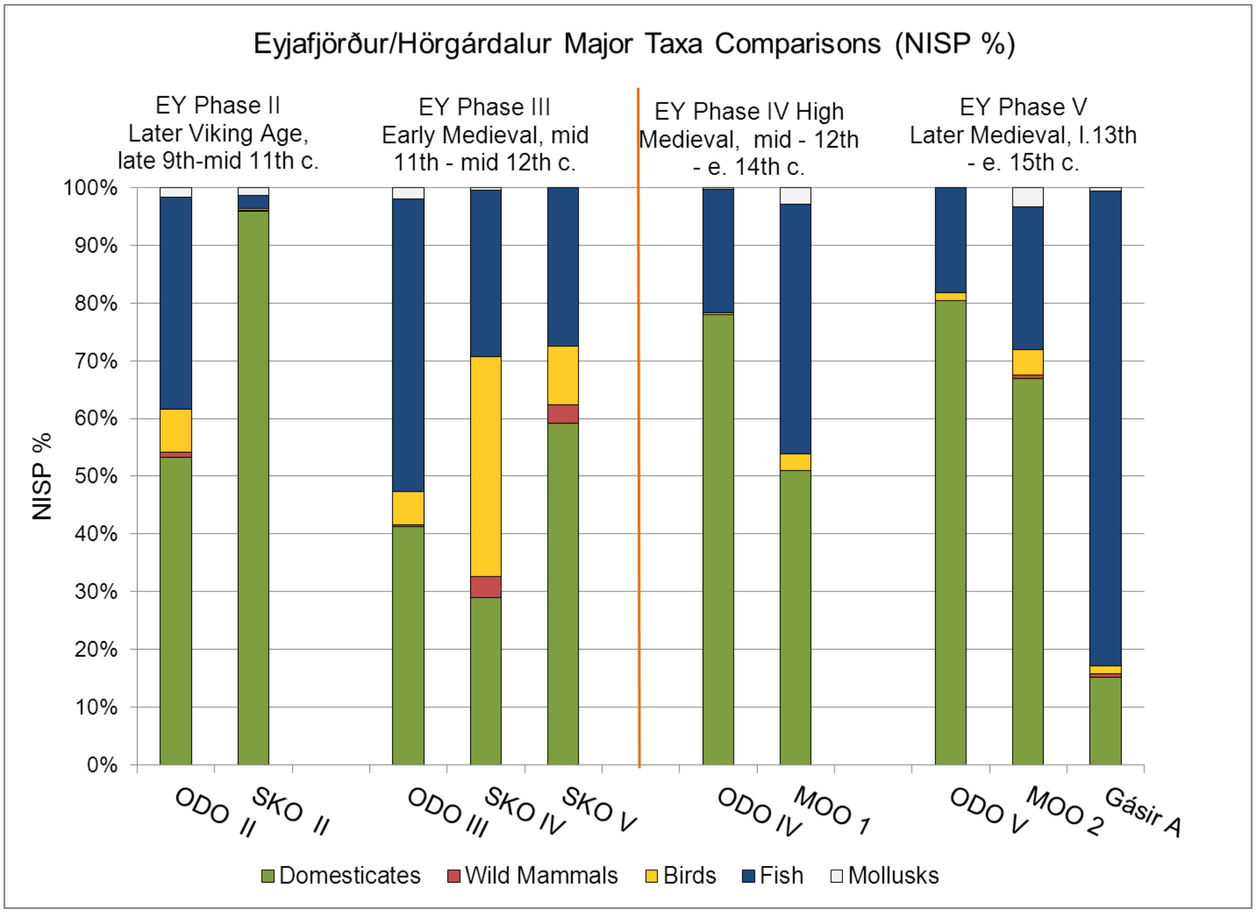


Figure 8.6. Gásir and Hörgárdalur sites; phased major animal taxa distributions. ODO II and SKO II are Viking Age faunas, ODO III and SKO IV, and SKO V from early, ODO IV and MOO 1 from high, and ODO V, MOO 2, and Gásir Area A from later, 13th and 14th c. medieval faunal materials.

The phased major taxa distribution profiles per site and period indicate that at some time after the mid-12th c., a shift in the regional resource management took place: in general, all sites seem to have shifted predominantly to domesticate consumption/utilization, with proportionally lower wild resources displayed in the phased NISP break-downs. This is a development that somewhat contrasts with patterns at other Icelandic medieval sites where there is a general increase in the proportion of marine fish bones relative to domestic mammal bones through time in sites with good organic preservation and large scale sieving (McGovern et al 2007). However in the current sample of Hörgárdalur sites the fish percentages (and marine mammal bones) decrease from the late Viking Age to the earlier, high, and later middle ages. In other parts of Northern Iceland (notably Svalbarðshreppur, Amorosi 1992, J. Woollett personal communication, 2013, Hébert-Dupont 2013) relative percentages of domestic animals drop when compared to those of both marine fish and seals during this same period. It would appear that some (archaeologically invisible?) resources were reaching the Hörgárdalur sites that permitted a different response to a potential climate impact on farming conditions.

Despite lacking an idea of the volume, the evidence for grain import into Gásir might suggest that imported grain could have played this supplementary role enabling a continued focus on domestic animal production despite worsening farming conditions. The example of the regular exchange of Baltic grain for dried fish in the North Norwegian Lofoten and Vesteralen islands (well underway by AD1200) and the provisioning of these arctic fishing settlements with non-local cereals provides a contemporary model of potential relevance (Urbancyzk 1992, Perdikaris 1999).

8.2.6.2. Models for the Local Food and Staple Supply System

If the Intermediate Scenario envisaging significant economic connections between Gásir and the nearby and wider Icelandic hinterland is to be made plausible, we need to marshal evidence for specialized meat production patterns different from normal mixed herding subsistence economy and for intensified wool production that could plausibly generate regular surpluses beyond the normal household or local community requirements. Under the Intermediate Scenario, specialized animal herding stations such as Klausturhús and Möðruvallasel could have provided the surplus production for vaðmál found at Möðruvellir and Gásir as well as the roving found at the latter. As argued above and in Harrison (2010), the replacement of small tenant households like Skuggi with specialized sheep herding structures at the same elevation and occupying the same pasture areas would dramatically change the economics of wool production in Hörgárdalur. However, a wool surplus is only valuable to landowners if a market exists for the product, as only then will the value of an in-place retainer family be outweighed by the value of an exportable staple good (Keller 2010, Perdikaris & McGovern 2008) Under the Intermediate Scenario, the locational choices reflected in the replacement of Skuggi with Klausturhús would reflect one part of the large scale local exchange system in place in Hörgárdalur to support an export of sheep wool products. The other regional exchange system, not geared for export, but for supplying the Gásir (summer) residents would then be based on the prime beef and mutton found at the trading site and seemingly supplied from sites such as Oddstaðir.

Möðruvellir was probably instrumental in the Gásir trading enterprise and may have potentially coordinated a concentration of goods from Hörgárdalur, but it likely was not the only Hörgárdalur or Eyjafjörður power broker in this system and additional work is needed to confirm or refute this assumption. The following sections will summarize the zooarchaeological evidence for specialized beef production and wool surplus production discussed in more detail in the chapters above.

8.2.6.2.1. Evidence for Cattle Management Aimed at Meat Production

As argued above, the overall proportions of domestic mammal bones at Gásir most resemble those of a large prosperous farm, especially in the high proportion of cattle bones (40% of mammals). On contemporary Icelandic farms (even large manors) the cattle culling profile reflected a strong dairy strategy that produced age at death profiles strongly dominated by very young calves (neo-natal) and aged worn out dairy cattle (old adults). This is a widespread pattern throughout the N Atlantic islands, reflecting the 4 to 1 energetic advantage of dairy production vs. beef production in an environmental context of short growing season and low pasture productivity (Mulville et al 2005). Production of animals for prime beef consumption requires raising milk-consuming young animals to near-adult size and weight, which prevents significant off-take of milk for human consumption. While sheep and goat flocks can normally be managed for multiple products, few modern farmers attempt to mix dairy and beef production strategies in cattle herding. Given the small probable total size of most medieval Norse cattle herds (byre areas where preserved suggest a dozen cattle would be a large farm herd), the tradeoff costs would become even more significant.

Thus when the high cattle bone percentage at medieval Gásir is combined with an exceptionally low percentage of neonatal cattle bones and a high ratio of “prime beef” age cattle bones, and a pattern of a surplus of high meat value bones it is reasonable to suspect that some farms in the surrounding areas were deciding to increase beef production to provision Gásir. Can we use the available zooarchaeology to identify potential sources of this high quality beef? At Oddstaðir, the proportion of cattle was the highest in the 13th and 14th c., taking up almost 30 % of the mammal taxa profile and equally high as the cattle percentage at contemporaneous

Möðruvellir. To date, Oddstaðir may be the only middle ranking inland farm from this period that has generated a quantifiable amount of faunal materials, although faunal remains from medieval deposits of middle to high ranking coastal farms, for example Gjögur in the West Fjords and Svalbarð in Svalbarðshreppur, have been analyzed (Krivogorskaya et al. 2005, Amorosi 1996, Woollett 2008). This of course calls for continued research to hopefully result in better fitting contemporaneous comparatives. For now, it is probably sufficient to note how divergent the economic trajectories evident on the Oddstaðir farm are from all other known medieval stratified archaeofauna in terms of cattle to caprine ratios, goat to sheep, and marine to terrestrial proportions. As discussed at length in the Gásir data chapter, the evidence from cattle skeletal remains distribution, Bone Density Ranking, and Meat Utility Ranking analyses suggest that a significant part of the cattle skeletons was removed to be consumed or exchanged elsewhere (Chapter 4, Section 4.6.2.).

In sum, the available vertebrate zooarchaeological evidence seems to support unusual patterns of cattle beef production, slaughter, and consumption at Gásir and Oddstaðir. While multiple interpretations remain possible, these data would seem to support the Intermediate Scenario for Gásir far better than the Minimalist Scenario.

8.2.6.2.2. Livestock Management Aimed at Wool Production

If an argument for Gásir hinterland impact can be built around intensified wool production, then we need to address the inter-connected patterns of 1) caprine to cattle ratios that reflect the overall mix of the different major domestic species; 2) ratios of goat to sheep within the caprine taxonomic category; 3) age at death of sheep (with older adults reflecting wool production).

If an argument for Gásir hinterland impact can be built around intensified wool production, then we need to address the inter-connected patterns of 1) caprine to cattle ratios that reflect the overall mix of the different major domestic species; 2) ratios of goat to sheep within the caprine taxonomic category; 3) age at death of sheep (with older adults reflecting wool production).

8.2.6.2.2.1. Caprine to Cattle Ratios

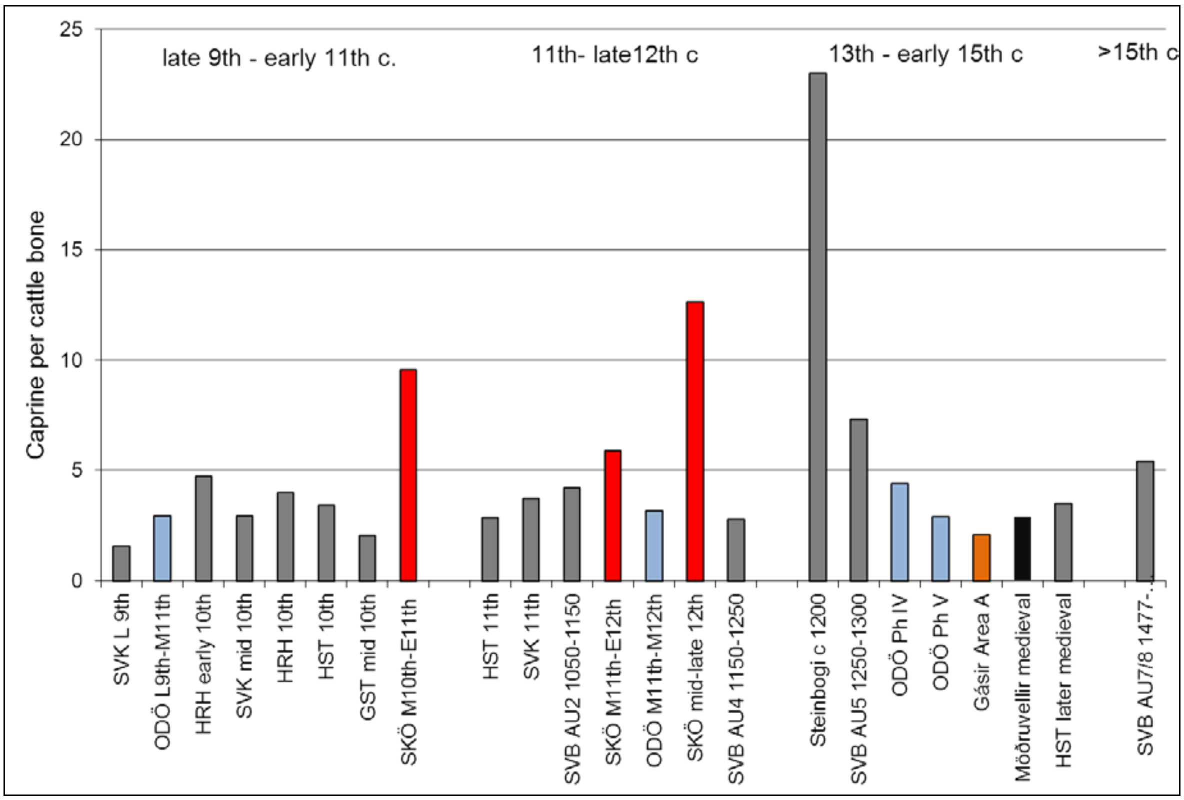


Figure 8.7. Comparison of caprine/cattle ratios from various Viking Age and medieval Icelandic sites. Sveigakot (McGovern et al 2004), Hrísheimar (McGovern & Perdikaris 2002), Selhagi (McGovern & Perdikaris 2003, Draft), Hofstaðir (McGovern et al 2009, post-1300 Hofstaðir data: McGovern f*orthcoming*) and Steinbogi (Brewington et al 2004) in Mývatnssveit; Svalbarð in Svalbarðshreppur (Amorosi 1996), Granastaðir (Amorosi & McGovern 1994), Skuggi, Oddstaðir, Gásir, and Möðruvellir in Eyjafjörður (SKÖ, ODÖ, Gásir, Möðruvellir data by author).

Except for the higher ratio of 4 caprine elements per 1 cattle element in Phase IV, the Oddstaðir caprine to cattle ratio seems to remain at a relatively constant 3 to 1 from early occupation through the latest. This pattern contrasts significantly with the one observed in the archaeofauna from neighboring Skuggi, where a ratio of ca. 9.5 caprine bones per cattle bone in the earliest phase changes to a caprine/cattle ratio of 6:1 for the mid-11th – early 12th century collection and then rises to 12.5 caprines per cattle in the terminal phase in the later 12th c. The overall Oddstaðir caprine/cattle ratio resembles the one from medieval Möðruvellir, and also the one from that of Gásir (caprine/cattle ratio = 2:1), albeit to a lesser degree (e.g. Harrison 2006).

The rather constant profile of these most frequently utilized domesticate species in medieval Iceland observed from the Oddstaðir archaeofauna may indicate that this farm site may have not seen much change in its cattle herd size relative to that of its sheep/goat herd size throughout its apparent occupation. It also demonstrates that the small scale site at Skuggi very clearly saw a change from high caprine to cattle ratio to a 14:1 caprine to cattle ratio, which could either be an indicator for a specialized herding strategy or for poverty. The section below shows comparative sheep vs. goat ratios to further discuss potential markers of local wool (surplus) production as suggested by the age-at-death profile in the following section.

8.2.6.2.2.2. Ratios of Goat to Sheep within the Caprine Taxonomic Category

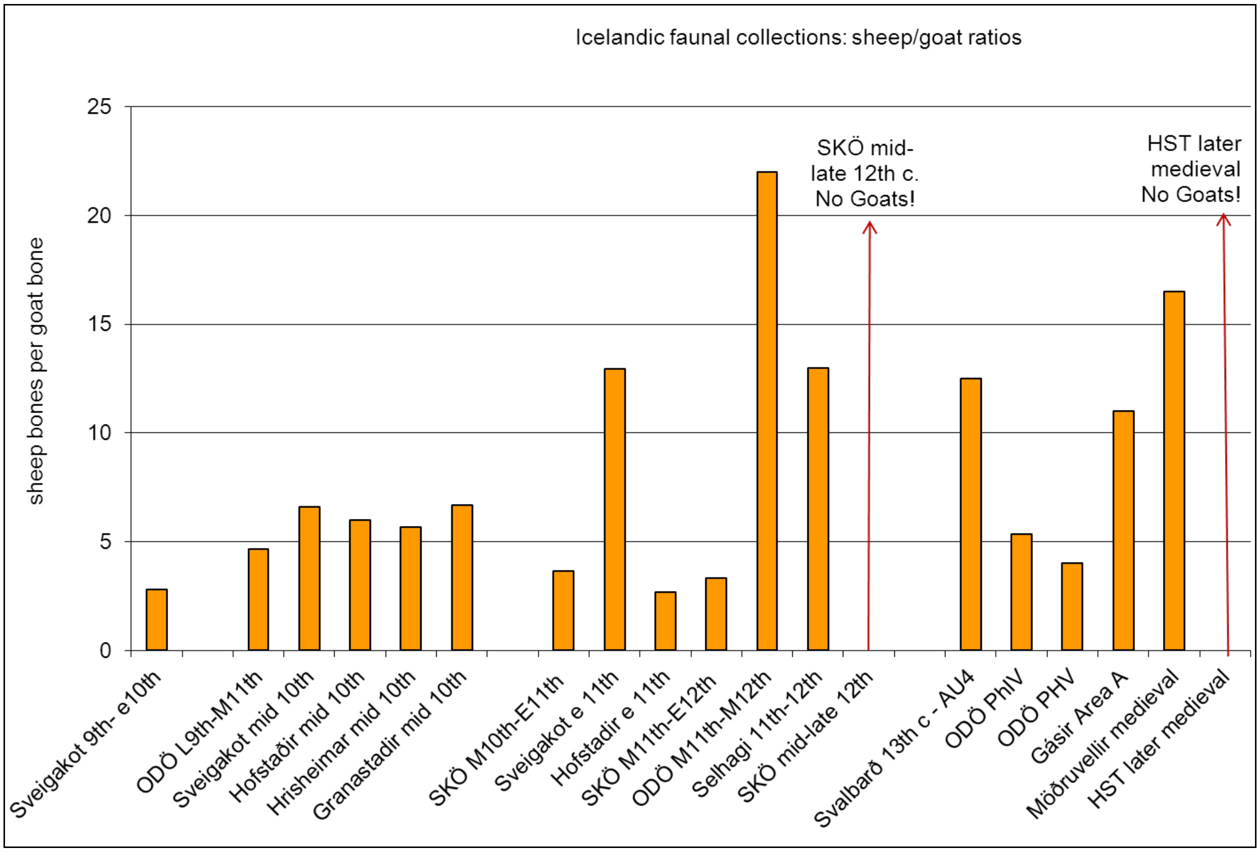


Figure 8.8. Icelandic sheep/goat ratio comparisons. The higher the bar, the more sheep were found in an assemblage. The 12th c. Skuggi (SKÖ) and later medieval (post 1300) Hofstaðir (HST) collections contained no goats and have therefor no ratios. Sveigakot (McGovern et al 2004), Hrísheimar (McGovern & Perdikaris 2002), Selhagi (McGovern & Perdikaris 2003, Draft), Hofstaðir (McGovern et al 2009, post-1300 Hofstaðir data: McGovern f*orthcoming*) and Steinbogi (Brewington et al 2004) in Mývatnssveit; Svalbarð in Svalbarðshreppur (Amorosi 1996), Granastaðir (Amorosi & McGovern 1994), Skuggi, Oddstaðir, Gásir, and Möðruvellir in Eyjafjörður (SKÖ, ODÖ, Gásir, Möðruvellir data by author).

The sheep / goat ratios presented here are from faunal collections spanning the time of the Viking Age through the late 14th/early 15th c from Mývatnssveit, Svalbarðshreppur, and Eyjafjörður. These ratios mainly serve a better understanding of a farm´s caprine herd strategy: the more balanced the ratio, the more likely the caprine herd containing equal (or at least more equal) numbers of sheep and goats and possibly - but not necessarily using the first for mainly wool production and the second for mainly meat, and also milk production. Clearly, a mix of dairying, meat, and wool was possible for the sheep proportion of the caprine herd strategy. But there could have been a clearer division for usage of animals for the one or the other purpose, with goats used likely for dairy and meat, and sheep likely used predominantly for wool and dairy.

These goat and sheep ratios would have been close to 1:1 in Iron Age Scandinavian herds (i.e. Perdikaris 1996), and have been found to range from ca. 3:1 to ca. 6:1 sheep elements per goat element in analyzed archaeofaunal collections from the Icelandic Settlement period in Northern Iceland (McGovern et al 2007, 2009). By the 11th and 12th centuries, goats were no longer utilized as heavily as sheep, possibly at least partially due to their destructive browsing habits, but also because sheep were a better 'package' in terms of utilization. One reason for a generally observed change from the Viking Age sheep vs. goat ratio to above 10:1 could be the fact that sheep had wool and wool became an important staple as well as export good in the later medieval times (Þorláksson 1989). Both sheep and goats produce milk and meat, but only sheep produce wool. If a wool surplus above local consumption needs were to be created, it would follow that many farms would need to shift the flock balance towards sheep.

As the graph above indicates, the 11th - 12th c. faunal collections from Sveigakot, Oddstaðir, and especially Svalbarð exhibit high ratios of sheep vs. goat bone, with a 20+:1 ratio for Oddstaðir, and no goats in the 12th c. Skuggi or later medieval Hofstaðir (post-1300) collections. In the post-1300 Hofstaðir deposits, there are no identified goat remains but 185 elements that could be identified as sheep. It seems that by the 13th-14th centuries many farms had shifted their flocks strongly towards sheep and away from goat raising. In the 13th and 14th c., Möðruvellir has a ratio of 15+ sheep: 1 goat element, and Gásir and Svalbarð exhibit ratios of ca. 10-12 sheep elements per 1 goat element. The Oddstaðir sheep/goat ratio on the other hand seems to have become much more balanced, with sheep vs. goat levels seemingly back to Settlement era levels. This represents another anomaly of the Oddstaðir domestic mammal management strategy, and it occurs during the period of Oddstaðir's change in cattle management. One potential explanation might be that goat milk was again being consumed by the Oddstaðir household as the cattle herd was being increasingly managed for meat, but in any case it suggests strongly that Oddstaðir was engaging in food production intensification rather than participating in the apparently widespread shift towards sheep and wool production, suggesting that this farm was indeed independent (Vésteinsson, personal communication May 2013).

8.2.6.2.2.3. Age at Death of Sheep (with Older Adults Reflecting Animals Utilized for Wool Production)

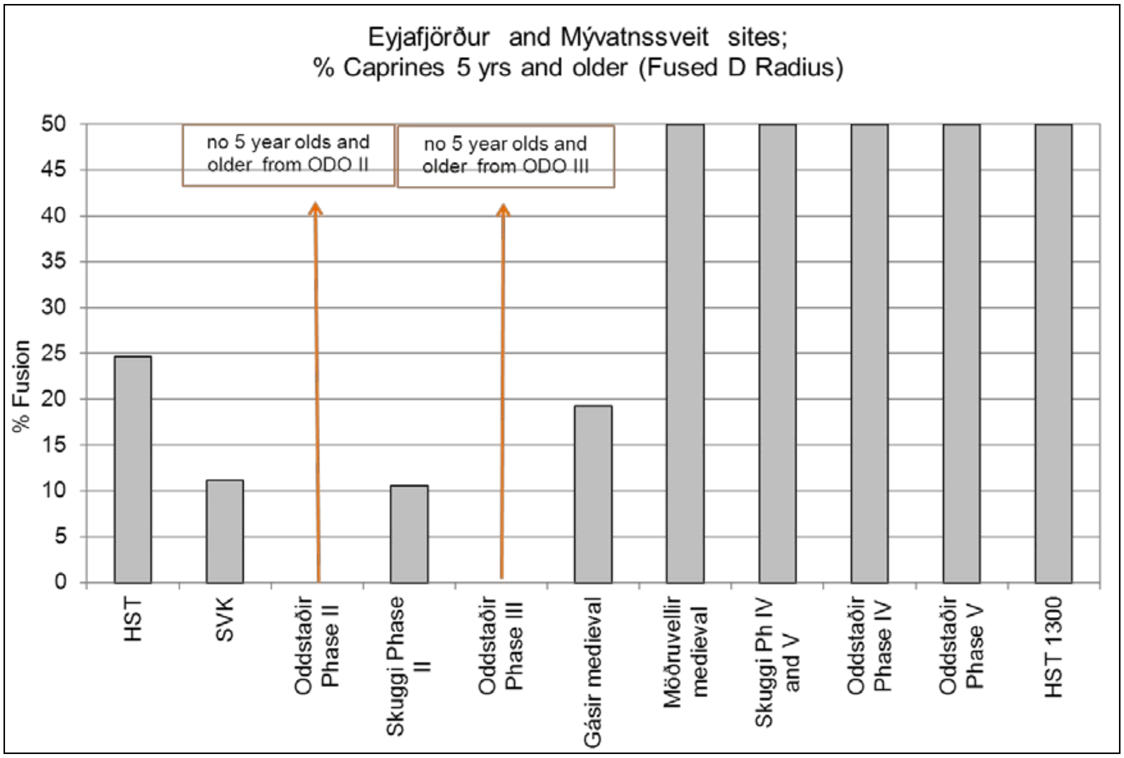


Figure 8.9. Gásir and Hörgárdalur 11th - 14th c. sites' ovi-caprine (predominantly sheep) age at death profiles compared to Mývatnssveit sites (HST - Hofstaðir, SVK - Sveigakot). Age at death reconstructions are based on long bone fusion data, with only the 5yrs+ data for distal radius fusion stages presented (Reitz and Wing 1999).

The data presented in the above graph indicate an observable change in the Skuggi sheep/goat management system from a more dairying oriented Viking Age sheep/caprine management to one strongly concentrating on wool production in the medieval deposits, with the same pattern also observed in 13th and 14th c. deposits from Oddstaðir and Möðruvellir. The late Viking Age/early medieval data from Skuggi is paralleled in the Mývatnssveit site of Sveigakot, with a higher amount of older sheep at the later Viking Age site and chieftain's farm at Hofstaðir. The contrast between Gásir and the Hörgárdalur sheep/goat (predominantly sheep -

see data chapters for NISPs) age at death profiles indicate that not only cattle but also sheep and goat were raised for meat provisioning purposes. Together with the above sheep/goat ratios, it is possible to argue here for sheep as wool producers first and dairy/meat producers second.
During the later Skuggi and Oddstaðir phases, a clear shift toward an 'older' sheep can be observed, and that may be indeed a sign of more intensified wool production. Especially compared to the Mývatnssveit farms of Sveigakot and Hofstaðir, where far fewer than half of the sheep survived until the fusion of the distal radius stage.

As a whole, the admittedly incomplete evidence for caprine herding strategies in Eyjafjörður, Mývatnssveit, and Svalbarðshreppur indicates a widespread shift in flock management during the Viking Age to high medieval transition. On some smaller farms (Skuggi, Steinbogi, Sveigakot) there seems to be a clear pattern of increasing overall caprine herds and reduction of cattle herds as observed during the Viking Age. Other farms (almost certainly richer) do not show the same clear trend in caprine to cattle bone ratios. However, all sites except Oddstaðir do show a shift in the balance of goats and sheep decisively tilting the flocks towards a specialization on sheep. All these later archaeofauna likewise show a shift towards an older flock (presumably old ewes and wethers). Taken together these data do suggest an overall pattern consistent with intensified wool production, while again flagging the anomalous pathway apparently taken by the Oddstaðir household.

These patterns in the vertebrate zooarchaeology together with the evidence of the woolen cloth fragments and invertebrate zooarchaeology (as well as available documents) indicate the importance of wool as a surplus product that could potentially be standardized and commoditized for both internal and overseas exchange.

8.3. Conclusion

The core objective of this doctoral dissertation has been to bring new light to the question whether and to what degree Iceland and especially Eyjafjörður experienced the impact of international trade systems ca. AD1250-1350. The full evaluation of this proto-world system impact is a task that will require much more work by many scholars, and this doctoral project does not claim to have settled the many questions associated with high medieval trade and exchange in Iceland. All evidence assembled remains open to multiple interpretations, and thus a scenario based approach has been adopted to attempt assessment of the diverse data sets and their patterning. While much work remains to be done to realistically test these (and potentially other) scenarios for regional-scale interaction in Viking Age to early Modern Eyjafjordur, the work of the Gásir Hinterlands Project can be seen to have significantly advanced the debate and widened the knowledge base for further investigation.

The evaluation of scenarios for interaction presented here remains inevitably preliminary, it is, however, based upon a large and diverse body of new evidence that will make significant contribution to any future investigation of these issues. While assembling and disseminating new data is a core responsibility of this doctoral project, it will also use the evidence currently available to provide an assessment of the three scenarios detailed above.

8.3.1. *Evaluating Scenarios*

The summary discussion and detailed data chapters above provide evidence from a range of sources that allow for different degrees of reasonable and effective quantification. It may now be helpful to summarize these diverse sources in a "box score" for consideration and evaluation. Drawing on the experience of the ongoing cross-regional comparative work of the LTVTP-

NABO collaboration (Hegmon et al. 2013), it may be useful to organize this box score presentation as a "fuzzy set qualitative comparative analysis" (fsQCA) matrix with variables scored on a four point scale (0 = no, 0.25 = more no than yes, 0.75= more yes than no, 1 = yes). This approach draws on the work of Charles Ragin (1987, 2000, 2008) and Matthew Peebles (Peebles et al., *forthcoming*) in seeking better ways of integrating diverse and often partly qualitative data sets. As Peebles notes:

> *"These approaches, which have gained considerable popularity in many branches of social science in recent years (see http://www.compasss.org/ for a bibliography of over 250 recent articles), provide a bridge between fully quantitative and qualitative approaches to systematic comparison. We argue that such approaches are particularly relevant for comparative archaeological research as they were designed to deal with many of the issues of data comparability and equifinality that we often face in such endeavors."*
> (Peebles et al forthcoming; see also Hegmon et al 2008 for a different application).

QCA approaches are thus gaining interest in archaeology as a means of combining qualitative data, presence/absence evidence (goats / no goats), interval scale quantitative data (e.g. 350 counted sheep bones vs. 12 counted goat bones), and rank scale quantitative data (e.g. "many more of x than y") through a coding approach that emphasizes degrees of uncertainty rather than presenting a single value. It presents a well-evaluated approach to assessing complex comparative problems that falls between inappropriately applied inferential statistics and highly personal *ad hoc* assessments and may provide a tool for clearer thinking about cases with multiple possible interpretations. While no great analytical rigor is claimed for this fsQCA application, the approach may at least serve to provide a useful summary evaluation table for the evidence accumulated to assess our three explanatory scenarios for the Gásir hinterlands. The fsQCA box score table below thus combines the qualitative and quantitative evidence assembled in the main body of the thesis above.

	Scenario				
fsQCA	Maximalist	Intermediate	Minimalist	score	
Gásir Site scale	0.25	0.75	0	0	no
Gásir Site layout	0	0.75	0	0.25	more no than yes
Gásir artifact assemblage	0.25	0.75	0.25	0.75	more yes than no
Gásir Animal isotope pattern	0.75	0.75	0.25	1	yes
Gásir invert. Zooarch. Evidence	0.75	0.75	0.25		
Gásir Cattle age distrib.	0.75	0.75	0.25		
Gásir Cattle element distrib.	0.75	0.75	0		
Gásir Caprine age distrib.	0.75	0.75	0		
Gásir Caprine element distrib.	0.75	0.75	0		
Gásir fish provisioning pattern	1	1	0.25		
Cloth standardization evidence	1	1	0.25		
Fish standardization evidence	1	1	0.25		
Oddstaðir artifact assemblage	0	0.25	0.75		
Oddstaðir Cattle age distrib.	1	1	0		
Oddstaðir Cattle element distrib.	1	1	0		
Oddstaðir decl. marine res.	0.75	0.75	0.25		
Oddstaðir stable Cattle/Caprine	0.75	0.75	0.25		
Oddstaðir goat %	0.75	0.75	0.25		
Landuse reorg. (sheep houses)	1	1	0.25		
Regional increase in Caprine ratio	1	1	0.25		
Regional increase in sheep vs. goat	1	1	0.25		
	Maximalist	Intermediate	Minimalist		
mean QCA score (1 to 0 scale)	0.73	0.82	0.19		

Table 8.3. Qualitative Comparative Analysis (fsQCA) table after Peeples et al (*forthcoming)*. The different scores indicate no likelihood (0), more not than yes likelihood (0.25), more yes than not likelihood (0.75), and most likelihood (0) of a certain variable fitting a certain set.

As the fsQCA table suggests, while there is much room for uncertainty and a definite need for further work, the Maximalist and Intermediate scenarios score higher than the Minimalist scenario in most categories and also in the summary assessment. However, we have good reason to reject the Maximalist scenario despite this box score.

The amount of materials retrieved and the ephemeral occupation nature of this relatively small (in comparison with other medieval towns, i.e. York Hall 1994), Novgorod (Brisbaine & Gaimster 2001), Winchester (Serjeantsen & Rees 2009), coastal sites do not support the idea of a fully-monetized, year-round urban institution. The maximalist scenario is not well supported by the full range of data available, even though some lines of evidence support or fail to contradict some of its basic requirements.

The Minimalist scenario also appears unlikely, and its basic assumptions do not seem to be well supported by the available evidence. The archaeological and especially the zooarchaeological record seem to negate the idea that Gásir was just a passage-site where not much exchange was happening beyond sailors waiting to be picked up for their journey home, or the occasional boat repair. There would be little need for a seemingly well-organized high-quality food provisioning system leaving traces in Hörgárdalur (i.e. Oddstaðir site) and at Gásir itself. This is not to say that the high-meat bearing cattle elements missing from the Oddstaðir collection were necessarily those found at Gásir, but that what we know of the overall patterning and trajectory of the Oddstaðir economy corresponds closely to the patterns of a farm economy that would be needed to provision Gásir with the proportions of animals and cuts of meat that are in fact observed in the Gásir archaeofauna. Specialized beef production products produced at Oddstaðir could potentially have been sent elsewhere, and could have provisioned magnate farms in Eyjafjördur and beyond. However, the temporal correlation of the production shifts with the establishment of Gasir, the complimentary patterning in cattle bone element distributions in Gásir and Oddstaðir, the geographic proximity of Oddstaðir to Gasir, and basic topography of this narrow valley system and known routeways clearly make Gásir one clear and logical destination for the beef produced at Oddstadir. More work in the region is clearly important, but at this stage in research it remains a reasonable hypothesis that Oddstaðir was indeed part of the Gásir hinterland.

In this scenario, it is possible to find aspects of a trading center meeting upon aspects of a small scale seasonal outpost to produce a set of activities likely encountered at Gásir: some local exchange and direct trade between people from Eyjafjörður and regions beyond with foreign traders, possibly some entertainment and feast days, with a show of social status and potentially social contracts such as marriages taking place, with no coin currency exchanged but instead likely barter being carried out.

In conclusion, the Gásir site seems to have enough of an effect on Hörgárdalur to impact local decision making on the farms researched so far. The local farmers seem to have made a significant investment in connections to Gásir, rather than just providing the site with the output of normal Icelandic farming and fishing subsistence. The Gásir site does not provide material culture markers equivalent of a post-1600 period economy (i.e. Lucas 2009, Hambrecht 2009, 2011) when the pottery or other material goods found at Gásir would be expected to also have been distributed to the sites researched to date; however, there are still enough impacts observed through the archaeofauna and other lines of evidence indicating that Gásir had a perhaps small but nevertheless real foot print on its hinterland.

8.3.2. *Future Work to follow up on this Dissertation Project*

As mentioned at the beginning of the conclusion chapter, there is not just one way of interpreting the data available, especially the faunal and environmental information gathered to date. And it seems clear that this increasingly rich regional case study requires more investigation and expanded data and modelling efforts to better understand patterns and evaluate scenarios.

This section provides a series of plans for future research to add to the body of data collected for this doctoral dissertation in order to arrive at an even finer resolution and therefore better idea of the human socio-ecodynamics at play between international trade/exchange at Gásir and the impact this had on medieval Eyjafjörður and beyond. Hörgárdalur work to be continue: Siglunes et al

Through a US NSF CIE grant (grant # 1202692), the Skuggi research will be continued in the 2013 and 2014 summer seasons. The entire midden material will be retrieved from the structure that is filled in. Following collection of the complete archaeofauna and exposure of the structural remains will be the excavation of this structure containing still standing walls built from turves with Landnám tephra layers and the examination of other, younger looking ruins at this site.

The second part of the Hörgárdalur and generally Eyjafjörður field work for the next three seasons will consist of series of midden site surveys including strategic coring and test-trenching of as many contemporary middens from as many different sites as possible to collect dating information regarding settlement structure and dynamics, as well as to study the impact Gásir and international trade may have had on the region. Selected sites will see larger excavation strategies to add refinement to the already substantial faunal record.

The hope is further to investigate sites with occupation periods between AD1400-1600 to investigate the potential reasons for Gásir´s demise and the extent of an impact it may have had on the region.

8.3.2.1. Siglunes: Continued Work at the Eroding Early Medieval Fishery Site

To find out more on the connection between Gásir and the bulk export of wool but also dried cod fish, a new project was started in 2011, and is part of the larger Eyjafjörður long-term Ecodynamics Research.

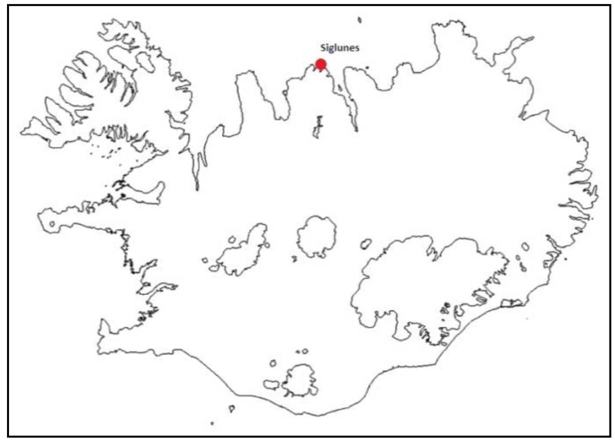


Figure 8.10. Map of Iceland, indicating the Siglunes location at the very mouth of Eyjafjörður´s western coast (Lárusdóttir & Roberts 2012:4.

Project Background

This rescue and excavation project in the far North of Eyjafjörður is a NABO collaboration with currently four team members from the Institute of Archaeology, Iceland and the CUNY Graduate School and University Center. The first two seasons in 2011 and 2012 were small team site investigations in preparation for larger projects in the 2013-15 field seasons. This approach will allow for a thorough assessment of the ruins´ preservation state and lead to an effective and comprehensive large-scale excavation plan for the next step of this project. The archaeological project builds on survey work done in the whole Siglufjörður district in 2004 and 2006 when the poor preservation state of some of the remaining Siglunes structures due to coastal erosion was detected, resulting in the currently ongoing rescue and research excavation project (http://www.nabohome.org/cgi_bin/explore3.pl?keyword=G%E1sir).

8.3.3. *World Systems and Human Ecodynamics in Medieval Iceland: Gásir in Eyjafjörður – Contributions to Knowledge*

This dissertation places the data from the Gásir, Möðruvellir, Skuggi, and Oddstaðir case studies into a general historic and environmental background to improve our understanding of economy and settlement in Hörgárdalur and to assess the impact Gásir might have had on the surrounding region. This research project has generated a working chronology of sites in the region based upon multiple radiocarbon dates, volcanic tephra, and the available artifactual and documentary record. The GHP project has undertaken major excavations at the sites of Möðruvellir, Skuggi, and Oddstaðir, and also Myrkárdalur (though not included in this dissertation), and has carried out second phase survey assessments of 8 additional sites in the immediate region. It has generated major new archaeofauna from datable contexts with a total fragment count of over 71,000. With the considerable help of collaborating specialists, this project has assembled data on landscape, stable isotopes, wool cloth, and invertebrate zooarchaeology for the region. This project also forms the basis for an ongoing and expanded multi-disciplinary investigation funded as part of the Comparative Island Ecodynamics project, which will build upon the years of field and laboratory work invested in the Gásir Hinterlands Project. While the work of this doctoral project inevitably has raised as many questions as it has answered, it has made significant contribution to the basic data available for the region and period, and provides a firm basis for further research.

Appendix I
Midden Site Prospection Report: 2008-09 Gásir Hinterlands Project sites[9]

Although no midden excavation was possible on the sites described here (put pictures back in), they do provide some information regarding their position in the landscape and/or the environmental conditions connected with that immediate landscape. One example is the farm at Skriða, already mentioned earlier in this chapter (see landslides discussion). Skriða was originally called Langahlíð but renamed after a landslide that had destroyed the main building of this one time manorial farm (Hreiðarsdóttir et al 2008, Júliusson 2010:10, Jónson 1992:306-308), the farm was moved and renamed. Several of the sites described below were heavily impacted by landslides and were either abandoned or the farm had to be moved elsewhere on the site's property.

The three letter abbreviations are a construct of the site name and the suffix '*öskuhóll*' or midden and are site codes.

Möðruvallasel MSÖ – (EY200_006)

Coordinates: 65º39.247'N, 18º37.820'W, Elevation: 41m asl.

This site was used as shieling site for sheep in medieval and early modern times and is associated with the church farm at Möðruvellir in several documents. The ruin is located about a 45 minute walk from the nearest jeep trail, and it would be logistically difficult to establish an excavation there.

[9] The great majority of the information presented here was duplicated from Harrison 2008 and Harrison et al 2010.

The landowner reports that while summer grazing was good, the weather in this steep sided glacial valley was often very bad, with high winds and deep snow in the winter. This may be a factor in the long term land use pattern, as it appears that the substantial MSÖ ruin (easily the size of a small medieval farm) remained only a seasonally occupied summer herding station.

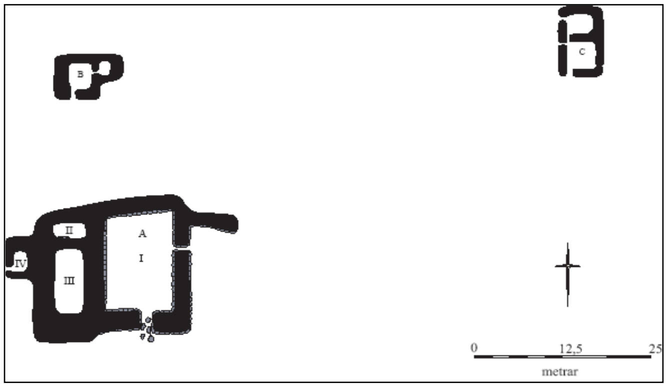


Fig. 1. Survey plan of the shieling; structure A is the main building (Hreiðarsdóttir et al 2008:127; © FSI/Hreiðarsdóttir).

There is a very easily visible raised feature next to the structural ruins that could be a midden mound *(coordinates MSO1 65°39.230'N, 18°37.853'W)*, but upon coring it was found that it was neither rich in ash, nor bone nor charcoal, but that it may have been the result of repeated deposits of sheep dung. A core into the inside of the sel suggested there may have been a floor layer, but if this was indeed a floor deposit, it was not as thick or as compacted as in a normal dwelling house.


Figure 2. Coring at MSÖ with a young helper.


Figure 3. Möðruvallasel ruin, direction S.

MSÖ is thus a very interesting evidence of seasonal herding and upland land use, but probably not a viable target for midden excavation.

Klausturhús KLÖ, (EY215_022)

Coordinates: 65º39.552’N, 18º29.702’W, Elevation: 120 [10] *asl.*

Klausturhús is a very clearly visible and substantial rectilinear ruin, ca. 35-38 m long, near the modern road through Hörgárdalur, situated mid-way up the valley, built on a gravel ridge.

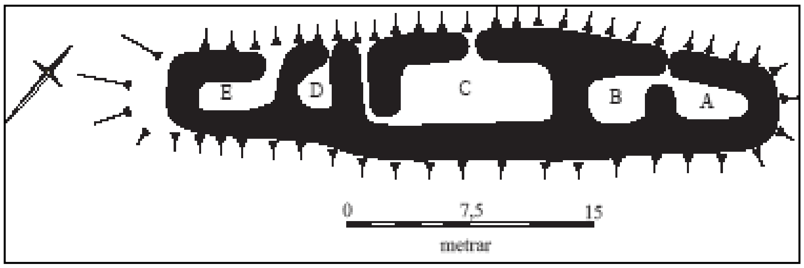


Figure 3. Klausturhús animal shelter, survey plan (Hreiðarsdóttir et al 2008:239; © FSI/Hreiðarsdóttir).


Figure 4. Coring at KLÖ. This structure is elongated E-W, view to East.

There was no clear surface indication of a midden mound, so coring transects were carried out around the structure and downslope where disposal of food and other refuse would be most likely.

Coring revealed that the prehistoric tephras (H3) were quite close to the surface, at a depth of ca 25 and 45 cm. Core number 7, just at the SE wall of the structure contained some turf that possibly included olive colored tephra. Two tephra samples were taken from this site, both tephras were found in a core at 12.40 m east (line running along the Northern wall; coordinates: KLO01 65º39.561’N, 18º29.693’W).

[10] Elevation above sea level was previously listed as 280 m asl (Harrison 2008). This is the correct elevation.

The first tephra sample may have been a layer within a turf that had been cut into deposits containing 1422 or 1477 AD tephra (purple-black), encountered in the core profile at a depth between 20-34 cm. From the same core, at 37cm below surface, an olive/black tephra was encountered and also sampled. Further investigation of the site by Dr. Simpson and the geoarchaeology team will clarify these relationships and help establish the chronology of this substantial old structure. The coring was successful in establishing that there was a floor inside the structure, but the only potential midden material were deposits that may represent repeated deposition of dung or stable cleaning materials but which lacked substantial bone or ash deposits. The results from the Klausturhús midden investigation are similar to the ones from Möðruvallasel, suggesting that both of these sites could have been managed largely as sel/shielings rather than as small farms that would have been likely to generate the full range of domestic refuse. At the very least, there was no year-round occupation evidenced here.

Skriða

The property that belongs to the modern farm at Skriða, located within ca. 20 km of Möðruvellir in Hörgárdalur (Coordinates: 65°43.103'N. 18°21.878W, 54m asl) may have previously been the site of at least two medieval farmsteads whose traces are no longer present. The survey data indicated potential midden mounds associated with these old farms that are now predominantly known from written sources (Jónsson 1905). Since the actual names of the old farmsteads are not entirely clear, they are both called Skriða for this survey, but were given the site Code of NLÖ, as the oldest farm on this site was called Neðri Langahlíð. The midden associated with what is maybe the more recent farm is discussed first and labeled as Skriða, NLÖ1. The second farm may have indeed been the Neðri Langahlíð farm that was destroyed by a landslide (Skriða in Icelandic) in 1390, covering the part of Rafn Bótólfsson´s farm, killing him as well as his entire family (Brynjúlfur Jónsson, 1906). As a result, the entire slope of the infield, situated to the NW of the modern Skriða farm house is more or less a gravel field covered with grass.

Skriða, NLÖ 1 (EY-192:023)

Coordinates: 65°43.103'N. 18°21.878W, 51m asl.

Figure 5. Coring at Skriða, NLÖ 1. The modern house visible on the right. Direction W.

The farm is located just North of a road. Cores were put in just SW of the modern house (*65º43.101'N, 18º21.876'W)*. There was occasional charcoal and a few tiny flecks of white burnt bone in a core put in at 10 m SW of the modern structure, as well are generally traces of peat in the coring profiles, but no convincing profiles indicating a midden. Another core put in at about 3 m NE of the last standing tree in the line indicates that there is potential midden material between 24 – 33 cm below the surface, right above a turf containing sequences of prehistoric tephras (at a depth of 33-40cm below surface). Coring has revealed evident traces of midden materials, but because the area was leveled in 1980, there no longer exists a well stratified midden associated with Skriða, NLÖ1.

Skriða, NLÖ 2 (EY-192:004)

Coordinates: 65°43.079'N,18°22.047'W, 54m asl

To find this potential farm midden, a 30 m line was put up in the Skriða infield at a location ca 30 – 40 m NW of the modern structure, the line running N-S.

The landslide(s) that covered this farm area left behind a surface that is very hard to core, and the only area where the Oakfield corer did not hit rock right away was just slightly North of the southern end of the line put in (S end: 65º43.073'N, 18º22.027'W),

Figure 6. Coring at Skriða, NLÖ2, the modern farm building is right behind the trees, to the E.

Two cores that contained distinctive midden deposits including black burnt bone were put in at the 2m mark; one directly at the line and one 1 m West of it. The core profiles showed clearly stratified deposits alternating in their contents of wood and/or peat ash, bone, and turf debris. Midden materials were encountered up to 72 cm below the surface, when a rock prevented the corer from going any deeper. The only potential tephra encountered here that may not be prehistoric was a black (1400s or 1766 AD?), found at ca. 20 to 40 cm below surface in one core. At the southern end of the line, most cores contained domestic midden materials and were prevented from reaching any deeper because of a rock. This midden seems to contain promising faunal materials, but trenching it will most likely require heavy machinery, i.e. JCB to gain access to the archaeology.

Myrkárdalur, MYÖ (EY205_006)

Coordinates: 65º37.845'N, 18º34.906'W, Elevation 280 m ASL

The Myrkárdalur farm is situated in a highland area at the end of a valley named after the river Myrká. The early farm ruin is clearly visible despite the overgrowth of grass: several rooms are connected through a central corridor, reminiscent of medieval houses from Greenland. A landslide in the 14th century destroyed part of the farm and the occupants were forced to move further west, where several more recent ruins are located (sources cited in Hreiðarsd. 2008:178). Myrkárdalur was abandoned in 1955 and the

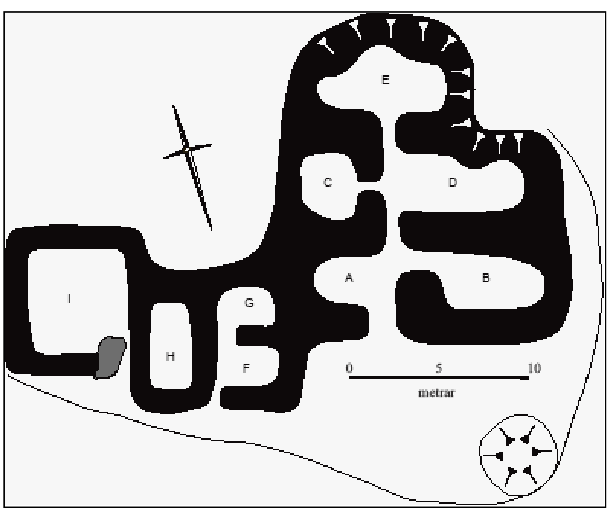


Figure 7. Myrkárdalur ruin, survey plan (Hreiðarsdóttir et al 2008:178; © FSI/Hreiðarsdóttir).

land has since been used by the nearest farm, Myrkárbakki. Several ruins encountered as either standing structures or overgrown ruins on the Myrkárdalur home field provide an instant if superficial overview of its settlement history from the middle ages through the 1950s.

Figure 8. Coring at the midden mounds.

In 2008, two likely midden mounds were located within 5m from each other, to the S of the older farm ruin (*coordinates: MYO04 65°37.840'N, 18 ° 34.901'W).* They are both visible due to rather rich vegetation growth, and the eastern one was indicated on the survey map.

Both mounds were cored and the western one, believed to be the older one, was test trenched. The upper deposits of the trench contained some bone material, but there were fewer faunal remains in the lower layers which contained mostly structural debris (i.e. turf collapse) and some peat ash deposits. Some green jasper was found there. The artifacts recovered from the test trench are still under analysis and may help date the deposits. Artifacts were mostly made from either metal or stone, but occasional glass and pottery were recovered, as well as one piece of wood. No tephra was recorded.

Figure 9. Trenching and planning the MYÖ midden.

In 2009, the team cored the small

mound to the east of the one trenched in the previous year and found again that the coring profiles did not indicate sufficient evidence of materials associated with household middens. Moreover, at ca. 40-50 c below surface, every coring hole had to be abandoned because it hit what is likely bedrock. Upon a thorough coring of the perimeter, a very promising looking area to the south of the structure and the two hillocks was detected. Figure 10 shows the hillock cored in 2009 in relationship to the structural remains (resembling those from medieval Greenland sites) and the small midden trenched in 2008.

Figure 10. Coring at the hillock south of TR1 (indicated by red circle). Picture faces NE.

Figure 11. The Myrkárdalur team at the beginning of excavation. Picture faces SSW, with view of Hraundrangur's peaks. Öxnadalur is on the other side of that mountain range.

A N-S transsect was laid, and the zero point on the new N-S line is located 40 m south (downhill) of the eastern mound and 10 m west of the sheep gate, the eastern mound´s most southern extent was located 25 - 30 m north of the southern mound. Several cores were taken along that line and an approximate extent of midden materials assessed. The core profiles from the southern mound demonstrated the presence of peat ash, woodash, and bone (usually burnt) from about 30 cm through 100 - 130 cm below surface. With a soil ph value at around 6,2, a decent bone preservation could be expected and the team decided to put a small test trench into the mound. The Myrkárdalur Trench 2 (TR2) measured 1 m in width (west to east) and 4 m in length (south to north). The datum point from where the height of instrument was measured (actual elevation asl still to be established) was given a GPS reading: *MYÖ DP N65º37,822´, W 018º34,878'.* [11]

Figure 12. Bakki church in Öxnadalur. NE Direction.

Bakki, BKÖ (EY-219:013)

Coordinates: 65°36.894´N, 18°30.378'W, 176m asl

Bakki used to be a wealthy church farm during the Middle Ages and is a working modern farm today, but the church is in use only on rare occasions. The investigated midden is associated with the old Bakki farm and is located in the SW corner of the new addition to the churchyard. A driveway belonging to the modern farm house offers easy access to the site.

At 14-16 cm below surface, right under windblown natural soil, a piece of a turf chunk that may have contained creamy white, potentially prehistoric tephra was found. This potential tephra should be further investigated as it can provide important references regarding time of deposition of associated layers. Several cores showed calcined bone fragments, frequent chunks of charcoal, peat ash deposits, turf debris, etc. The Bakki midden seems to be well stratified, containing peat

[11] The results of the 2008 and 2009 test excavations are presented in Appendix I.

ash, a considerable amount of charcoal as well as burnt and unburnt bone. The only logistical problem may be the fact that the midden is located in the churchyard.

Figure 13. Bakki, SW corner of churchyard. Picture on left: The modern farm house is visible on the right. Picture faces WNW. Picture on right: Revisiting midden in SW corner of churchyard. Picture faces ESE.

The site was revisited in 2009 in another attempt to find undisturbed midden deposits:

As in the 2008 midden coring transsects (see Harrison 2008b), the 2009 Bakki cores showed calcined bone fragments, frequent chunks of charcoal, peat ash deposits, turf debris, etc. What seemed to be very loose voids already noticed in the previous year were determined as the results of the churchyard extension in the 20th century. These voided spaces seem to be occurring throughout the midden limits newly tested in 2009 and thus indicate a disturbance to the midden layers that prevents the establishment of a secure midden formation chronology. The team decided to omit the Bakki midden from their research plan and instead concentrate on household midden sites that were not disturbed by construction, field leveling, or other recent earth moving activities.

Bakki is located in Öxnadalur and is currently the only site in this valley investigated for midden materials associated with the project. Future research in Eyjafjörður will include more research in this valley system.

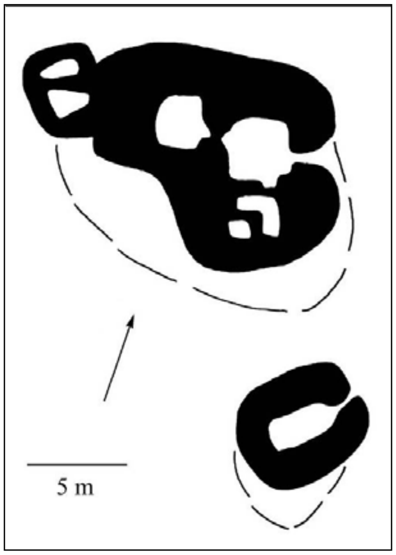


Fig. 14. Survey plan of the Jaðar ruins (Vésteinsson, 2001:32; © FSI/Vésteinsson).

Jaðar, JRÖ (EY-068:022)

Coordinates: 65°46.179', N 18°14.791'W, 18m asl.

The Jaðar ruin is located on Möðruvellir land, on top of a promontory to the SE of the modern church. Several coring lines were placed in association with the structural ruins that were visible despite the high grass growth. Þúfa (overgrown hummocks created by repeated freezing and thawing actions) cover the raised area that holds the ruins as well as the modern cemetery.

Coring at the line set up at the northern Structure (the large one on the survey plan) revealed some traces of charcoal and rather greasy deposits, possibly indicating a floor. Cores also contained some very patchy prehistoric tephra layers that could have been disturbed by digging into the prehistoric substrata. No conclusive structural or midden deposits were found. Many of the cores contained natural soil and some

Figure 15. Jaðar ruin, center of promontory. Möðruvellir church in NW.

in situ prehistoric tephras.

Another coring line was set up along a north to south line at a small mound that looked very lush (*JAD-HLN 65°46.166' N, 18°14.814´ W).* Various cores contained very loose deposits and many seemed to go through voids, which may be due to root action and/or þúfa-related cryoturbation? Except for the occasional charcoal bits, no cultural deposits were encountered. Root growth in most cores reached down to almost half a meter below surface. At 3.50 m and at 5 m south of the N end of the line black tephra was encountered at 52 and 72 cm depth from surface, respectively. In both cases, the tephra was right on top of prehistoric deposits and may thus be prehistoric as well.

Figure 16. One promising spot: NE of the modern cemetery, Core 4.

The most promising area for midden deposits seemed to be at the the Eastern center of the promontory, indicated by very green vegetation. The first core on that spot (*JADESC 65º46.167' N, 18º14.770' W)* went to a depth of 70 cm below the surface and hit a rock. A black tephra layer (1400s or 1766? AD) was found at 23-24cm below the surface. The core further contained a stratigraphic sequence of wood ash followed by peat and next by a layer of very clean soil at 37-38 cm down. Between 38 and 65 cm below surface, there was another series of peat ash, wood ash, lots of charcoal deposited on top of each other. The last five centimeters before the core hit the rock contained a rather large lump (2cm) of charcoal. Several other core profiles contained a black or grey tephra band under the topsoil between ca. 10 and 15 cm below the surface. This tephra layer needs further investigation as it can provide valuable dating information. Followed by the tephra layer are cultural deposits: rather uncompacted layers containing charcoal, peat and wood ash. The most promising soil core (Core 4) was taken at 4m E of the NE boundary of the new cemetery (*JADSS 65º46.155'N, 18º14.767'W)* and it is suggested that a test trench be put in here or/and at *JADESC N65º46.167' W18º14.770'*.

Neskot, NKÖ (EY-068:018)

Coordinates: 65°46.707'N, 18°13.548'W, 16m asl.

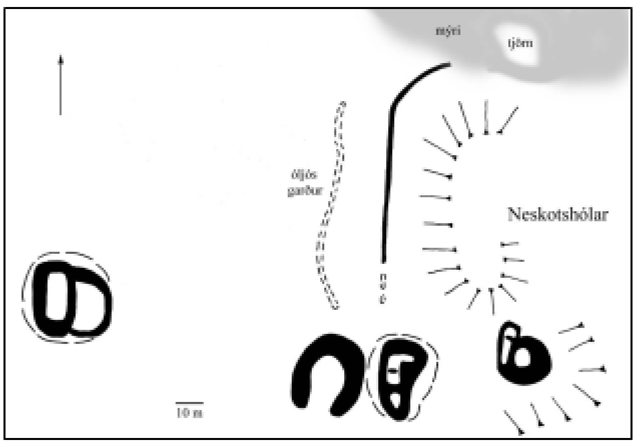


Figure 17. Neskot ruins, survey plan (Vésteinsson, 2001: 30; © FSI/Vésteinsson).

Neskot was a cottage associated with Möðruvellir that may have become abandoned at around the time when Möðruvellir became the seat of the resident governor in 1772 (Ólafsson in Vésteinsson, 2001:30). There are several ruins that are located about 1 km NE from Möðruvellir, on the Eastern side of the main road. Access to this site is very difficult, as fences had to be climbed and a wetland area traversed. Due to the dry summer, there was not that much water in the meadow and thus our work was a bit easier than it could have been.

Despite extensive coring at the possibly 4 Neskot ruins, no midden material was found at that site. The whole area seems to be naturally raised by gravel deposits, and there are gravel hills right to the north of the ruins. The soil was extremely dry, even after a couple of nights of rain. Many prehistoric tephra layers were encountered, following topsoil and clean soil (windblown) layers that contained no charcoal or any other indicators for human activity. Many cores contained deposits that consisted of very coarse sand and even gravel which were interpreted as natural depositions as the whole area consists of gravel hills:

The western most of the three structures found in a cluster on the eastern part of the site (*NES02 E 65º46.685'N, 18º13.560'W)* presents a good example: Underneath topsoil and another 20 cm of natural sandy silt deposit, a black tephra (1400s or 1766 AD?) was encountered at 35cm below surface. Next, there was very uniform, homogenous sandy silt for another 10cm down, followed by a prehistoric tephra (H3?) at 45 – 46 cm below surface. This was followed by another 15 cm of silty sand deposits, and a second prehistoric tephra at 60 cm below surface. The ph levels at all structures were between 6.8 -7, but beyond some faint traces of turf collapse in the most southern structure, no midden materials were found. No further activities at this site are suggested.

Figure 18. Neskot. Möðruvellir is indicated by black circle, SW direction. Left arrow points to road (Nr. 1) toward Akureyri, right arrow points to road (Nr. 82) toward Dalvík.

Uppsalir, UPÖ (EY-196:008)

Coordinates: 65°40.999´N, 18°27.620’W, 180 m ASL

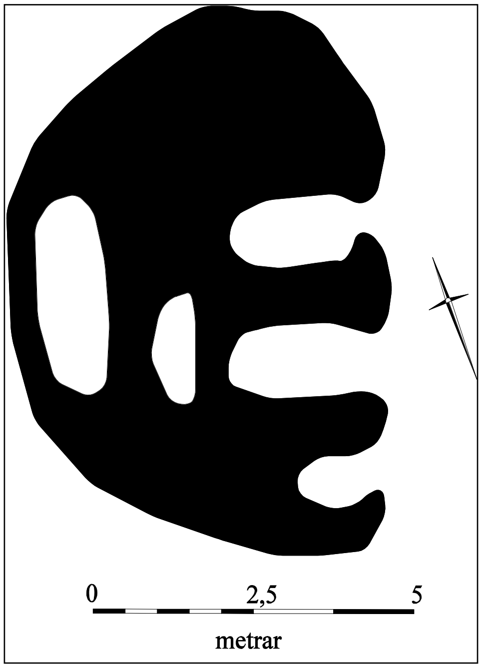


Figure 19. Survey plan of the Uppsalir farm ruin. (Hreiðarsdóttir et al 2008: 96; © FSI/Hreiðarsdóttir).

Uppsalir is situated on Öxnhóll land, in Hörgárdalur.

A prominent feature in the surrounding landscape, the light green farm ruin mound of Uppsalir is located ca. 200 m northeast of the modern Öxnhóll farm complex (see Oddstaðir description above).

According to sources listed in the survey report (Hreiðarsdóttir 2008, Vol.1:96), this site was also hit by several landslides (and it is also situated beneath Lönguhlíðarfjall); one particularly strong one occurred in 1769, leading to the property’s abandonment. The sources also indicate that Uppsalir may have been a cottage associated with the larger Öxnhóll church farm. The farm ruin measures about 6 m by 10 m and is located on the mound mentioned earlier.

Figure 20. Left picture: Uppsalir ruin (circled) and Öxnhóll farm (arrow). Picture direction: SSW. Right picture: Uppsalir ruin mound indicated by arrow. Picture direction: ENE.

The team put in several cores into its perimeter, concentration on the southwestern (downward facing) slope of the mound. While a few inclusions of turf and charcoal could be detected in Cores 1, (GPS coordinates: *65°40.999´N, 18°27.620'W)* and 2, no obvious indication for a midden deposit were found.

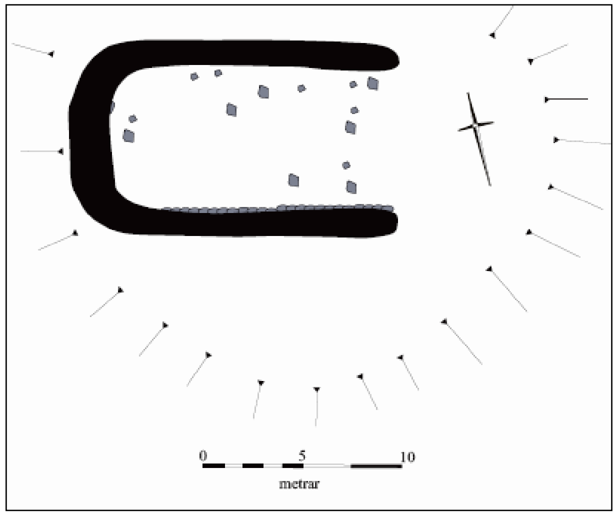


Figure 21. Beinirsgerði ruin, most likely the 19th Century animal shelter (Hreiðarsdóttir et al 2008:74; © FSI/Hreiðarsdóttir).

Beinirsgerði BGÖ (EY-192:014)

Coordinates: 65°42.296´N, 18°23.420'W, 75 m ASL

The Beinirsgerði site is situated on Skriða ground, about 2 km SW from the Skriða sites cored in 2008 (Harrison 2008b), and is said to have been abandoned in the latter half of the 17th Century AD (Hreiðarsdóttir et al 2008:74). It is not exactly known where the ruins are and the home field seems to have been flattened a bit, this could explain why the team had no success in finding the ruin of the old farm building in 2009.

Figure 22. Beinirsgerði, coring for the midden associated with the farm ruin abandoned in 17th Century (Hreiðarsdóttir 2008 Vol.1:74). The structural remains are circled. Picture faces NE.

The ruin visible in figure 22 likely saw its last use as a shelter for farm animals (beitarhús) in the 19th century. Beinirsgerði may have been abandoned as early as the late 1600s, but re-used briefly before the turn of the century (1900) (see Hreiðarsdóttir

2008, Vol.1:74). Most of the grassland surrounding the ruin is wetland – water running down slope is creates a marshland-like environment.

Several of the cores hit bedrock at about 30 cm below the surface. The first core was put in ca. 30 m NW of the very visible ruin and the GPS point taken reads as: *BGO N65º42.296', W018º23.420'.* Core 8, put in at ca. 40-50 m SW of the ruin, has the following GPS datum: *BGO-2 N65º42.261', W018º23.406'* Cores 8 and 7 (4m east of core 8) produced the deepest soil profiles and Core 8 contained traces of charcoal, and several layers of reddish deposits that may indicate bog iron formation. The wet, muddy ground, and the more or less natural looking core profiles that are rather colorful (see figure 38 below) are not good indicators for a household refuse midden location in this place.

Also, the field may have been flattened, and cores 7 and 8 may reflect a redepositioning of upturned materials that contain iron particles. As at Uppsalir, to determine the potential presence of an *in situ* midden associated with the older farm building at Beinirsgerði, a coring exercise lasting several days would be advisable.

Figure 23. Beinirsgerði; profile of Core 8. The colorful section may be a reflection of the natural environment found at this site.

Appendix II

Myrkárdalur Faunal Report

Myrkárdalur in Hörgárdalur, N. Iceland:
Brief Summary of the 2008/2009 Archaeofauna.

Ramona Harrison

CUNY Human Ecodynamics Research Center
CUNY Northern Science and Education Center

NORSEC/ HERC

Brooklyn College Zooarchaeology Laboratory
Hunter College Bioarchaeology Laboratory
CUNY Doctoral Program in Anthropology

HERC/NORSEC Zooarchaeology Laboratory REPORT No.57

September 2011 *ramona.harrison@gmail.com*

Introduction

In summer of 2008 and 2009, an excavation team led by the author and Howell M. Roberts (FSI) investigated the potential for midden remains at Myrkárdalur, a farm ruin site situated in a highland area in the most interior part of a minor valley system in Hörgárdalur, Eyjafjörður. The results of these exercises were two small collections of archaeological materials from two middens of the post-medieval and Early Modern Periods. The results of zooarchaeological analysis are presented here, with a very limited discussion on potential site economy. While the ruins visible in the landscape are likely from the medieval period and are reminiscent of medieval corridor houses from Greenland, faunal remains are from a later point in time and indicative of a long term use of this area, at least in terms of structural remains from the early 20th c. still standing. Today, this area is frequented by fox hunters and the land used by the nearest farm further down the valley.

Myrkárdalur project as part of larger regional Research History

- 2001–2006: Gásir; Howell M. Roberts (FSÍ) excavation of the high medieval (13th to early 15th centuries) trading site and its merchant's church (2004 and 2006, by Orri Vésteinsson, FSÍ) (i.e. Roberts et al 2002, 2006, 2009, Vésteinsson 2009, Vésteinsson in. Roberts et al. 2006, 2009, Vésteinsson et al. in press, Harrison et al 2008, Harrison 2009, Harrison 2006).
- 2004-2006: Skriðuhreppur; Regional surveys by FSÍ staff members, directed by Elín Ó. Hreiðarsdóttir (Hreiðarsdóttir et al. 2008).
- 2006: Möðruvellir; H M. Roberts and Ramona Harrison (CUNY), excavation of an evaluation trench into the Midden Mound (Öskuhóll) adjacent to the Möðruvellir Farm Mound (Harrison and Roberts 2006, Harrison 2007). This project builds on work done by Orri Vésteinsson´s expanded archaeological survey and site registration (Vésteinsson, 2001).
- 2007: Möðruvellir; H. M. Roberts and R Harrison; extension of the evaluation trench opened in 2006 (Harrison and Roberts 2007, Harrison. 2008a)
- 2008 – 2009: Gásir Hinterlands Project (GHP), directed by R. Harrison (2009) and H.M. Roberts (2008). Program of midden prospecting, testing and excavation. Sites

producing archaeofaunal remains: Möðruvellir (continuation), Skuggi, Oddstaðir, and Myrkárdalur; all in Hörgárdalur (Harrison 2008b, Harrison et al. 2010).

The **Gásir Hinterlands Project**, mainly funded through a **Dissertation Improvement Grant through the US National Science Foundation** (OPP ARC 0809033, PI: Harrison), is aimed at improving our understanding of the interactions of local farming strategies affected by changing climate and ongoing human impact with medieval overseas trade and long-distance exchange centered on Gásir. GHP also focuses on the long term human ecodynamics in this historically important part of Iceland, contributing to the reconstruction of a detailed historical ecology of Eyjafjörður from first settlement down to modern times.

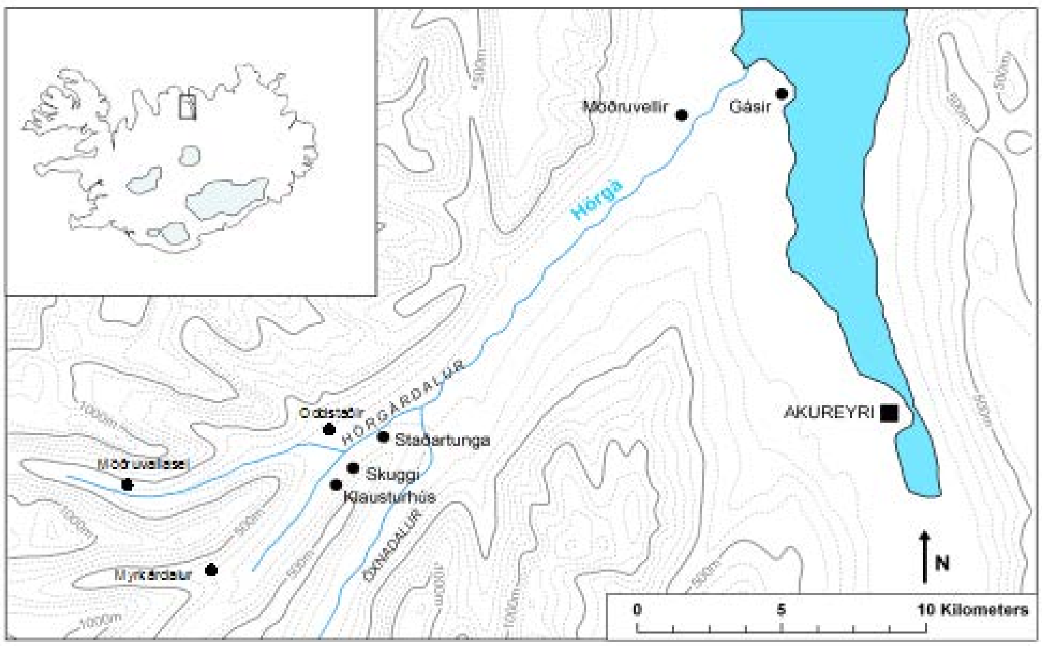


Figure 1. Map of Iceland, locating Myrkárdalur, Skuggi, Möðruvellir in Hörgárdalur, and Gásir, located at a coastal inlet in Eyjafjörður (Orig. Map: Streeter, edited by author)..

Materials and Methods

All the Myrkárdalur midden materials were dry-sieved through 4 mm mesh and where applicable materials were targeted for whole-soil sampling for post-excavation analysis, in accordance with NABO recommendations to study plant remains, industrial activities, and other aspects of the site formation process.

The faunal materials were processed at the CUNY Northern Science & Education Center (NORSEC) laboratories in New York City and Brooklyn. Recording and data curation followed the NABONE protocols followed for other archaeofauna from Iceland, Faroes, Greenland, and northern Norway (NABONE, 2009, 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 follow von den Driesch, (1976) and von den Driesch & Boessneck (1974), fish metrics follow Wheeler and Jones (1989) fish identifications follow FISHBONE 1.1 (2004, also at www.nabohome.org), bird identifications follow Cohen and Serjeantson (1996, 2nd Ed.),and Serjeantson (2009) and sheep/goat distinctions follow Boessneck, (1969) and Mainland and Halstead (2005), and Zeder and Pilaar (2010). Tooth-wear stage studies follow Grant (1982) and long-bone fusion stage calibrations follow Reitz and Wing (1999), with overall presentation of age reconstruction following Enghoff (2003).

Location

The Myrkárdalur farm ruin lies on 280 m ASL and is located at the end of a valley named after the river Myrká. The early farm ruin is clearly visible despite the overgrowth of grass: several rooms are connected through a central corridor, reminiscent of medieval houses from Greenland A landslide in the 14th century destroyed part of the farm and the occupants were forced to move further west, where several more recent ruins are present (sources cited in Hreiðarsdóttir 2008:178). Myrkárdalur was abandoned in 1955 and the grazing land has since been used by the nearest farm to the east and down the valley: Myrkárbakki. A number of ruins present either as standing structures or overgrown ruins on the Myrkárdalur home field provide a partial overview of its settlement history from the middle ages through the 1950s

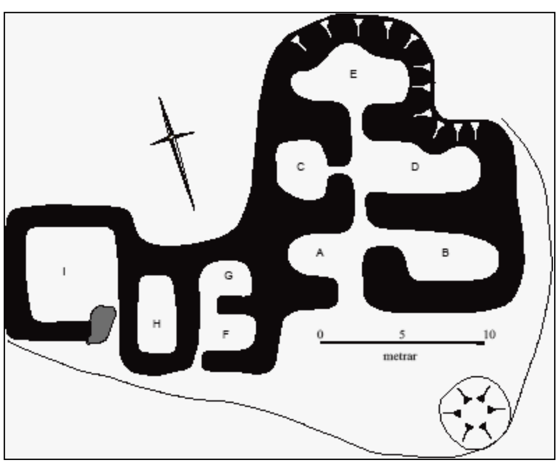


Figure 2. Myrkárdalur ruin, survey plan (Hreiðarsdóttir 2008, p 178).

Trench 1/TR1

In 2008, the more westerly hillock of the two possible midden locations, just south east of the medieval farm ruin (indicated on the survey plan in figure 2) was test trenched and found to consist of predominantly structural debris (see Harrison 2008b for a more detailed report on the Myrkárdalur 2008 coring and test trenching activities). TR1 measured 1 m (west to east) by 1 m (north to south) and less than 0.5 m in overall depth.

Figure 3. Coring at the hillock south of TR1 (indicated by red circle). Picture faces ENE.

Trench 2/TR2

In 2009, upon systematic coring of the entire Myrkárdalur perimeter, a very promising looking area to the south of the medieval structure and the two associated hillocks was detected. Figure 3 shows the hillock cored and subsequently trenched in 2009 in relationship to the medieval structural remains and the small midden trenched in 2008. The team decided to put a small test trench into the mound. The Myrkárdalur Trench 2 (TR2) measured 1 m in width (west to east) and 4 m in length (south to north).

<u>Relative Dating evidence</u>

Trench 1/TR1

According to Lucas (2010), this trench contains pottery (i.e. blue painted tin-glazed earthenware, glazed red earthenware cooking pot) and glass artifacts (i.e. green vessel glass, possible mirror fragment) of types tentatively grouping these archaeological remains to the 17th/18th c.

Figure 4 - MYÖ09 TR 2, context 203, finds no 16, Raeren Stoneware jug handle, dated to late 16/17th century (Lucas 2010).

Trench 2/TR2

One of the artefacts recovered from TR 2 was a Raeren stoneware jug handle (context 203), placing the midden contents into the late 16th or early 17th centuries AD. (Lucas, 2010). Myrkárdalur midden TR2 produced a number of animal bones and artefacts datable to the Icelandic post-medieval period, roughly placing the contents into the late 16th to early 17th centuries.

While the two archaeological sets were loosely placed into two slightly different time periods, they can be viewed as materials from the post-medieval – Early Modern times, likely deposited some time during the late 16th to early 18th centuries.

The Myrkárdalur archaeofauna

The faunal collections from TR1 and TR2 are very small and only allow for basic presence and absence discussions.

NISP (number of identified specimens) refers to all fragments that could be identified to a useful level. TNF is a count of all bone fragments (identifiable or not), MTM is "medium terrestrial mammal" (sheep-dog-pig sized), LTM is "large terrestrial mammal" (cattle-horse sized), MM is an "unidentifiable marine mammal" (i.e. whale, dolphin, walrus, seal), UNIM or unidentified mammal are small fragments that cannot be identified beyond this broad category. UNI or unidentifiable bone fragments simply indicate the existing degree of erosion.

TR 1 had a **NISP** of **178** out of a TNF of 485. TR 2 contained a **NISP** of **309** of a TNF of 1,921.

As indicated by the Element Counts in table 1, the majority of analyzed domesticate elements were of ovi/caprines, comprising 55 % of the total TR 1 NISP, and 43 of that from TR 2. For both trenches, about 5 % of the total percentage are made up by cattle elements, with one pig element (0.56 %) collected during the TR 1 excavation.

Four goat elements could be analyzed from the TR 2 collection, indicating that these animals were still utilized by the Myrkárdalur farm in the late 16th – early 17th c. One horse element from TR 1 (0.56 % NISP) and 4 from TR 2 (1,29 % NISP) complete the domesticate assemblage count.

With the exception of one seal element from TR1, no other wild mammals were identified from the site.

TR 2 contained one element each of Ptarmigan, Swan, and Auk bird, and three unidentified bird elements, with no birds analyzed from TR 1.

Both trenches contained some Gadid fishes, namely Cod (< 2% NISP), Haddock (8 – 10 % NISP), and Saithe (< 1% NISP). Unidentified marine fish elements made up the largest proportion of the Fish category (TR 1: 26 % NISP; TR 2: 33 % NISP).

A few clam species and unidentified mollusk fragments complete the Myrkárdalur fauna distribution list.

Overview of Species Present

Myrkárdalur TR 1 / TR2 Element Counts	Area				
Taxon	Trench1/TR 1 (ca 17/18th c)	Trench1/TR 1 NISP %	Trench 2/TR2 (late16th - early 17th c.)	Trench 2/TR2NISP %	Total NISP
Domestic mammals					
Cow (*Bos taurus* (L.))	9	5.06	13	4.21	22
Horse (*Equus caballus* (L.))	1	0.56	4	1.29	5
Pig (*Sus scrofa* (L.))	1	0.56			1
Goat (*Capra hircus* (L.))			4	1.29	4
Sheep (*Ovis aries* (L.))	4	2.25	6	1.94	10
Unidentified caprine	93	52.25	122	39.48	215
Total caprine	97	54.49	132	42.72	229
Total domestic	108	60.67	149	48.22	257
Wild Mammals					
Unidentified seal species	1	0.56			1
Total seal	1	0.56			1
Total wild mammal	1	0.56			1
Birds					
Auk species (Alcid sp.)			1	0.32	1
Swan (Cygnus species)			1	0.32	1
Ptarming (*Lagopus muta*)			1	0.32	1
Unidentified bird species			3	0.97	3
Total bird			6	1.94	6
Fish					
Cod (*Gadus morhua* (L.))	2	1.12	6	1.94	8

Haddock (*Melanogrammus aeglefinus (L.))*	14	7.87	32	10.36	46
Saithe (*Pollachius virens* (L.))	1	0.56	3	0.97	4
Gadid species	3	1.69	7	2.27	10
Marine fish non-speciated	47	26.40	101	32.69	148
Total fish	67	37.64	149	48.22	216
Mollusca					
Clam sp. (Mya sp.)	2	1.12	2	0.65	4
Unidentified mollusc species			3	0.97	3
Total mollusca	2	1.12	5	1.62	7
Total Number of Identified Species (NISP)	**178**	**100.00**	**309**	**100.00**	**487**
Large terrestrial mammal	23		13		36
Medium terrestrial mammal	126		176		302
Uni. terrestrial mammal fragments	158		1,422		1580
Unidentified marine mammal fragments			1		1
Total number of fragments (TNF)	**485**		**1,921**		2406

Table 1. Myrkárdalur NISP table.

Major Taxa Summary

The graph in figure 5 presents relative % of all Myrkárdalur Major Taxa, indicating a dominance in sheep/goat (caprine) elements analyzed. The bar representing the fish taxon includes unidentifiable fish remains and therefore has not as much analytical weight as if it represented fish remains analyzed to family or species level. Since all the Myrkárdalur fish elements were found to be from marine species, these were nevertheless included here. This graph summarizes the findings from table 1; this time the faunal materials from both trenches were lumped together.

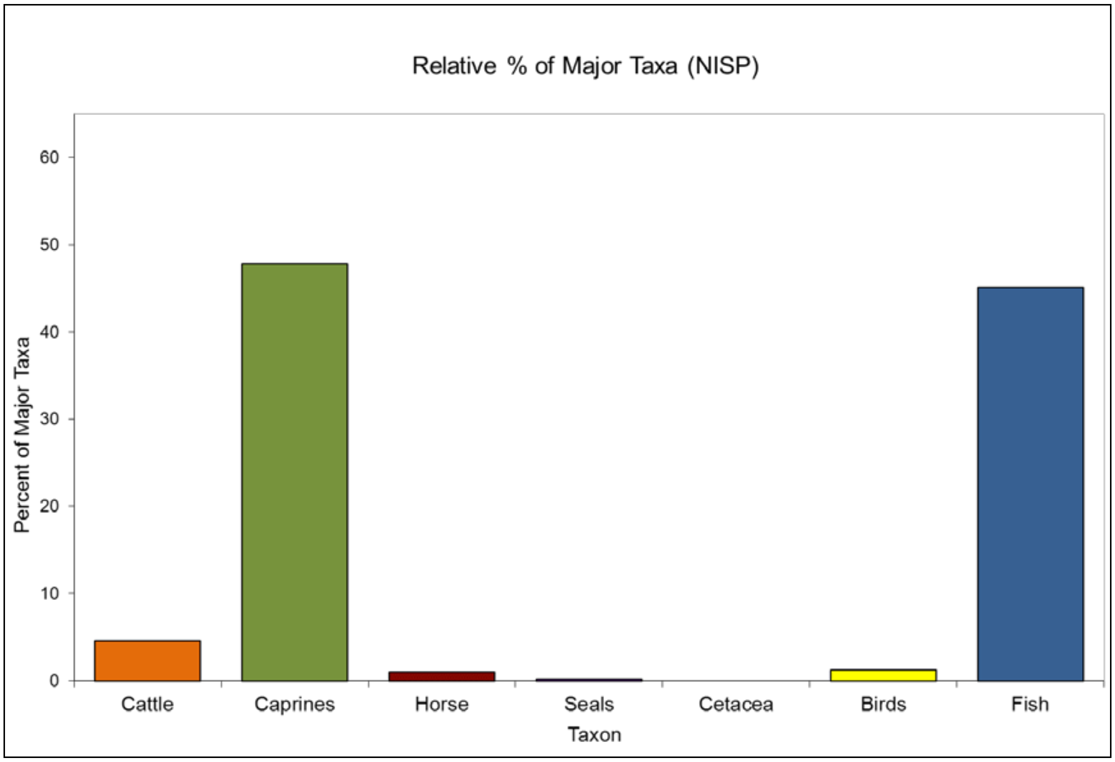


Figure 5. Total Myrkárdalur Major Taxa distribution

Domestic Mammals

Table 2 presents the percentages of the domestic mammal assemblage by area.

Scientific Names	*English Common Names*	Trench/TR1	% NISP Trench/TR 1	Trench/TR2	% NISP Trench/TR2
Bos taurus dom.	cattle	9	8	13	9
Equus caballus	horse	1	1	4	3
Sus scrofa	pig	1	1		0
Ovis aries	sheep	4	4	6	4
Capra hircus	goat			4	3
Ovis/ Capra sp. Indet.	caprine	93	86	122	82
Total		**108**	**100**	**149**	**100**

Table 2. Percentage of domestic mammal distributions by area.

As indicated by table 2, the overall domesticate species distribution percentages differ only slightly from the earlier faunal collection in TR2, and that of the more recent one in TR1. One difference worth mentioning may be the disappearance in goats in the later period, which could of course be also due to poorer preservation conditions in TR 1, containing the more recent archaeofaunal samples.

Concluding Remarks

Due to the poor condition of the faunal materials, only a very basic analysis was possible for the late 16th – early 18th c. Myrkárdalur archaeofauna. During that time, this was clearly a farming operation, utilizing caprines, cattle, and some horses and the occasional pigs. It seems from this faunal assemblage that heavy emphasis was laid on use of domesticated terrestrial resource, but also on gadids, brought to site either from Skagafjörður in the West, or from Eyjafjörður further east.

The position of the Trench 2/TR 2 midden mound on the downhill end of a steep slope may have enabled good drainage of water and leaching of organic materials. The site's fuel economy was visible in a series of excavated midden layers from the post-medieval era: Several contexts consisted almost entirely of either peat ash or wood ash, or a mixture of both. Similar is true for the midden mound where Trench 1/TR 1 was placed in 2008: the area were the medieval ruin is located lies on a down slope and water from the mountains may have leached the bone materials from both mounds. Also, the peat and wood ash layers may have further degraded the PH levels, leading to increased degradation of the bones. Since Myrkárdalur lies in a highland zone, it is likely that freeze-thawing activities have placed further mechanical stresses on the midden remains.

After two seasons of locating and testing the Myrkárdalur midden remains, the medieval materials remain elusive. A GPR survey may have to be done in this area if these materials were to be recovered, should they remain intact still and have not been spread around the homefield by centuries´ worth of farming activities.

Acknowledgments

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