Community, Ecology, and Modernity: Faunal Analysis of Skútustaðir in Mývatnssveit, Northern Iceland

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Community, Ecology, and Modernity: Faunal Analysis of Skútustaðir in Mývatnssveit, Northern Iceland

By
Megan Hicks

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

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

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Abstract

Community, Ecology, and Modernity: Faunal Analysis of Skútustaðir in Mývatnssveit, Northern Iceland

By Megan Hicks

Advisor: Professor Thomas McGovern

The dissertation examines the archaeofaunal remains from Skútustaðir, a middle to high-status farm in Mývatnssveit, Northern Iceland, to understand the experience of rural communities and their ecologies during Iceland’s transition from regulated colonial exchange to a capitalist economy during the 17th through 19th centuries. Archaeofaunal analysis is used to reconstruct changes in the ways that people herded, hunted, fished, providing insights into how they managed their local environments for subsistence and novel contexts of exchange. In addition to archaeofaunal analysis, primary textual sources are explored to assess how the Skútustaðir household and its rural community mobilized long-term knowledge and adopted forms of scientific knowledge production as they converted local ecologies into economic resources. This research is aimed at generating an understanding of the engagement of Iceland’s people and nature within broader Atlantic World economies. It also presents a view of the changing ecologies of a region that is widely recognized for its uncommon arctic biodiversity.

Dissertation Keywords: Iceland, colonialism, capitalism, zooarchaeology, archaeofaunal analysis, herding, fishing, birding, hunting, modernization, conservation, Local Traditional Knowledge, enlightenment, commodification.
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explores their heritage and experience as a source of knowledge about ecological history, resilience, and economic change.

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Chapter 1. Introduction

This thesis focuses upon the archaeofauna of Skútustaðir, a middle to high-ranking farm in Northern Iceland, in order to understand the role of rural Icelandic communities and their ecologies in colonial and capitalist economic formations from the 17th through the late 19th century. Zooarchaeology is a useful way to interrogate Iceland’s historical economic organization for two reasons. Icelanders relied primarily upon animals as central dietary and economic resources from the first settlement in the late 9th century until the 20th century. Second, the archaeological remains of herding, hunting, fishing, butchery, and exchange at the household level allow us to see how people transformed animals from their local ecologies into useful and fungible things. In this way, these remains reveal the cultural and ecological influences of broader political economic systems which drew products and value from local places and communities and thus re-shaped them.

Atlantic communities and environments have been radically transformed over the last millennium by the westward migration of people, other biota, and ideas between societies and lands (e.g.; Cronon, 1983; Crosby, 2004; Roberts, 2019). This process began in the North Atlantic during the Viking Age (c.750-1050 CE) (see, Hambrecht, 2015; Perdikaris & McGovern, 2007) and intensified during the early modern period as communities and places were integrated, often forcefully, into the uneven economic relations of commodity markets and European sovereignties (Smith, 1982; Wolf, 1982). Mercantile and capitalist institutions redefined intersecting conditions of daily life including categories of personhood (Wynter,
2003) as well as the manner in which various communities used, understood, accessed, and negotiated their environments. Examples of this include the colonial institution of plantation systems, ranching economies, and other agro-industries (Chang & Koster, 2004; Crosby, 2004; Mintz, 1985; Tsing, 2014).

Iceland and the broader North Atlantic (inclusive of Greenland, Iceland, Faeroes, Scotland, and Norway) have, until recently, been overlooked as contributing to understandings of how colonial economic governance and capitalism have re-shaped the Atlantic scene (but see Hambrecht, 2015; Lucas & Edwald, 2015). One reason for this may be that urbanism and industry came later to Iceland than many other places. It was almost entirely a rural society of farmers and fishers and effectively preindustrial until the late 19th early 20th century. An additional aspect that seems to set Iceland apart is its debated status as a colony versus an extension of ethnically similar Scandinavian states (see Lucas & Parigoris, 2013; Pálsson & Loftsdóttir, 2013). Within this debate, some scholars argue that Norway and Denmark’s colonial administrations did not perceive the Iceland and its people as their external colony but as an appendage of their culture and territory. Others find evidence that Denmark viewed Iceland as an unfamiliar wilderness to be tamed and comprehended (e.g. Oslund, 2011). In my view the latter points to colonial economic integration as a project or process in need of further questioning. Despite nuanced distinctions from familiar Atlantic colonial-era histories, Iceland’s communities and ecologies were significantly re-formed through their involvement within shifting economic hierarchies of the Atlantic World.
Here I study the Skútustaðir household and community via their changing farming, fishing, and hunting practices to interrogate the ecological dimensions of Iceland’s colonial economy and transition to capitalism. The Mývatn Region (Mývatnssveit) is a key location to carry out this research. For the first time it will provide a critical assessment of developing market orientations and capitalism in Iceland from the perspective of a rural, inland community and bioregion. The Mývatn region has special significance as the home of the first Icelandic free trade association - the Kaupfélag Pingeyinga. Finally, this research will contribute narratives from the early modern period to the understanding of the most intensively researched region in Iceland – one that is considered globally important for its biodiversity and has been a proving ground for interdisciplinary social and environmental research.

**Skútustaðir and the Mývatn Region**

Skútustaðir, the rural household at the center of this dissertation was historically a middle to high-ranking farm its region and well situated at the center of the Mývatnssveit community. It was established during the late 9th century. Like the overwhelming majority of farms in Iceland during the early modern period (1500-1850), it was often a tenant farm, and at times housed two tenant families as well as subsidiary households. From the late 19th century onward, Skútustaðir functioned as the administrative center (hreppaþingstaður) of its municipality and was a central venue for rural politics. Being at the nexus of its community and advantageously oriented to resources in its environs, it represents a secure and historically prosperous farm, rather than a small or marginal stead.
The expansive Mývatn area (Mývatnssveit) is a rural region organized around a biodiverse and ecologically productive lake. The lake’s spring-fed, eutrophic waters support an array of microfauna and flora, as well as midges and blackflies which in turn support three species of fish: char, trout, and stickleback. The lake and wetlands on the southern side of the lake are globally one of the most important breeding sites for migratory waterfowl from the North Atlantic, Eurasia, and North America. Due to the region’s unusual geology and biodiversity it is a recommended UNESCO world heritage site as well as a Ramsar site (Convention on Wetlands).

Figure 1. A map of early archaeological farm sites in the Mývatn region including Skútustaðir in red. Created by Oscar Aldred. Used with permission (from McGovern et al., 2007).
The Mývatn-focused *Landscapes of Settlement project 1997-2007* (LOS), was the first regional-scale long term interdisciplinary investigation in Iceland with several subprojects and offbranching projects ongoing. The initial LOS project included three large-scale excavations of Mývatn farms (Sveigakot, Hrísheimar, and Hofstaðir) as well as numerous surveys and test trenches useful for establishing regional household site chronologies (Lucas, 2009; McGovern et al., 2006; McGovern et al, 2007; Vésteinsson et al., 2002, see also project reports and data on the NABO website and Project Management System [www.nabohome.org](http://www.nabohome.org)). These large, collaborative research initiatives exemplify interdisciplinary collaboration among paleoecologists and archaeologists and they exemplify a „longitudinal“ research strategy (Crumley, 1994) of returning to the same area repeatedly to layer information and provide a long term perspective of social and environmental interaction.

At the end of the LOS project the international collaborating teams undertook a task of locating a long-term site to extend research beyond the Middle Ages (AD 11th-15th centuries) into the early modern period (AD 16th-18th centuries). The archaeological remains of Skútustaðir were first tested in 2007 via a coring survey and test trenches were excavated in 2008 large network of collaborating teams from the City University of New York and The Archaeological Institute of Iceland (FSÍ) (Vésteinsson, 2008). I joined the Skútustaðir research project in 2009 as a student excavator. I directed the excavations in the year 2011 and 2013 (Hicks et al., 2011; Hicks et al., 2014). Our excavations and subsequent work produced well-dated and
well-preserved archaeofaunal assemblages analyzed as the central material for this thesis.

**Historical Context**

Current archaeological evidence indicates that Iceland was settled in the mid to late 9th century by people from Norway and the British Isles and had no prior inhabitants. They brought with them livestock, farming modes, approaches to agriculture, fishing and hunting from Norwegian and Celtic homelands (Vésteinsson, 2000; Vésteinsson and McGovern, 2012). Within a century, the island was organized into tracts of divided farmland adjacent to useful wild resources like fishing areas, fowling zones, and walrus hunting grounds (see Schmid et al., 2017). In 1264, Iceland was incorporated into an expanding Norwegian political and economic system. Then, in 1397 Iceland, along with Greenland, and the Faroe Islands, followed Norway into the Kalmar Union. This united Norway and its dependencies with Denmark and Sweden under a single monarch. Apart from two Catholic bishoprics founded in the Middle Ages, monasteries, and few temporary dense settlements at seasonal trading or fishing stations, Icelandic settlement would remain rural and farm-based until the 19th century.

Iceland is an early site of migration and commercial projects, with hunting of walrus for exchange with Norway providing one of many motives for occupying one of the “last unsettled places” (Frei et al., 2015; Hambrecht, 2015; McGovern et al., 2014; Perdikaris & McGovern, 2007, 2008). By the mid-13th century, the island was firmly situated a high-medieval proto-world system that brought traders to the island for fish, falcons, sulfur, and woolen cloth for European markets (Harrison et
al., 2008) which likely impacted local farming strategies, and promoted intensification of marine fishing and production of dried fish for export (Bulhosa, 2010; Harrison, 2014).

This dissertation initially finds Iceland during the 17th and 18th centuries, when it was a stratified rural society governed by local elites and Danish administrators – what has been described as internal colonialism (Lucas & Parigoris, 2013). The majority of Iceland’s rural households were tenancies and a population of indentured servants was employed in herding and coastal fishing. Production of milk, meat, and wool from livestock was the central preoccupation and the majority of products remained in the country. However, surpluses of specified goods were exchanged mostly mobilized by elites in the restricted Danish Monopoly trade in which all trade items were turned over be Danish merchants (Gunnarsson, 1983). Iceland’s Rural, premodern Icelandic society suffered hardships that were a result of both of environmental conditions and social inequality. The 18th century, for example, began with a devastating smallpox epidemic. Then, extreme cold contributed to a famine in 1755. Then in 1783 a catastrophic volcanic eruption killed people and livestock and plunged the island into famine once again. The web of natural and social vulnerability and the effects of elite control and colonial markets on production are central to historical understandings of this time period -seen as internally stagnant and economically repressive (Gunnarsson, 1983). During the late 18th and 19th centuries the rigid social institutions governing colonial trade and the landed labor system underwent transformation.
Beginning in the early 19th century there was unprecedented sustained growth in production in sheep farming and fisheries. Steps toward self-rule began in the 1830s. These shifts, especially after the 1850s culminated in the initial formation of a free trade capitalist economic system in the late 19th century. Although the most conspicuous area of change is the formation and expansion of fishing villages and urban life in the late 19th and early 20th century, some beginnings of “modern” colonial and capitalist economics may also be viewed from the standpoint of changes in rural places, starting in the 18th century.

The heightening of Iceland’s overseas economic connections over the 18th to 19th centuries has traditionally been observed in the material record as a flood of imported manufactured goods appear in archaeological deposits across Iceland signaling an uptick of cultural participation in European lifestyles and modes of consumption (Lucas, 2007; Lucas & Parigoris, 2013). An archaeology of production, offered here, can contribute another side as local communities and ecosystems provided the labor and materials for these markets and connections.

**Thesis Contributions**

This research focuses on the analysis of Skútustaðir’s archaeofaunal material excavated from two phases of production. The first includes the 17th to early 18th centuries, during the period traditionally characterized as a stagnating colonial economy characterized by elite control, internal colonialism and Denmark’s Monopoly trade (Gunnarsson, 1983). The second phase includes the mid-19th to early 20th centuries - a period of economic and social change including dramatic institutional change in agricultural society (Jónsson, 1993) and the organization of
rural capitalism. The present work thus contributes to a detailed understanding of how rural communities and ecologies constituted these scenarios and the transformation from the former to the latter. It also presents some understandings of community responses to associated predicaments and opportunities.

**Data Sources**

The archaeofaunal remains excavated from the Skútustaðir’s middens form the main focus of this work in terms of data. This includes bones of domesticated mammals, wild mammals, wild birds and fish. Bird eggshell was also recovered from the middens. Eggshell identification data here is derived from a new methodology developed as part of this dissertation research (See also Hicks et al., 2016). The present work only represents a fraction of the data that has been gathered from faunal analysis which is ongoing. All data are archived on the NABO project management system, at the tDAR Digital Antiquity archive, and at the National Science Foundation Arctic Data Center, and will be part of an NSF-funded DataARC program aimed at facilitating access and discoverability of North Atlantic Archaeological Data.

Beyond archaeofaunal remains, this work also makes use of local writings of the Mývatn community. This includes writings produced during the 18th century including handwritten municipal records and diaries are included in this research especially those that have to do with economic planning, trade, and the management of local resources. Additionally, a few island-wide information sources like censuses and nature surveys are discussed and sourced.
**Thesis Chapters**

The next chapter (2) describes the research traditions related to this current work and its theoretical orientation. I outline how conceptual frameworks from critical environmental studies might add complexity to archaeological understandings of economies of scale. In Chapter 3, I provide necessary background to Icelandic environmental conditions, subsistence practices, and politics. Iceland's colonial economy under the Danish Trade Monopoly conditions during the 17\textsuperscript{th} and 18\textsuperscript{th} centuries is explained. I then provide a timeline of how that system gradually was replaced by different framework, in the late 19\textsuperscript{th} century. I then situate the Skútustaðir farm and its residents within these historical circumstances and elaborate upon its local environment of Mývatnssveit.

In Chapter 4, I summarize the excavations at Skútustaðir and the approaches to dating the archaeological remains. The methods of archaeofaunal analysis methods are presented in Chapter 5 along with brief notes on a newly devised method for the identification of archaeological bird eggshell which was collaboratively developed as part of maximizing the use of this archaeological record (Hicks et al., 2016). The method not only adds to the paleoeconomic study of Mývatn but can be applicable to other Icelandic archaeological sites and could be extended to function in other regions of the globe.

Chapter 6 presents the archaeofaunal analysis of animal remains from two phases at Skútustaðir, investigating how the household organized subsistence activities and engaged in exchange during the colonial Danish Trade Monopoly period and then after the mid-19\textsuperscript{th} century transition to increasingly free market-
capitalist economic and social arrangements. Patterns of herding, fishing, fowling, butchery, and exchange are evaluated from osteological evidence to interpret subsistence and the creation of products and commodities; the social organization and ecological implications of these tasks is also considered.

In Chapter 7, I argue that enlightenment-era natural knowledge impacted Icelandic rural economic cultures and was also symptomatic of increased market orientaiton from the 18th century and onward. By the 19th century, Icelanders commonly used information science to manage local resources near their productive maximums. These “knowledge technologies” facilitated and represented another facet of the “ commodification of nature” (Mrozowski, 1999) and predated other commonly cited technologies associated with “modernization”.

Chapter 8 documents the 19th century transformations in the sheep economy at Skútustaðir and in Mývatnssveit finding that sheep became central to rural capitalism and specifically to the Icelandic free trade movement which first emerged in Mývatnssveit and its larger county. This chapter contextualizes the organization of rural capitalism in Iceland within local, rural communities and ecosystems. It also documents how people navigated certain plights of productive expansion in a near-arctic environment.

Chapter 9 provides a contrast to the intensification projects through which the Icelandic economy grew and changed. I reconstruct how the Mývatn community made use of local populations of waterfowl (Anatidae) in a sustainable, subsistence-based manner supported by dense local traditional knowledge that predated modern science by a millennium. The study of this conservation economy offers a
counterpoint to the understanding of the logics of commodification and economic modernization as all-encompassing.

The conclusion (Chapter 10) presents a brief summary of findings and indicates directions for future research.

Until the past decade, postmedieval archaeology in Iceland was dwarfed by attention to the Viking Age and Middle Ages (Lucas & Snæsdóttir, 2006), and postmedieval work was comparatively underexplored and underpublished (discussion in Hambrecht, 2009; Lucas, 2012; Lucas & Snaesdottir, 2006; Vésteinsson, 2004). The excavations at Skútustaðir were carried out to remedy this dearth of postmedieval archaeological investigation. The central contribution of this thesis is an account of the role and experience of an Icelandic rural community in the colonial trade economy and in the organization of capitalism. This work uses zooarchaeology to question the place of „nature“ in large scale economics and conversely the influence of economics on „nature“.
Chapter 2. Theoretical Concerns

I intend for this work to contribute to interaction between two overlapping communities of practice in North Atlantic archaeology - the Historical Ecology-influenced work exemplified by McGovern et al. (2007) and Historical Archaeology as argued for by Lucas and Snæsdóttir (2006, see review in Lucas, 2012). Here, I briefly describe the development and character of these two research areas. Following that, I outline additional selected concepts and terms from critical environmental studies and describe how they function as touchstones for this work.

Research History

My work is influenced by a turn in North Atlantic archaeology toward the use of environmental data and archaeological science to interrogate past socio-environmental phenomena. This turn brought about the collaboration of diverse specialists and fostered a large research community. Collaborative archaeological research since the early 1980s in Iceland, inclusive of this dissertation, has been environmental and multi-disciplinary applying the methods and research agendas of prehistoric archaeology to the Viking Age, Medieval, and Early Modern archaeology of the North Atlantic (e.g. Amorosi et al., 1997; Buckland and Panagiotakopulu, 2005; 1996; McGovern, 1990, 2012; Ogilvie & McGovern, 2000; Vésteinsson et al. 2002). The NABO research cooperative (North Atlantic Biocultural Organisation) in particular contributed much to initiate the application of archaeological science (zooarchaeology, archaeobotany, geoarchaeology, palynology, paleoentomology, human bioarchaeology, stable isotope analysis, ancient DNA, Bayesian modeling of AMS radiometry and tephrochronology) to the
context of the Atlantic Norse diaspora from the late 8th century and onward (McGovern, 2004). The initial NABO orientation drew heavily upon the dominant processual research approach, though the work contributed complex understandings of issues including cultural influences on island ecosystems, the creation of cultural landscapes and seascapes in some of the “last settled places”, climate impacts and social resilience, culture contact, early Scandinavian state formation, as well as the effects of trade, early globalization and social inequalities.

This approach to research signaled a departure from early 20th century Icelandic archaeology which was significantly influenced by saga scholarship and was also distinct from the culture history orientation of the 20th century (Lucas, 2004). Saga-oriented archaeology was centered upon the Viking Age (AD 871-930), its high-status settlements, pagan burials, and sites of storied significance which were thought to reflect Iceland’s “golden age” (discussion in Friðriksson, 1994). Within this school, excavations were carried out with Romantic and nationalist undertones (Lucas & Snæsdóttir, 2006) and very much in tandem with the goals of rooting a modern national identity in the Viking Age. But the newer research collaborations of the late 20th century named different types of sites as critical loci of inquiry. These included lower and middle status households, fishing stations, and shielings (high-altitude shepherd huts). In this way, collaborative environmental research refocused attention toward everyday activities and how they constituted larger social relations, historical landscapes, and changing ecologies. The present work is very much descended from this research strategy and has benefited from the presently thriving research community.
The deliberate reframing of sites and subjects of interest was also underway in the community of Historical Archaeologists working in Iceland in the early 2000s. Lucas and Snæsdóttir advocated for an Icelandic archaeology that could, and should, contribute to “understandings of the development of the modern world” (Lucas & Snæsdóttir, 2006) and this contributed to a broadening of the time periods deemed important to Icelandic archaeology. Although a small number of post-medieval Icelandic sites had been excavated before the early 2000s, such investigations were, at that time, still comparatively rare and were most often rescue excavations (Vésteinsson, 2004). Post-medieval sites deemed interesting were high-status sites (discussion in Lucas, 2012). Lucas and Snæsdóttir argued that new research agendas were needed to substantively engage with a critical analysis of Iceland's post-medieval period, and these must elucidate experiences and implications of modernization, industrialization, capitalism, urbanization, as well as shifting production and consumption, rather than high-status people or places (2006).

Over the last decade, Historical Archaeologists in Iceland have rigorously examined these phenomena including the character of colonialism (Lucas & Parigoris, 2013), the emergence capitalism, urbanizing village spaces (Harrison & Snæsdóttir, 2013), and the specialization and vicissitudes of free laborer arrangements (Lucas & Hreiðarsdóttir, 2012), migration and mobility (Edwald, 2012b; Lucas & Edwald, 2015, ). The archaeological focus of these studies has tended to be on portable human-made objects, architecture, and text – (but see Hambrecht, 2011; Hambrecht, 2015; and Harrison & Snæsdóttir, 2013) and this
means that there is still significant opening for archaeofaunal and other environmental data sets to broaden debates about the material dimensions of Iceland’s colonial economics and transitions to capitalism.

Research in Mývatnsveit has been carried out by practitioners from both of the above described communities and has become a proving ground for interdisciplinary work (e.g. Lucas, 2009; McGovern et al. 2007). Research in Mývatnssveit has also co-emerged with the Historical Ecology research community (Crumley, 1994; McGovern 1994; McGovern et al., 2019). Historical Ecology and related Human Ecodynamics research frameworks share a set of methodologies and common concerns that tend to frame questions around long term interactions among societies, landscapes and seascapes, and they integrate these with understandings of histories, experiences and events at smaller temporal scales (Dugmore et al., 2004, 2007; Fitzhugh, 2017; Harrison & Maher, 2014; Lucas & McGovern, 2008; Vésteinsson et al., 2014).

Historical Ecology and Human Ecodynamics approaches respond to the growing awareness that human societies and especially large scale economic projects are transforming people and environments on a global scale, and that these may be better understood through intensive, interdisciplinary regional-scale research projects often with an applied aspect (see Armstrong et al., 2017). These research programs are connected to the recognition and description of the Anthropocene (Crutzen & Stoermer, 2000). Historical Ecology has linkages to resilience thinking as it considers reasons for long term stability versus change in ecology and economy (Davies et al.; 2018; van der Leeuw et al., 2011; Walker & Salt,
It also shares Political Ecology’s concern for identifying issues around power inequality, commons, and enclosure that create conditions extending from the past into the present (Netting 1981, 1993; Ostrom & Hess, 2006; Wolf, 1982, 1990).

In Iceland, the application of the Historical Ecology and Human Ecodynamics research agendas has involved the gathering of multiproxy data from field excavation (exemplified by Dugmore et al., 2004, 2005, 2007; Harrison & Maher, 2014; McGovern et al, 2006, 2009; Simpson et al., 2003; Streeter et al., 2012; Vésteinsson et al., 2002). These are supported by robust chronological understandings produced through tephrochronology: the dating of archaeological and paleoenvironmental records using the identification, correlation, and independent dating of Iceland’s stratified geological record of tephra layers generated by volcanic eruptions (Thórarinsson, 1944, 1958, 1967, 1975, 1981). The particulate ejecta (tephra) from explosive volcanic eruptions form isochrons (soil horizons of a uniform age) that extend across Iceland’s landscapes and sites of past human activity. These identifiable horizons make possible temporal linkages between material evidence recovered from different archaeological sites, written archives, Greenland Ice core records, and radiometric dating.

This dissertation builds upon and benefits from transdisciplinary collaborations that preceded it in Mývatnssveit and represents but one branch of ongoing research dedicated to collaborative “longitudinal research strategies” returning many times over many years to the same geographic area (Meyer & Crumley, 2011). The collaborative, longitudinal model allows for expertise to be developed and shared and for a combination of different fieldwork approaches to be
layered and compared inquiry. In the context of this research it has afforded opportunities for collaboration and resource sharing not only with other academics but with local residents, local schools, museums and the Mývatn science station which, under the direction of Árni Einarsson, has been the center for ecological research in Lake Mývatn since 1979.

**The Present Work**

This thesis is concerned with reconstructing and understanding changes in rural communities and their production that are associated with Iceland's integration into colonial and capitalist economies during the 17th through 19th century. Central concepts and understandings are drawn from zooarchaeological work as well as critical environmental studies. The work and ideas discussed below aid in the establishment of connections between the archaeological record of animal use in rural production and broader phenomena like colonial commerce, politics, and systems of knowledge.

Zooarchaeological work in Iceland has contributed valuable insight and perspectives about earlier social and environmental impact of commercial production and engagement in economies of scale. Perdikaris and McGovern (2007) traced walrus ivory and codfish as early marine commodities of importance to state-level Scandinavian societies during the Viking Age, whose trade bridged newly settled lands (Iceland and Greenland) with centers to the south (see also Frei et al., 2015). Harrison has argued for a link between archaeofaunal evidence of wool and falcon trading from the medieval Gásir trading post and its local hinterland in Hörgárdalur, to the early world systems connecting Iceland’s rural spaces with
Norway and beyond (Harrison et al., 2008; Harrison, 2013; Harrison, 2014). Feeley has located and assessed proto industrial commercial fishing from the late Middle Ages and beyond at the fishing station called Gúfuskálar in Snæfellsness, Western Iceland (Pálsdóttir & Feeley, 2016). These are only a few examples of work on the evidence of the impacts of large scale commerce.

Zooarchaeology in Iceland has also characterized urbanization, commercial, and specialized production during more recent centuries in ways that inspire this thesis. Harrison and Snæsdóttir studied the household deposits in the urbanizing village of Reykjavik, finding indications of specialization production and consumption patterns (2013). In his work on the archaeofauna from the 18th century bishopric at Skálholt, Hambrecht identified consumption practices resulting from the participation of elite Icelanders in Euromodern status performance. He also argued the Bishopric’s cattle production - including breeding styles and physical modifications - reflected the materialization of European notions of enlightenment era agricultural improvement (2006, 2007, 2011). In my prior work, I have contributed a detailed case study concerning the intensification and specialization of sheep production during the 19th century for emergent free markets (Hicks, 2014; Hicks et al.; 2017). I have also studied the engagement of inland communities in Iceland’s early modern commercial coastal fisheries during the 17th and 18th centuries - bringing attention the social category of seasonally-mobile servant and tenant laborers as an integral part of pre-urban cod fisheries (Hicks, 2018).
Based upon the swath of collected evidence of commercial activity from as early as the Viking Age, Hambrecht has argued rather convincingly that Iceland should be viewed as a first threshold in Atlantic world economic systems and an early horizon of Atlantic-world capitalism (2015). This is both an important and stimulating assertion. These abovementioned studies also demonstrate that the contributions of zooarchaeology (sometimes reductively described as an environmental subdiscipline) are in fact extremely revealing of the unwritten histories and the deep timeline of large-scale commerce as European economic projects merged westward. Our work contributes new kinds of information and perspectives toward understanding the role of Iceland’s people and nature in the uneven economic networks of the Atlantic World (e.g. Haldon et al., 2018; Wolf, 1982; Worster 1993).

Iceland’s 18th century and onward marked a time of economic intensification and one of the main tasks of this dissertation is to investigate this in specific terms in the context of rural economies and ecologies. From the late 18th century, markets for animal products from Iceland grew and „market orientation“ (Jónsson, 2004) of Icelandic producers became a more institutionalized and intensively governed part of society than it had previously been (Róbertsdóttir, 2008). Administrators evaluated and tweaked Iceland’s economy with growth in mind. At the same time there were new scientific modes of though being applied to assess the economic potentials of people and nature. The colonial modernization project- aimed at furthering commodity production- was propeled by emerging forms of scientific knowledge production.
Research themes concerning the “commodification of nature” (Mrozowski, 1999) provide a valuable framework for understanding Iceland’s colonial and capitalist economies. Commodification is a social process through which living beings and materials are converted into normalized and exchangeable forms and assigned a shared understanding of value. Commodification isn’t just practiced on “things” but encompasses the human labor that transforms materials because labor ultimately becomes part of the value of the finished product. The transformations associated with commodification include: the subsumption of nature under systems of private ownership, the abstraction and definition of living beings, materials, and labor(ers) into things (objectification), as well as the exchange or movement of these identified and standardized “things”. The commodification of nature helps characterize how people understand “nature” the environment in “modernized” societies today - as thoroughly penetrated by an active reckoning of potential market values (see Smith, 2007). Commodification depends on both physical production practices and knowledge practices.

Steven Mrozowski has argued that archaeologists have much to contribute to the understanding the histories of commodification particularly as foundational to colonial projects and capitalism (1999). He noted, following Paynter (1988) that the majority of the spaces/landscapes, laboring people, and everyday objects studied by archaeologists of the historical period are commodified. However, comparatively less attention has been given to how these entities became commodities, and this is where interdisciplinary archaeology - with its material
focus, long chronological scope, and environmental approaches - can contribute (ibid).

Questioning the commodification of nature is a particularly approachable framework for zooarchaeologists because we are confronted with the remains of animals that may have been commodified through detectable activities like reproductive control, captivity, imposition of private ownership, slaughter, butchery, preservation, measurement, carcass division, and valuation. These actions may leave physical traces on animal bone and may affect the distribution of carcass parts across space. Through multi-site investigations we may see how specific practices manifest in space and time (e.g. across households or industrial sites) to document and understand large-scale economies. Part of this includes detecting how parts of animals (or whole animals) move from producer sites to consumer sites. All of these lines of evidence, commonly addressed through zooarchaeology then contribute to our understanding of how goods might have been produced and then alienated from local contexts and moved into exchange contexts, thus creating insight into larger issues of social organization and environmental interactions.

Puputti's zooarchaeological study of urbanizing Tornio, northern Finland is exemplary of such an approach (2008). Puputti additionally outlined what zooarchaeologists might expect to encounter as signs of commodification. Among these are normalized meat butchery, a narrowing of focus on particular products and production, selective breeding of livestock, and animals which are increasingly spatially alienated from future consumers (Puputti, 2008). Hambrecht, as mentioned above has looked at physical alteration of Icelandic cattle as a hallmark
of modernist attitudes of agricultural improvement in Iceland (2011). Their works exemplify how the theoretical frameworks around the commodification can be translated into zooarchaeological interpretation. As Hambrecht has previously argued, archaeofaunal remains can tells us just as much about economies and participants as other material objects found in the archaeological record (Hambrecht, 2007, see also Albarella, 1997; Anderson, 2002).

Commodification is often intimately aligned with another practice - scaling up. Anna Tsing has defined scaling up as increasing the output of a certain product by expanding productive conditions (2014). Scaling up is a cultural and ecological field of activity and may include the expansion of land area or intensification of land usage, increases in the reproductive rates, size or spatial density of reared plants and animals, or the intensification of labor including increases in the quantity of laborers involved in production. Seeing the nuances of scaling up becomes important to this work because Iceland’s 19th century was the beginning of unprecedented growth in both the economic productivity of animal economies. And I will discuss instances in which the increases in production were accomplished or limited.

Commodification and scaling up involve specific ways of understanding and knowing environments (Mrozowski, 1999; Scott, 1989; Tsing, 2014). Several scholars have pointed out that scientific knowledge production enabled colonial economic governance and colonialism was a central context for of the development of what is today called modern science (Smith, 1984; Wynter, 2003). Numerics, measurement, and statistical sciences enabled rationalized and synthetic views of
people and resources—views that were meant to be useful to economic administrators attempting to organize large scale economic projects (Scott, 1989). These knowledge practices are therefore technical and potent instruments.

Understanding specific practices around commodification and scaling up is key for the characterization of activities at the heart of the colonial economy of Iceland’s 17th and 18th centuries and later, a rapidly growing and even more market-focused economy by the mid to late 19th century. My suggestion that some of the economic intensification practices from the colonial project contributed to 19th century capitalism echo Mrozowski’s formulation that the cultures of commodification which were mobilized in colonial, mercantile contexts in the early modern atlantic world later became important to later capitalism (1999).

Investigating commodification and scaling up during the mid 18th century in Iceland can be viewed as part of the broader narrative of enlightenment economic „improvements“ on both sides of the Atlantic ocean from approximately the mid 18th century through the early 19th century. In the Americas, England, Scandinavia, and mainland Europe, rural producers were engaging increasingly with empiricism and experimental means of increasing yields of plants and animal products to interact with and form new markets (e.g.; Jones, 2016; Koerner, 1999; Tarlow, 2007). This included breeding programs, transfer of biota, soil amendment, and experimentation with labor-saving technologies among other practices. Iceland’s engagement with the enlightenment and agricultural improvement intensified during the Danish colonial improvement project especially after 1750s (Róbertsdóttir, 2008; Sigurðsson, 2010) and extended beyond this time as farmers
took up scientific practices locally. Rural producers became ever more strongly oriented toward markets as both sellers and consumers and new commercial production practices were brought into contexts of long-term and traditional knowledge and production practices.

Within the last few decades, the term Local Traditional Knowledge (LTK) has been used to define the long-term knowledge developed through practice by groups who have lived in a particular place for several generations (Berkes et al., 2007; Huntington et al., 2011; Hicks et al., 2016). It is often contrasted with modern scientific knowledge which is tied to a European colonial history may thus may have a shorter time frame of reference, especially when generated by visiting researchers, who may not have local practice and experienced-based expertise. An example of the short-term aspect of science is formal modern fisheries science, which began in the 19th century, and in some cases assumed 19th century observations as baseline “natural” conditions (Jackson et al., 2011). In many historical Atlantic World colonial contexts, European scientific knowledge practitioners have sought to supplant and diminish the knowledge systems of indigenous communities via the imposition of enlightenment science and other Judeo Christian, European frameworks. As Sylvia Wynter - paraphrasing Walter Mignolo - puts it: “the imaginary of the modern/colonial world system . . . disregarded Amerindian ways of knowing and knowledge production that were reduced to curious practices of strange people” (2003).

The distinction between modernist colonial science and traditional knowledge remains important for the sake of illuminating historical contours of
domination and rectifying them. Some scholars, however, remind that binary attributions of indigenous versus western knowledge do not always reflect actual relations because fragments of knowledge systems are commonly borrowed between groups and mobilized in a variety of manners (e.g. Agrawal, 1995). As is made clear in subsequent chapters, Iceland’s local, long term knowledge and newer, imported scientific approaches did become intertwined and combined by the Mývatn community. We can nevertheless still see the institutional origins and specific functionality of scientific natural knowledge and its linkages to colonially-introduced cultures of economic management and commodification – for these shaped Iceland’s 18th and 19th century economic transformations and have significantly shaped our contemporary world.

Archaeology is itself a descendant of enlightenment natural knowledge. It may seem contradictory that this dissertation applies zooarchaeological science to reconstruct and study past economic activity while at the same time generating a historicized, critical understanding of science as emergent from within contexts of colonial commerce. The common ground between this zooarchaeological study (as part of an anthropological archaeology) and such critical environmental studies is an emphasis on the investigation of complex historical and material contexts rather than an aim to make generalizing or broadly applicable observations (See discussion in Mrozowski, 1999).
Chapter 3. Historical and Environmental Background

Seafaring Scandinavians and members of their diasporic communities in Northern Europe settled Iceland around AD 871+/−2. Place names and some early accounts suggest an earlier ephemeral inhabitation of the island by a small number of Irish hermits, though no convincing material evidence of pre-Scandinavian settlement has been found. In contrast to the 8th century “Viking” raids and settlements in the British Isles and Dublin, 9th century Iceland was not settled via occupational takeover. Instead, Iceland’s landnám (settlement) was characterized by the establishment of rural society based around farming imported livestock (cows, horses, sheep, goats, and pigs) with a heavy emphasis on marine fishing and seasonal hunting; farmsteads were set up in coastal and lowland valley areas with access to grazing resources, fishing, hunting, and birding as well as forests, driftwood beaches, and peatlands for fuel (see Byock, 2001; Simpson et al., 2003; Smith, 1995; Vésteinsson, 2000; Vésteinsson et al., 2002; Vésteinsson & McGovern, 2012).

Despite their distance from their original homelands, early Icelanders engaged in market interactions with Northern Europe. Walrus ivory from Iceland and Greenland (settled by Icelanders in AD 985) was an early high-status, high-value, commodity and walrus seem to have been hunted in Iceland from the first settlement (Frei et al., 2015; Perdikaris & McGovern, 2007, 2008). Ivory was traded through Norway to broader networks (along with furs and skins) until probably the High Middle Ages.
During the late 13th century Iceland was incorporated into the Norwegian Kingdom along with the Faeroe Islands and Greenland. Then, when Norway became a subject of Denmark in 1397 under the Kalmar Union, its dependencies followed and were united along with Sweden under a Danish monarch. While under Scandinavian rule, Iceland was visited opportunistically by English and German traders as well as traders from the Basque provinces and France during the 15th and 16th centuries (Mehler, 2009; Edvardsson & Rafnsson, 2006). For most of the 16th century, the Danish crown devised plans to expel German merchants from Iceland, but instead leased trading harbors to the German Hansa traders (mostly from Hamburg), to Danes, and to Icelanders (Karlsson, 2000). Scandinavian hegemony extended to areas of society beyond trade. For example, in the mid-16th century King Christian III of Denmark forcefully replaced the catholic Bishops at Skálholt and Hólar (ibid). After the 16th century, steady efforts by the Danish crown and administrators wove Iceland’s local production into closer relations with the Danish crown and Danish merchants (Gunnarsson, 1983; Róbertsdóttir, 2008).

**Iceland’s Early Modern Period**

Iceland’s 17th through 19th century conditions are consistently written about in terms of the challenges they presented to base level subsistence, economic mobility, and prosperity (e.g. Jónsson, 1993). These difficulties were the result of the contemporary political economy as well as variable and cold climatic conditions (Ogilvie & Jónsdóttir, 2000). The hardships resulting from farming imported livestock in Iceland’s subarctic environment were unevenly distributed via the structural social inequalities of the time.
The structural economic predicaments experienced by modern Icelanders included the tenancy system and the legal maintenance of a large servant class (Jónsson, 1993). Statistics from the 1703 census, indicate that about 95% of Icelandic households were tenancies and 5% were owner occupancies (Karlsson, 2000)- the upper class was a small group of landowners and officials. Tenant heads of households and their families made up 60% of all people – a category with significant wealth variability. The second largest segment of the population were servant farmhands working on one-year contracts – most in tenant households (Magnússon & Vídalín, 1943 cited in Karlsson, 2000). Servant farmhands were young men and women mostly born to tenant farmers who would typically leave home in their teen years and work until around age 30 (though often beyond) with the hopes of accumulating the minimum legal resources and finding a housing opportunity for starting tenant households of their own- which was not guaranteed (Magnússon, 2010).

Dispossession and precarity was a precondition of daily life in this social system. Tenant households could be subject to year-long leases and this counteracted incentive to improve land or buildings (Jónsson, 1993). Servant farmhands also worked on one-year contracts. The number of legal households in Iceland did not expand much, and servants who eventually gathered enough money and livestock could become tenants only when vacancies allowed. Meanwhile, annual servant farmhand wages were kept low as an intentional social mechanism to limit them from forming their own households. Additionally, they were formally prohibited from marriage and having children (Magnússon, 2010; Ólafsson &
Pálsson, 1975). Paupers, another social category, were usually very young or very old, nonworking people, without families, who were placed within households in exchange for tax relief. Freedom of choice in mobility, work, residence, and family life was limited.

According to Magnússon, the mean Icelandic household size in Early Modern Iceland was between 5 and 8 people (2010). It generally included a male head of household, his wife, their children, and potentially servants, foster children, paupers, or relatives. All able bodied members of the household worked, and the patriarch was the public and official representative of the household.

Tenant farmers and the servant farmhands who resided with them produced the overwhelming majority of subsistence and trade goods on farms (Róbertsdóttir, 2008) and subsistence production was marked by a strict seasonality between fishing and herding activities. Significant labor was necessary for cutting hay by hand during the summer, drying it, and storing it to get animals through winter. The production of dairy food items from cows and sheep was also fairly labor intensive, as was collecting, washing, spinning, and weaving or knitting wool into marketable goods. The needs of tenants and landowners for such land-based labor in material processing on farms was a main driver behind the legally maintained class of servant farmhands. The second strongly seasonal activity was cod fishing which took advantage of cod coming to spawning grounds in in the south and west of Iceland in the winter and spring. Coastal farms managed a mixed fishing and herding economy while on inland valley farms indentured servants and less-well-off farmers would travel significant distances to camp on the coast in the late winter to
fish, returning to make hay and tend to herds in the summer (Magnússon, 2010).

Surpluses from these activities - butter, fish, wool, and meat - were extracted as rent by landowners and this was facilitated by cheap servant labor.

The main export goods during the 17th century were dried cod, wool, and mutton produced on the household level (Gunnarsson, 1983; Róbertsdóttir, 2008). In 1602, Denmark instituted monopoly trade conditions in which all of Iceland’s trade was secured for Danish merchants alone and all goods passed through Danish centers (Copenhagen, Elsinore, and Malmo). After 1620 all Icelandic trade went through Copenhagen alone (Gunnarsson, 1987). Under this arrangement, Danish officials designated 20-25 Icelandic harbors as seasonal trade centers.

The Danish Trade Monopoly (1602-1786) was not, at first, an enormous shift from trade circumstances in the previous century, but the monopoly conditions allowed the Danish crown to schedule trade with more consistency via at specific harbors with centralized price fixing (Karlsson, 2000). Trade was restricted to summer meaning merchants were prohibited from overwintering. This was intended to prevent the formation of fishing and trading villages which would have drained servant labor away from agricultural work and would have disadvantaged the land-based system (Karlsson, 2000). According to late 18th century documentarians, Danish trade supplied mainly upper-class Icelandic consumers with imported goods like grain, timber, cloth (Ólafsson and Pálsson, 1975). Price fixing of Icelandic goods was intended to be stabilizing influence that would shield Icelanders from the market fluctuations on the continent. But price fixing also entailed Icelanders being paid less for their bulk products than what middle
merchants would receive through later sales, creating class differentiation between merchants and suppliers. The Icelandic legal structuring of tenancy and servitude advantaged the Icelandic landowning elite while it also supplied Danish trade. Up until the late 19th century, the Icelandic landed class did not allow the tenure or servitude system to change.

The Danish Trade Monopoly varied in organization over time based upon companies to whom the crown sold leases and sometimes the crown ran the trade directly (Karlsson, 2000). During the 17th century, Danish administration was chiefly focused on excluding other merchants from trade and ensuring a regular Danish presence in Iceland, however, the relationship would change in the 18th century. Following a famine during the 1750s, the crown took over trade and Danish administrators initiated an economic improvement project focused on agricultural production and experiments with wool manufacturing workshops (Karlsson, 2000; Róbertsdóttir, 2008). A stream of Danish and Icelandic specialists and scientists scrutinized Iceland’s environment and modes of production looking for ways to increase and improve output. They found 18th century Iceland to be a difficult place in which to institute economic and social reforms.

One impediment to reform was the long-standing rigid social system of underpaid servant laborers held in place by Icelandic landowners and tenants (Jónsson, 1993). When Danish administrators attempted to improve conditions for tenants and servants they were met with resistance from Icelandic elites (Róbertsdóttir, 2008). While free labor was partially legalized in 1863 (Jónsson,
resistance to reducing restrictions on servant laborers persisted until the end of the 19th century (Karlsson, 2000).

Another reason why Iceland was difficult to “improve” was that the islanders’ herding economy was at the shifting edge of climatic and longitudinal limits for grass production and the climate at this time was especially variable and often in hospitable. Southward shifts in the Greenland current could periodically bring colder water bearing drift ice to Iceland’s shores, mostly in the North of Iceland but sometimes to the south as well. According to ethnohistorical research and climate reconstructions by Ogilvie and Jónsdóttir, sea ice conditions could severely diminish hay production, reduce fishing catches and prevent trade ships from reaching the coast (2000). The common sea ice incidences and a climate plagued by variable cold may have increased between the 13th and 19th centuries constituting what many have termed the Little Ice Age (White, 2014).

Poor weather, disease, volcanism, and famine struck particularly hard during the 18th century. Smallpox killed up to a quarter of the population of Iceland in 1707–10. Beyond this, volcanic eruptions could damage agricultural land. A late eighteenth-century lava flow nearly destroyed the Reykjahlöð farm in the Mývatn region (Sæmundsson, 1991). The catastrophic eruptions of the Laki craters in 1783 set off a famine that lasted until 1785 and killed a total of 9,000 people in Iceland half of all horses and cows and 30% of ewes in some districts. After these extreme 18th century hardships, Danish administrators considered evacuation of Icelanders to Denmark. After the “Famine of the Mist”, that followed the Laki eruption, population numbers did not rebound to above 50,000, (pre-famine levels) until
1800 (Karlsson, 2000). These very real hazards contributed to Iceland’s lasting reputation as a harsh wilderness and to specific colonial discourses of Iceland as a nature needing to be tamed (Oslund, 2011).

**The Nineteenth Century**

The colonial monopoly trade lasted officially until 1786 though in practice Danish merchants maintained control over trade until the mid-19th century. During the 19th century, several changes transformed the previous order, but they did not happen all at once. Beginning in 1830, Icelanders took steps toward self-rule forming their own consultative assembly in the 1845 (Karlsson, 2000). Democratic self-rule and modernization were core goals, though the country remained part of the constitutional monarchy of Denmark and continued to pay taxes to Denmark, and Denmark operated in Iceland at a financial loss (ibid). Danish traders dominated trade in Iceland until the late 19th century.

Iceland’s mid-late 19th century saw unprecedented growth in the human population. In 1801 there were around 47,000 people on the island. In 1860 there were about 67,000 and numbers reached 78,000 by 1901. The growth in population was surpassed by the growth in the number livestock on the land. Between 1810 and 1854 the numbers of sheep were almost doubled in Iceland. Gunnar Karlsson has noted that most of the growth seems to have been for the most part the category of wethers (castrated male sheep) which were used to produce wool for markets and that the increases in sheep production were undertaken with no new technology (2000). Part of the growth in agriculture was afforded by favourable climatic conditions in the 40s and 50s. But that was short lived. Karlsson also
estimates that fishing grew by 28% indicated by the number of oars counted, but that catches doubled. The economic booms in production in Iceland may have been tied to the growth of markets initiated by the slightly earlier population increases in Europe perhaps creating new consumer markets seeking out Iceland’s goods (Magnússon, 2010).

Although reform-focused sentiments informed 19th century Icelandic politics on some levels, this didn’t include a significant change in policies that governed the servant labor, which tenants and landowners depended upon for the production and extraction of cheap bulk goods (Magnússon, 2010). During the late 18th and most of the 19th century, keeping able bodied Icelanders involved in indentured land-based production was a central preoccupation of elites in governance because the servant farmhand class was potentially drawn toward making a living in landless fishing cottages (Karlsson, 2000). As late as the 1880s the Icelandic government passed laws to prevent people from forming landless fishing-only households, though after 1863 people could purchase their way out of servitude. Even as late as the early 20th century, legal household formation was limited to favor the labor needs of landowners and tenants.

The Danish system of trade was also in some respects tenacious. The Trade Monopoly period had ended in 1787, and free trade was legalized for Icelanders in 1855. But by the late 19th century, all of the trading firms in Iceland were still run by Danish firms. In the 1870s, a new market for the sale of live sheep to Britain opened up which brought more cash into the country and presented a significant deviation from Danish-run trade. Then, in the late 19th century, Iceland’s first
national bank, Landsbankinn made financing capital available to Icelanders and provided loans for fishing enterprise. The investment capital allowed for the formation of Iceland's first rural trade cooperatives. The very first was formed in the Mývatn region and is at the center of this dissertation - and others formed in other rural regions as Icelandic rural communities connected their goods with markets directly.

Icelanders were not only engaging differently as producers but also as consumers. Archaeologists find a conspicuous increase in the amounts of exotic manufactured goods in household middens in deposits that post-date 1850, including crockery, windowglass and other common consumables (Edwald, 2012b; Lucas, 2007; Lucas & Parigoris, 2013).

The investments in commercial production also changed space. As Gunnar Karlsson describes, booms in specific areas of production in the 19th century pulled people in two directions: some people carved out new, formerly marginal areas for cottages and agriculture and increased pressure on the rural landscape while others moved toward the newly forming coastal fishing villages (2000). The Mývatn region, being an inland farming region certainly was a part of these broader changes. The ways in which the community played an active role in their enactment will be explored in subsequent chapters.

**Environment of the Mývatn Region**

The inland Mývatn region in Northern Iceland (Mývatnssveit) straddles the Mid-Atlantic Ridge and has been volcanically active for thousands of years (Thórarinsson, 1979). Mývatn is a eutrophic, spring-fed, shallow lake, consisting of
two main basins: the southern basin of the lake is called Syðriflói while the northern segment of the lake is called Ytriflói. The waters flow out via the Laxá River which runs northwards to the ocean approximately 60 km away. Another river, the Kráka, joins the outflow of the Laxá from the highlands to the south and is spring fed. At the juncture of the Kráka and the southern basin of the lake is a swath of sedge-dominated wetlands called Framengjar. The region is punctuated with volcanic craters and pseudocraters large and small with an active geothermal area on the northern side of the lake.

Mývatn supports three species of fish: arctic char (*Salvelinus alpinus*), brown trout (*Salmo trutta*), and three-spined stickleback (*Gasterosteus aculeatus*), as well as midges (chironomid flies) that provide its name (‘Midge Lake’) (Einarsson et al., 2004). The salmonidae fish are historically noted as an important source of food and wealth for Mývatn farms. A third Salmonidae species, atlantic salmon (*Salmo salar*) anadramously inhabits the Laxá river but is prevented from migrating past a waterfall approximately 10 kilometers north of Lake Mývatn. Despite its high altitude (250–300 m above sea level) the region supports grazing land as well as anthropogenic hay fields upon which residents base their harvest of winter fodder for livestock. The hayfields are the central features of historical and present-day farms and these farm plots cluster in the lower elevation areas of the region, and especially by the lakeshore. The broader social landscape is mainly a mosaic of different kinds of grazing land such as upland common summer grazing areas. Mývatnssveit represents the largest inland farming community in northern Iceland.
Figure 2. An engraving by Thienemann (1827) capturing the avian biodiversity, insect fauna, and geology of the Mývatn region. (Manner of use approved under present copyright).

Mývatn and the outflowing Laxá River form the core of a wetland complex that is exceptionally rich in breeding and moulting waterfowl (Anatidae). At present 15 species of ducks, two species of geese, and one species of swan breed there regularly. About half of the species overwinter in coastal or inland waters in north-western Europe. Four species spend the winter in coastal seas around Iceland and three species are sedentary, staying on unfrozen spring-fed streams and bays in the Lake Mývatn region. Other waterbird species include arctic tern (Sterna paradisaea), red-necked phalarope (Phalaropus lobatus), great northern and red-
throated divers (Gavia immer and G. stellata), and horned grebe (Podiceps auritus). Approximately 15,000 breeding pairs of waterfowl nest in the Mývatn region and the migratory waterfowl arrive in early May – making it one of the most important waterfowl breeding habitats in the world. Ptarmigan (grouse, Lagopus muta) are present in upland heaths surrounding the lake, as is the only native land mammal: arctic fox (Vulpes lagopus). There were no large land mammals in Iceland prior to human arrivals with livestock in the mid-late 9th century, except for the rare polar bear drifting in with sea ice.

**The Mývatn Region’s Archaeology**

Mývatnssveit saw some of the earliest professional archaeological excavations in Iceland just over a century ago (Bruun & Jónsson, 1911) and since 1996 has hosted international collaborative projects combining archaeology, palaeoecology, and community engagement as part of the long-running Landscapes of Settlement project led by the Icelandic Institute of Archaeology, with collaboration from the international North Atlantic Biocultural Organisation (NABO) research cooperative, the Mývatn Research Station, and the Thingeyjarsýsla Archaeological Association. This sustained effort has allowed the collaborative excavation and interdisciplinary analysis of sites including Hofstaðir (site code HST), Sveigakot (SVK), Steinbogi, Selhagi, Hríðheimar (HRH), and Skútustaðir (SKU) (See Figure 1) (Aldred, 2008; Ascough et al., 2007, 2010; Einarsson et al., 2002; Friðriksson, 2013; Gestsdóttir & Isaksen, 2011; Lawson, 2009; Lawson et al., 2007; Lucas, 2009; McGovern et al., 2007; Sayle et al., 2013; Simpson et al., 2001, 2002, 2003, 2004;

Archaeology is not the only sustained research initiative in Mývatn. The focus of the work of several university groups, together with the Mývatn Research Station (established in 1974) and the Icelandic Institute of Freshwater Fisheries, has been to characterize the rich ecosystem of Lake Mývatn and the Laxá River, with particular emphasis on strongly cyclic food web dynamics (Einarsson et al., 2004; Ives et al., 2008). Part of the ecological work involves close monitoring of food web components like waterfowl, fish, and their invertebrate food species (e.g. Einarsson et al., 2004; Gratton et al., 2008). The history of the biota has been extended 2,000 years back in lake sediment cores (see Einarsson, 1982; Hauptfleisch, 2012).

Mývatnssveit has been a nucleus of settlement since the late 9th century, so the region’s archaeological remains are among the earliest in Iceland (Schmid et al., 2017). There seems to have consistently been about 20-40 households in the area around the lake, and they fall into two types that characterized all households in Iceland from the Middle Ages: permanent farms called (lögbyli) and subdivisions of lögbyli called hjáleigur (Teitsson, 1973). Archaeological and documentary evidence supports the persistence of legal main farm parcels especially in advantageous resource locations such as the farms of Skútustaðir and Hofstaðir to name only two examples.

Households in Mývatnssveit tend to cluster around the main basins of the lake, the river junctions, which provide access to fish and birds, the wetlands, which additionally have been an important source of hay. Farms become more rare 5-10
kilometers to the south of the lake where the elevation steadily increases towards Iceland’s highlands. This is due to the fact that cold is more persistent in the higher elevations and the landscape therefore less favorable for haymaking and grazing. To the northwest of the lake, leaving the lakeside, one ascends a heath and subsequently enters the next valley system.

In addition to persistent legal lögbyli parcels that provide a basic unit for understanding the historical landscape there are other aspects of the local environment that make Mývatnssveit an ideal region for long-term archaeological research. The region’s soils provide favourable conditions for long-term organic preservation of archaeological remains, with soil pH consistently in the range of 6.25–6.5 allowing the preservation of anthropogenic deposits of delicate fish and bird bones from archaeological middens as well as substantial amounts of bird eggshell. Precisely dated Icelandic volcanic ash layers (tephra) provide isochrones that temporally connect archaeological sites, via accurate correlations between soil layers uncovered at different excavations, as well as those observed in soil profiles, and lake and bog cores on the landscape scale. Locally visible tephra layers around Mývatn date from about AD 871, c.938, 1104, 1158, 1300, 1410, 1477, and 1717.

As part of the Landscapes of Settlement project, excavations of household refuse have provided a record of farm-based production and interregional food networks (McGovern et al., 2006). While individual farms were the basic settlement unit, marine fish, bird, and sea mammal bones previously excavated from inland farms in the area indicate a broader community of economic interaction linking

Current evidence indicates that Mývatnssveit was probably a fully settled community by the early tenth century (Vésteinsson & McGovern, 2012). By the mid-eleventh century Hofstaðir, a large main farm in the area, had lost its importance as a central place (Lucas, 2009), leaving two centers of local power, at Skútustaðir on the south-western side of the lake and Reykjahlíð on the north-eastern side, both of which remain rural centers to the present.

Mývatn apparently participated in the intensification of wool production around the thirteenth century. Cattle to sheep and goat ratios changed from one cow to four or five caprine during the ninth–twelfth centuries to a 1:20 ratio on smaller farms by the thirteenth century (McGovern et al., 2009, McGovern et al., 2014).

The highland lake basin was probably affected by the sudden onset of colder temperatures followed by an increase in sea ice beginning c.1275–1300 in northern Iceland/southern Greenland (Miller et al., 2012). This may be correlated with the Samalas crater eruption in Lombok, Indonesia, which sent sulphate aerosols into the upper atmosphere, blocking solar radiation and causing global cooling. This may have initiated large scale climatic variability with notable cold periods from the 13th through 19th centuries - what some scholars call the Little Ice Age (e.g. White, 2014).

This climatic cooling and variability is known to have affected Icelandic subsistence. McGovern et al. have argued that an animal bone collection from a domestic midden deposit just above (i.e. later than) the AD H1300 tephra layer at Hofstaðir showed evidence of subsistence stress including uncommonly heavily
processed bone fragments (indicating efforts to extract additional nutrients) and the presence of bones from intentionally killed dogs and cats, both possibly point to dietary shortfalls on the farm. In addition, bones of ice-riding harp seals were found within this AD 1300 assemblage (McGovern et al., 2013). While it is difficult to entirely prove the linkage of some of this archaeofaunal evidence to cold weather spells, the harp seals, by their presence alone indicate sea ice on the coast, which is known to have cooled the air on land. Harp seals are traditionally hunted while they breed on sea ice and are therefore a proxy for its presence. While the Mývatn region was historically considered privileged by its plentiful wild bird and fish populations, the findings from the AD 1300 midden assemblage suggest that the Mývatn community was not immune to periods of subsistence stress. In addition to cooling air temperatures on land and denting fodder production on an annual basis, successive years of sea ice would have reduced livestock populations (see Hicks, 2014). The impacts of these highly variable cold climate episodes become important to the present work as they extent through to the 19th century.

The diverse archive of these environmental conditions including written records and proxy climate indicators form important touchstones for understanding the zooarchaeological record of subsistence adaptation and Icelander’s efforts to engage in commercial production beyond the Middle Ages and into early contemporary times.
Figure 3. Skútustaðir in the Mývatn Landscape. The camera is pointed roughly northward. Photo by Árni Einarsson. Used with permission.

The Skútustaðir Household

Skútustaðir is located on a rise in the landscape between the main lake basin – Sýðrifloi - and the framengjar wetlands to the south. The main Skútustaðir lógbýli household has historical legal rights to these productive habitats for fishing, haymaking, and birding, including large islands in the middle of the lake. According to the Járnábók cadastral survey made in the early 18th century, Skútustaðir and its hjáleiger subdivisions were valued at 30 hundreds which made it and its neighboring farm, Grænavatn the two wealthiest in their municipality. Farms values were expressed in hundreds where 1 hundred was the equivalent of either one cow, six ewes or 120 ells of homespun (Teitsson, 1973) and farm value was assessed as what the farm could support in one year in terms of sheep and cows. The farm with
the highest value (40 hundreds) in the Mývatn region was Reykjahlíð, the parish center of the Northern municipality. The lowest-valued farm on the edge of the community was Máskot, valued at 5 hundreds (Magnússon & Vídalín, 1943).

Skútustaðir had three subsidiary households on its land called Álftagerði (still a farm today), Arnarbæli, and Kirkjubær (also known as Rófugerði) and all were located at a significant distance away from the main farm. The midden remains examined in for this thesis were excavated in the vicinity of the main household of Skútustaðir. In 1839 the subsidiary household of Álftagerði separated from Skútustaðir (Hreiðarsdóttir & Vésteinsson, 1996) and was valued at 10 hundreds and this change shifted Skútustaðir’s value to 20 hundreds.

In the early 18th century Skútustaðir was apparently occupied by two tenants and their families and quite likely, servant farmhands (Magnusson & Viðalín, 1973). According to the census (Manntal), from 1738 to 1822 Skútustaðir was owner-occupied. From 1822 to the mid 1800s it was mostly owner occupied. And records show that during the 19th century the household was made up of a large intergenerational family that was blended as the result of re-marriage. The intergenerational inhabitance at Skútustaðir during the 19th century is made evident by the patronymic system by which individuals last names were made up of two parts: their father’s first name plus “son” or “daughter”. During this time, the household regularly included 2-5 servant farmhands (listed as vinnumaður or vinnukona meaning workman or workwoman). After 1860, Skútustaðir was listed as a church farm housing the priest and two farming families. In 1930, the Skútustaðir farm was 25% owner occupied (information from the census Manntal).
It becomes clear that Skútustaðir’s total land and resources were split among intergenerational families, multiple heads of households, and servants. This complicates issues of “household status” as defined by numerical farm values alone. And in terms of the material record, landowners, heads of household, and servants alike have contributed to the the archaeological evidence of production and consumption left behind in the middens. Barbara Voss has usefully navigated the interpretive issues that apply to complex household archaeologies like this one (2008). The household, she says, can be an unwieldy term due to diverse definitions as „a group of people, a locus of consumption, or a scale of social practice and social reproduction” (ibid). Additionally, the household is historically specific. Skútustaðir exemplifies the fact that a household and its archaeological assemblages do not necessarily correspond to one family, in one monolithic domestic structure, but rather, a group of people of different statuses brought together by complex webs of specific social relations and institutions - in Iceland, this would be the tenancy and servitude systems.

Although the total property value of Skútustaðir (until 1839) was among the highest in the Mývatn community, I would resist interpretation of the farm as simply a high status household. The farm was undeniably a well-positioned in terms of its broader environment and legal rights - with access to large hayfields, fishing, and birding grounds. However was internal difference. Some residents may have been rather comfortable, while some, such as servants, may have experienced a degree of precarity. Foodways, daily work, and material consumption patterns (activities that contribute to the archaeofaunal record) may have differed among diverse members
of the household. For this reason, household status should not be simply conflated with the listed value of the farm but actively questioned and evaluated.

![Image](image.jpg)

**Figure 4.** A pen and ink sketch by Daniel Bruun in 1892 showing the Skútustaðir farmhouse and the early modern church in the foreground. Between the turf farmhouse and the large timber church, the roof of the small medieval church is just visible (from Hreiðarsóttir & Vésteinsson, 1996).

Björn Teitsson traced some broader trends in household inhabitance and ownership that are worth mentioning for additional perspective (1973). He observed that two large events caused farm abandonment in the broader Suður Þingeyjarðarsýsla region during the 18th century. The first was smallpox epidemic in the first decade of the 18th century and the second was the Famine of the Mist 1783-1785. Another significant shift occurred when the catholic diocese of Hólar was discontinued in 1801, and perhaps half of the (30) farms it owned in the larger county of Suður Þingeyjarðarsýsla were sold to tenants suggesting a rise in tenant purchase and hence owner occupancy. Teitsson suggests that in addition to Hólar’s
end, the circulation of cash in the economy may have made these purchases more feasible. In Iceland at this time, owner occupancy was low when compared to Norway and Denmark. As we have seen, common movement of tenants and families during those centuries contrasts the unusually long term persistence of farms as named legal parcels.

Between 1870 and 1890, the overall population Mývatn’s larger rural region -Suður Pingeyjarsístla- decreased by 13% due to emigration to America. Following that, eased restrictions on free labor and growing village life attracted people from rural areas to towns, but at the same time, Iceland experienced general population growth (Teitsson, 1973).

During the late 19th century, Skútustaðir perhaps became even more socially central to the Mývatn community. The small, medieval turf church on the farm (just barely visible in Figure 4) was joined by a larger, timber clad church in 1863 (on the right side of the drawing Figure 4). The farm also became the local hreppaþingstædur or district assembly place - taking the role over from a neighboring farm called Haganes - and a þinghús (local assembly house) was built there in 1896 (Hreiðarsdóttir & Vésteinsson, 1996).

Farmers in the Mývatn region seem to have experienced an increase in self-determination over the 19th century. In addition to some becoming land owners, they began to administer their own trade from within the community after the formation of the Kaupfélag Pingeyinga, the first Icelandic free trade cooperative- and to earn cash. Literacy increased over the 19th century and Mývatn residents organized diverse local associations around different collective goals and interests
from sports, to temperance, to resource conservation. The prevalence of tenancy, however, remained and the legal conditions around indentured servitude didn’t shift until 1890s (Jónsson, 1993). The 19th century was clearly a time of shifting social and economic conditions. The following chapters interrogate how local ecologies were a part of these larger social changes.
Chapter 4. Summary of Excavation and Chronology

In 2007, after a decade of interdisciplinary collaboration in the Mývatn region, archaeological teams from the City University of New York and FSÍ worked together on an archaeological survey with the aim of locating a long-term site to add to the investigations that had, until then, focused mostly on the 9th through 13th centuries. Archaeofaunal assemblages had been previously recovered from Viking Age to early Medieval contexts at Hofstaðir, Hrísheimar, Steinbogi and Selhagi (see location map Figure 1). However, the late Middle Ages and early modern period had been less archaeologically documented. No single site with deep continuous stratigraphy spanning the whole human occupation of Mývatnssveit had yet been identified. The aim of the 2007 collaborative survey project was to locate a site with midden deposits extending from recent times to the medieval period (Vésteinsson, 2008).

During the 2007 survey, CUNY teams located and tested middens at Mývatn historical farm locations of Beinistaðir, Hofstaðir, Grænavatn, Geirastaðir, Litlu Gautlønd, Þorleifsstaðir, Baldursheimur, Grímstaðir, and Skútustaðir. The key discovery of the 2007 season was made at Skútustaðir by Árni Einarsson, who observed a patch of erosion at the southern edge of the field behind the modern farm and church area. The erosion had exposed a soil deposit of well-preserved mammal and fish bones. And subsequent soil coring revealed rich cultural deposits up to two meters in depth (Vésteinsson, 2008). Excavations in 2008-2013 targeted
these areas and produced a large archaeofauna and artifact collection that date from first settlement at the farm in the late 9th century to the 20th century.

This chapter provides a summary of the midden excavations at Skútustaðir and toward the end, the chronological phasing of the archaeofaunal collections discussed in this dissertation. Post-excavation work on artifacts and ecofacts is ongoing, so this chapter - and the thesis generally - do not represent a final report. Readers are referred to the annual excavation reports, listed in Table 1, for more detailed information on unit-by-unit excavation. In these they may find all of the relevant Harris matrices and profile drawings. A planned site-monograph will bring together these and other records.

**Excavation Overview**

The focal area of the coring and all subsequent midden excavations was the central farm mound, a grassy hill in the middle of the farm’s hayfields, and amidst contemporary farm structures including homes, cattle barns, and a commercial fish smokehouse. Skútustaðir is named as an early farm in Reykdæla Saga (ÍF X) and the coring and excavations in 2007 seem to confirm that this has been the long-term settlement area within the historically-known farm boundary. This is not surprising given that the tún (the enriched main hayfield) visible in Figure 6, is by definition a long-term cultural landscape feature. The coring results from 2007, which focused on the tún, indicated that Skútustaðir’s midden layers were well preserved, nearly two meters deep, and separated by several identifiable dateable volcanic tephra layers providing excellent chronological relationships (McGovern et al., 2008).
The landscape in the southern side of Mývatnssveit, is marked by upcropped lava features in the environment called pseudocraters. These form when molten lava moves over a wet landscape; steam gathers below the lava and then erupts through the surface while it hardens creating a hill sized mound. The large steam burst produces a cavity in the center (Thórarinsson, 1979). Those dotting the landscape around Skútustaðir were produced by a lava flow that swept over this area in 300 BC (ibid). Some of the craters’ bare lava surfaces consist of friable gravel and appear as hills with central concavities. Other craters have a folded, craggy, and irregular shape created by the undulations of cooled lava into brittle bedrock.

The hillock on which the Skútustaðir main farm area sits may be a pseudocrater, though it is now covered by over a millennium of anthropogenic soil and midden accumulations and is a homefield for hay production. Excavations revealed that the original ground surface consisted of craggy lava that would have been both agriculturally unproductive and difficult to traverse. The use of midden material and other fill to create the smooth, grassy, and productive home field was thus a multi-purpose and multi-generational project of landscape transformation rather than simply refuse disposal. Icelanders application of household refuse and animal dung for fertilizing and re-modelling a homefield area was widespread, especially where larger farms could deploy sufficient labor (Adderly et al., 2008).

The 2008, excavation teams opened test units D, E1, E2, and F, shown in Figure 5, and located midden deposits with excellent organic preservation and multiple tephra horizons. The excavations recovered evidence of daily life on the
farm in the form of food waste, craftworking debris, broken and discarded household objects, consumables, fuels, and other household materials. Coring was continued in 2008 in order to create an understanding of the deposits across the entire hilltop (Edwald & McGovern, 2008). In 2009, areas G and H were added downslope of Area D (see Figure 5). In 2010, area H was continued and a new area E3 was opened to extend E1 and E2. Area H was finally completely excavated down to bedrock in the year 2011 (Hicks, 2013). In 2013, two new areas were again opened: area E4 (an extension of E3, E2, & E1) and area I. All excavation areas opened have been in the same general location on the hill within the farm mound (Figures 6 and 5). The preservation of osseous materials was generally excellent, with pH of 6.5 consistent in most contexts. Delicate remains like egg shell and small fishbones were recovered regularly.

<table>
<thead>
<tr>
<th>Year</th>
<th>Approach</th>
<th>Areas Excavated</th>
<th>Report Published</th>
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<tbody>
<tr>
<td>2008</td>
<td>Trenches and continued coring</td>
<td>D, E1, E2, F</td>
<td>Edwald &amp; McGovern, 2008; Hicks &amp; Harrison 2009</td>
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<tr>
<td>2009</td>
<td>Trenches</td>
<td>G, H</td>
<td>Edwald, 2009; Hicks, 2010</td>
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<td>2010</td>
<td>Trenches</td>
<td>E3, H</td>
<td>Hicks &amp; Pálsdóttir, 2011</td>
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<tr>
<td>2011</td>
<td>Trenches</td>
<td>H</td>
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<tr>
<td>2013</td>
<td>Trenches</td>
<td>E4, I</td>
<td>Hicks et al., 2014</td>
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Figure 5. Horizontal plan of excavation units 2008-13. Drawing by Gisli Pálsson. Used with permission (from Hicks et al., 2014).
Figure 6. A view of Skútustaðir from the SE prior to 2008 excavation season. The small greenhouse overlies the location of the 19th century sod house. Note the builders’ trench visible around the white modern house in center. This was to provide the area E profiles. Photo T.H. McGovern. Used with permission.
Figure 7. View towards the south across the Skútustaðir home field with area G under excavation 2008. The Framengjar wet meadows and Grænavatn are in the distance. Photograph by T.H. McGovern. Used with permission.

Figure 8. Excavation team, George Hambrecht, Ágústa Edwald, Marianne Robson, & Megan Hicks working in area G on bone-rich early deposits. Photograph by T.H. McGovern. Used with permission.
In three instances, during multiple excavation seasons, edges of structural remains were encountered in excavation areas F, E3, and E4. Apart from a line of stones in E3, these were left undisturbed and excavated. Instead, crews shifted the limits of excavation slightly to exclude the structural ruins, continuing excavation of the adjacent midden remains only. The structural ruin in area F lay below the 1717 Veïðivötn volcanic tephra, another in Area E3 was found below the 1262 tephra, and in Area E4 the structural remains lay clearly below the 1477 Veïðivötn volcanic tephra. Historical records attest that the early modern farmhouse building was located about 10 to 20 meters to the north of from our excavation trenches G and H. The demolition of this house seems to have provided a thick deposit of jumbled structural turves and late 19th c window glass in the uppermost layers of the eastern side of trench G that overlayed the midden deposits below.

Figure 4 provides a view from the SE of the late 19th century turf and wood farm and the church and church yard. The modern house of Gerður Benediktsdóttir, visible in Figure 6, center, was built first as an animal byre on the back of the large turf-built farmhouse complex visible in the upper left corner of the sketch. It was later converted into the contemporary home.

**Excavation Method & Data Curation**

Mapping of the site areas was carried out at centimeter scale accuracy with a Trimble GPS kindly carried out by Oscar Aldred and Garðar Guðmundsson, providing a secure base map. Coring transects were carried out using Oakfield tube soil corers with visible stratigraphy logged by depth from surface. Excavation and recovery methods followed FSI standards (Lucas, 2003), using single context
planning and 100% sieving (through 4mm dry sieve) of all deposits with standard 10 litre bulk samples also taken for flotation (supervised by Mike Church of Durham University) from every context as specified in the archaeobotanical sampling protocol. Bulk samples were also taken for insect analysis (Veronique Forbes). Kubiena tins for soil micromorphology (Val Defeu and Ian Simpson, Stirling University) and tephra samples were hand-collected from profiles. Animal bone for AMS C14 was also pulled from selected strata. Tephra were identified by Magnús Á. Sigurgeirsson (in Vésteinsson, 2008). All finds and data are now curated by FSÍ in Reykjavik with eventual deposit for long term curation at the Icelandic National Museum. Site data and annual reports appear on the NABO Project Management system (www.nabohome.org) and will be curated long term by the Digital Antiquity repository (tDAR, https://core.tdar.org/) and the NSF Arctic Data Center (https://arcticdata.io/) along with the final zooarchaeological digital data (in MS Access and Excel).

**Excavations in 2008, Areas D, E1, E2, F**

The test trench called area D was placed near the southern and upslope side of the hillock and oriented down slope toward the east. Midden remains were mostly found between the V1477 and V1717 tephra in this excavation area. This was the first excavation area to confirm that there were substantial midden deposits and intact tephra surfaces. The accumulation of deposits in excavation unit D were not as deep as some of the other areas excavated in later years, but they did reach 50cm to 1 meter in depth.
The long and narrow excavation area area E1 was placed at the edge of a cut already made by a builder’s trench on the western side of the modern house (see Figure 6). It is oriented in a N/S direction and excavators in 2008 essentially excavated from the edge of the builder’s trench into the exposed midden layers by approximately one meter. This area was important for establishing that there were several volcanic tephra in situ as well as midden remains deposited on top of the LNS (Edwald & McGovern, 2008).

Area E2 was placed to investigate deposits adjacent to another flank of the builders’ cut and the area was oriented in an EW direction. The richest midden deposits in this area were found under a thick grey-green tephra - the V1477. Midden deposits were dense and clearly included including common livestock, pigs, goat, and bird bone. Marine fish and eggshell fragments were also noted during excavation diagnostic iron objects, a small steatite vessel sherd and the Viking Age glass double bead. At the base of the excavation unit, a patchy green grey tephra was noted.

At the base of E2, excavators noted a mixture of gravel and animal bone within the natural concavities of the bedrock surface. These deposits may have been intentionally made to in-fill the uneven natural lava bedrock. The uneven surfaces, on which the LNS, and tephra V-SV 938+/-6 fell give us an idea of the rough bedrock that would have been here when people first decided to settle this location as a farm. It seems like not an ideal location at first, with shallow soils and very uneven terrain around the first household. But as we can see, soils were built up through time and the ground surface was significantly more even by the time the H1300
tephra fell. When the V1477 tephra fell, the homefield was a very even soil surface and had been improved upon through spreading of refuse and possible turf and dung to eventually become the rich homefield that it is today, on one of the wealthiest farms in the area.

Area F was placed on the eastern side of the hillcrest. It is adjacent to a steep edge with a rocky lava outcrop. Cores in this area indicated deep midden deposits, and the soils were damp with poor drainage. The upper layers of area F immediately produced bone and artifact finds that were datable to the 19th century. This area was used intensively for refuse during the early modern period, during the time when residents occupied the historically documented turf farmhouse adjacent to, and facing, the church approximately 15 to 20 meters away. The V1717 tephra was present and clearly visible under the aforementioned deposits. Below the 1717 tephra turf and stone wall were uncovered in the N side of the unit. After the wall was found, crews ceased excavating and closed the unit to avoid excavating structural remains (Edwald & McGovern, 2008).

**Excavations 2009, Areas G and H**

Area G was first opened in 2009. The first deposit encountered was a thick turf dump layer that most likely resulted from the demolition of the site’s early modern turf house in the early 20th century (Figure 4). Several midden layers were excavated from below this turfhouse demolition layer containing 19th century artifacts and these likely correspond to the period of inhabitance of the turf farmhouse. Below these was the V1717 tephra layer. Midden was excavated from below V1717 but it notably thinned out in terms of density of anthropogenic
inclusions around the 1477 tephra below. Below the 1477 tephra however, middens remains became dense in Viking Age deposits, including one substantial deposit that lay atop the Veiðavötn tephra which fell around approximately AD 938 (Schmid et al, 2017). Figure 9 captures the south profile of area G including the visible sequence of the above-mentioned deposits.

Figure 9. Unit G south profile carried to the lava bedrock. Note the marked change in color and texture of the tan Viking Age infilling of the rough lava surface and the establishment of a relatively level and probably grass covered infield surface. The bone rich Viking Age deposit was dumped into the fissure in photo center. The landnám tephra runs directly upon the lava surface in the profile, and dips down into the fissure opening in the middle of the profile. Photograph by Megan Hicks.
Figure 10. Area H at the end of the 2009 excavation season. View of the N profile with the whole surface excavated down to the top of an early 17th c tephra surface. Coring from this layer indicates another 80-90 cm of stratified deposit covering the entire unit. Note the changes in bedding angle evident in the profile as the midden dumping patterns shifted through time. The probable early 20th c. turf house demolition layer is evident in the left of the photo. Photograph by T.H. McGovern. Used with permission.

Area H, shown in Figure 10, was opened in 2009 but would require three field seasons to complete due to the depth of deposits in that area. The trench provided excellent early modern material with dense midden remains noted above and below the V1717 tephra. The ashy deposits seemed to provide good conditions for bone preservation. In 2009 we paused excavation when we reached an early 17th century tephra due to time constraints.

Excavations in 2010, Areas H and E3
Area E3 formed an “L” shape around the southwestern corner of the modern home building (see Figures 5 and 6). The area was truncated to the east by the two areas excavated in 2008 - E1 and E2 - as well as the home itself. The trench edges and corners do not align with the site grid created in 2008. Instead Óskar Gísli Sveinbjarnarson established absolute points using a Trimble DGPS (see Hicks & Pálsdóttir, 2011).

Intact midden layers and improved homefield soils compose the ground surface and subsurface. After unturfing in area E3, we were able to work back from a clear profile of midden deposits, soil amendment deposits and tephra layers that were previously exposed by the excavation of areas E1 and E2 in 2008. Very intact, flat surfaces of the V1717 tephra and the V1477 tephra were encountered beneath relatively homogeneous soil layers containing very scant anthropogenic debris. Such deposits including thinly dispersed domestic waste may likely relate to those described as soil amendments - varying types of waste added to soil to improve its fertility (Adderly et al., 2008). The build-up of homefield soil at Skútustaðir sharply contrasts the farming landscapes to the south that surround the archaeological farms of Sveigakot and Hrísheimar (both abandoned before the high Middle Ages) which lost soil and thus productive land to the extent that this may have contributed to their abandonments.

When the V1477 tephra was excavated, the team noted its intermingling with a cracked ground surface. The tephra ran into small craze lines converging in polygon shapes which resembled frost polygons. The pattern of cracking descended through a few stratigraphic units, creating uneven surfaces and was visible in the
profiles. This potential frost cracking and related vertical disturbance was noted in Area E3, though not in Area H. Further excavation of soils not rich in midden down to the Hekla 1300 tephra began to reveal a more uneven landscape, with familiar lava bedrock crags appearing in slopes and ridges.

Below the H1300 tephra, a ridge of lava bedrock emerged which divided the deposits in Area E3. To north side of the bedrock ridge within the trench, deposits lay in a basin created by the bedrock and to the south, deposits lay flat on a more evenly sloped and higher plane of loose bedrock gravel.

We encountered southward sloping deposits in the northern side of Area E3 that, when removed, were overlying the remains of the edge of a turf and stone wall. Several stones, approximately 20-30 centimeters in length, were aligned in an east-west direction with turves apparently packed around them. The entire feature lay under the 1262 tephra and the turves contained both the landnám tephra and the V-SV 938+/-6 tephra placing the wall’s construction at post AD 940 and predating AD 1262. As more deposits were removed, we found the crevices in the lava surface were deep.

In area H, turf, in-fill and protective teram fabric were removed on the first excavation day to reveal the archaeological levels left in place in 2009. The 2010 excavation unit differed slightly in extent: the trench’s northern and southern boundary were consistent with the previous years (being four meters apart, however the western boundary was a baulk of turves placed to protect H from the backfill of the contiguous area G. This baulk was approximately 64 cm wide, making the total length of the excavated area 8 m and 36 cm. This eastern end was reduced
to come into phase with the main body of the trench and the context relations were recorded. The early 17th century tephra thought to have brought the trench into phase at the end of 2009 was found to not be a continuous deposit, rather significant deposits were removed toward the western edge of the trench before it was in phase with the eastern edge.

Several deposits excavated in Area H, were extremely soft and friable, containing wood ash with plentiful midden material, interspersed with orange turf lenses. The turf lenses were not excavated as separate lenses, but the observations in the field lead us to ask whether turf was laid on this loose midden material to prevent its dispersal by wind and weather. There was a notable decrease in clay pipe fragments as the excavation progressed toward the very distinct V1477 tephra. The density of ash and midden also decreased sharply approaching the depths at which the V1477 tephra was uncovered. On the second to last day of excavation, the crew removed the V1477 tephra. In the previous year of excavation, we found few bones or artifacts below the V1477 tephra until we encountered Viking Age material. This low density of midden corresponding with what are probably the 15th century is seen both in Area H and Area E3 and was noted in Area G. Excavation continued in Area H in the summer of 2011.

**Excavations in 2011, Area H**

Excavations in 2011 began with the opening of Trench H from under a large volume of backfill under which the archaeological layers were protected by barrier cloth. Excavation started where that in 2010 it had left off, the deposit directly below the V1477 tephra and context numbering began at. The two deposits
following the V1477 tephra were void of visible anthropogenic material as those directly above the V1477 tephra. Soon below, we encountered the V1410 tephra, again encapsulated by deposits devoid of bone and artifacts. It is notable that these “empty” deposits surrounding the V1477 and V1410 tephra are lacking the usual of human activity during a period in which Iceland is known to be impacted by the bubonic plague, though we cannot prove this to be the cause. Other reasons for their lack of artifacts and animal bone may be changes in spatial organization of activities on the farm.

Below these sterile layers, a context was identified containing turf with a visible tephra resembling the H1300 in color and grain size, though this tephra was not found as an intact, totally continuous deposit, but rather patchy. However, the tephra identification is strengthened by the fact that it was found below the 1410 tephra and above the H12th century tephra. Below this turfy context with patchy tephra, deposits containing midden bone, charcoal, ash and artifacts again appeared. Two large lenses contained twig-sized charcoal and wood ash. Below, a midden dump was characterized pink-hued peat ash, and bone. Under these, the white Hekla 12th c tephra, though present only in wisps in the east side of the trench, was traceable as a broader deposit. Below the Hekla 12th c tephra, the contexts began to dip further into what we suspected were crevices in the bedrock, seen in previous years in Trenches G and E 1,2, and 3.

The deposits we found at the base of Trench H in 2011 were nearly similar to those found in 2009 in the base of area G (dense midden in a lava crevice), though they sloped downward significantly to the east with the natural ground surface. All
were non-compact midden layers inclusive of large fragments of mammal bones, fire cracked rock, egg shell and large gravel; charcoal fragments were present and the deposit appeared to be mixed with the 938+/−6 tephra, but was later confirmed to be laying above it.

Below the lowest deposits was a clear boundary to a gritty, silty deposit on an undulating lava bedrock surface, banded with the Landnám sequence and bearing no anthropogenic contents. The removal of this gravelly midden layer on to the 10th c tephra and bedrock concluded the 2011 excavation. It seems the inhabitants of Skútustaðir were filling natural crevices with midden until about the high Middle Ages, when the soils and middens filling the surface are level with the crevice edges. This long-term pattern of activity eventually made the terrain more even, easier to traverse, and eventually, soil-rich.

**Excavations in 2013, Areas E4 and I**

The excavations in 2013 were informed by those in 2010. In 2013, we opened area E4 was opened exactly 50 cm west of Area E3. To summarize the findings in area E4, deposits descending from the topsoil to the V1477 tephra are categorized as amended infield soils (following Adderly et al., 2008) with sparse midden remains and occasional artifacts including bone, ash and early modern/modern artifacts. These deposits are clearly unlike dense middens with ash and bone uncovered elswhere on site. The V1477 and V1410 tephra, which were surrounded by visibly empty soils. Below the 1410 tephra the density of midden remains increased and deposits were identified as intentional dumps of midden mixed with turf. Structural remains consisting of row of stones oriented in a general N/S direction uncovered in
the SW side of the trench. Below the H1104/1158 tephra, the deposits laid in a natural elongated depression in the lava bedrock and are composed of midden, turf dumps, and collapsed or discarded stone, perhaps structural. This area seems to have seen common usage as a domestic refuse dumping area, which had the effect of evening out the undulating lava landscape.

Without indulging too much in literal interpretations of the sagas, this early structure straddling a ravine in the bedrock is evocative of the descriptions of the Viking Age dwelling of “Killer Skúta” in the Saga of the People of Reykjadalur, that describes his domestic space overlying “a subterranean passage” (Reykdæla saga, ÍF X, chap. 28). While this fragment of “saga archaeology” is interesting as an aside, it’s veracity doesn’t factor into the subjects covered by this dissertation.

Area I, a small trench, was also opened just south of the crest of the hill – the aim was to test deposits here as they have only been documented through coring. The very dense midden deposits of modern and early modern remains in area I were pitted by subsequent modern holes and cuts of an unknown purpose. The anthropogenic content of deposits generally decreased in density as the excavation progressed toward the older layers.

**Phasing of Archaeofaunal Remains for this Dissertation**

The deposits analyzed and reported in this work are phased into chronological groupings through the use of both tephrochronology and ceramic typology.

The Veíðivötn 1717 volcanic tephra was present in every excavation area of Skútustaðir and therefore provides a consistent anchor for phasing of remains from all excavation units. Ágústa Edwald’s ongoing ceramic typology work lends further
detail to the chronology of stratified deposits as it provides ceramic identification of
ware and decorative typology, corresponding manufacture dates which are both
general and specific, and the percentage of each ceramic type within a given deposit.
This constructs a reliable framework for chronological understanding because the
timeframes for innovations in ceramic manufacture are known and the timing of
initial imports to Iceland are increasingly well-understood (e.g. Lucas, 2007).

Icelanders became consumers of an abundance of imported good after the
mid 19th century. Among these was industrial white earthenware table settings from
England (Lucas, 2007). Thus, deposits with a preponderance of these can be
assigned a post 1850 date (Edwald pers. Comm.). The innovation of certain
decorative styles after 1900 lends further chronological information (ibid), but for
the purpose of this dissertation, the post 1850 and post 1900 materials are
combined into one analytical unit called “post 1850”. The post 1850 phase has an
end date in the early 20th century because the use of home-adjacent areas for refuse
disposal seems to have diminished when municipal refuse areas were established.
Analysis of both archaeofaunal remains and artifacts from the entire site is ongoing.

The earlier phase, designated as AD 1630-1717, is defined using tephra
chronology and ceramic typology of pipe fragments. This phase includes materials
found below the 1717 tephra and inclusive of clay tabacco pipe fragments. Work by
Natascha Mehler on the identification and chronology of clay pipe stems in Iceland,
as well as related written records places early instances of their use around 1630
For the research questions of this dissertation, it would have been useful to also include phase that encompassed the 1717-1850 phase. But this was complicated by two issues. First that pre 1850 remains cannot be securely identified by the absence of white earthenwares; the absence of white earthenwares in the midden layers does not constitute evidence of absence in general. Second, when this phasing was tested preliminarily the sample size was not large. The creation this provisional phase will be cautiously re-considered ongoing and future work. With ongoing identification of material culture in the midden layers, an analysis of this phase may be possible.

The chronological phasing of deposits examined in this dissertation is organized below in Table 2. Deposits are labeled with a unique 3-digit number in the 3 columns to the right and they are organized into rows according to their excavation area of origin (labeled by letter in the leftmost row).

Table 1

*Phasing of the Archaeological Contexts Included in this Work*

<table>
<thead>
<tr>
<th>Analytical Units</th>
<th>1630-1717</th>
<th>Post 1850</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1630-1717 A.D.</td>
<td>1850-1900 A.D.</td>
</tr>
<tr>
<td>Area D</td>
<td>032, 046, 044, 052</td>
<td>002, 005, 030, 001</td>
</tr>
<tr>
<td>Area E1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area G</td>
<td></td>
<td>105</td>
</tr>
<tr>
<td>Area H</td>
<td>167</td>
<td></td>
</tr>
</tbody>
</table>
Table 3
*Tephra Identified at Skútustaðir*

<table>
<thead>
<tr>
<th>Volcano of origin</th>
<th>Established date AD</th>
<th>Alternate names used in reports.</th>
<th>Contemporary sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veíðivötn</td>
<td>1717</td>
<td>V1717</td>
<td></td>
</tr>
<tr>
<td>Veíðivötn</td>
<td>1477</td>
<td>V1477</td>
<td>Thordarsson &amp; Larsen 2007</td>
</tr>
<tr>
<td>Veíðivötn</td>
<td>1410</td>
<td>V1410</td>
<td></td>
</tr>
<tr>
<td>Hekla</td>
<td>1300</td>
<td>H1300</td>
<td></td>
</tr>
<tr>
<td>Hekla</td>
<td>1262</td>
<td>H1262</td>
<td></td>
</tr>
<tr>
<td>Hekla</td>
<td>1104</td>
<td>H1104</td>
<td></td>
</tr>
<tr>
<td>Hekla</td>
<td>1158</td>
<td>H1158</td>
<td></td>
</tr>
<tr>
<td>Veíðivötn (V-Sv)</td>
<td>938+/−6</td>
<td>V-Sv 938+/−6 formerly V-Sv 938+/−6</td>
<td>Schmid et al., 2017</td>
</tr>
<tr>
<td>Veíðivötn</td>
<td>877+/−1</td>
<td>Landnám tephra, LNS formerly 877+/−1 +/-2</td>
<td>Schmid et al., 2017</td>
</tr>
</tbody>
</table>

Figure 11. The 2008 profile from Area E1, showing the unusually complete tephra record (identifications by Magnús Á. Sigurgeirsson 2008) which match the AMS radiocarbon dates (two sigma) quite closely. Digitized profile depiction by Agústa Edwald. Used with permission (from Edwald, 2009).
Chapter 5. Methods

This chapter describes how the archaeofaunal remains from Skútustaðir were sampled from midden deposits during the excavation and how the animal bones were identified and analyzed to reach conclusions about past usage of various species. I also describe in necessary but minimal detail, how the remains of egg shell (also recovered from middens) were identified to the level of species. I briefly outline an improved methodology for that task, which is a product of a fruitful, ongoing collaboration with colleagues at the University of Iceland and the Mývatn Research Station. A formal presentation of the identification method will be in the form of a multiauthor manual currently in progress.

Sampling in the Field

The excavation of Skútustaðir was carried out using single context recording. This entails that archaeological layers (deposits) are identified, described, and given unique identification numbers. They were excavated and sampled alone, excluding other deposits or materials. Layers correspond to an event hypothesized and detailed by the excavator. The event may vary in duration and intensity; it may be a rapid depositional event such as a burial or a slow depositional process like 100 years of refuse disposal. It is up to the excavator to decide and to describe the layer they are excavating, doing their best to separate events or deposits with different makeups (in terms of the soils, their contents, or features). Materials collected from each unique layer are examined as a group and never mixed with material from other layers. However, resulting data may be grouped during analysis to form an
analytical unit, as is done here (Table 2), though layer numbers remain connected to the individual fragments or objects recovered.

During the single-context excavations at Skútustaðir, all midden material was dry-sieved through 4mm mesh. Back dirt was regularly checked and it was observed that few elements were missed by the sieving methods. Any articulated animal bones (representing bones that were disposed of when attached by flesh) were placed together in one bag in the field and subsequently recorded as one specimen. Bird eggshell was sampled by collecting the shell fragments and surrounding soil into a plastic sample bag. This method was used because bird eggshell fragments are often smaller than the 4mm mesh of the sieve. The archaeofaunal collections were then shipped, with permission, to Hunter College, where they were identified in the zooarchaeology laboratory there.

**Archaeofaunal Identification**

The approach to data collection used in this report is the NABO standardized and common method (see McGovern et al. 2009). I completed the analyses at the Hunter College Zooarchaeological Laboratory and made use of the comprehensive, North Atlantic- focused reference collections housed there. All bone fragments were identified as far as taxonomically possible (a selected element approach was not employed), however, following standard method most mammal ribs, long bone shaft fragments and vertebral fragments were assigned to “Large Terrestrial Mammal” (cattle or horse sized), “Medium Terrestrial Mammal” (sheep, goat, pig or large dog sized), and “Small Terrestrial Mammal” (small dog-fox sized).

Sheep and goat bones can only be differentiated in some cases. Only elements
positively identified as *Ovis aries* and *Capra hircus* were assigned to the separate sheep and goat categories respectively while all other more ambiguous sheep/goat element were assigned to the “caprine” category which may include both sheep and goats. Sheep/goat distinctions follow Boessneck, (1969), Halstead and Mainland (2005), and Zeder et al. (2010). Tooth-wear stage studies, used for determining the age of death of animals follow Grant (1982), dental terminology follows Hillson (1986), and long-bone fusion stage assessments follow Reitz and Wing (1999).

The fish identification criteria I used follow the most current ICAZ Fish Remains Working Group recommendations (including most cranial and vertebral elements), with only positively identified fragments being given species level identification (thus creating the usual large cod-family (also called gadid) category and an equally substantial freshwater salmonid category as well as a substantial number of unidentified fish bones).

Following NABO Zooarchaeology Working Group recommendations and the established traditions of North Atlantic zooarchaeology, I use an identified fragment count- number of identified specimens- (NISP) the basis for most quantitative presentation. Total fragment counts (total number of fragments, TNF) which include both identified and unidentified bone fragments are recorded. Where corrections for the different frequencies of bones in a skeleton are required, an MAU (minimal animal unit) measure is used, which divides the count for a species’ bone element by the number of times it appears in the skeleton (terminology and formulas follow Grayson, 1984).

**Data and Curation**
Digital records of all data collected were made following the 9th edition NABONE recording package (Microsoft Access database supplemented with specialized Excel spreadsheets, see discussion and downloadable version of NABONE at www.nabohome.org).

Basic data will also be deposited in the tDAR system and at www.nabohome.org. The animal bones excavated will be permanently curated at the National Museum of Iceland. All digital records (including archival element by element bone records) and the bone samples will be permanently curated at the Icelandic National Museum, Reykjavik. The completed archaeofauna will be part of the NSF funded DataARC program, and final data sets will be deposited in the NSF Arctic Data Repository.

Method for the Identification of Bird Egg Shell

As part of this dissertation research, I formed a collaborative team to further develop a method for the identification of archaeological bird egg shell with collaborators Dr. Kesara Anamthawat-Jónsson, and Dr. Árni Einarsson from 2013-2015 (see also Hicks et al. 2016). That method is utilized here is described here in moderate -but not complete -detail. A complete methodological manual will be presented in a separate multi-authour publication.

Our method hinged on the creation of a reference collection of Scanning Electron Microscope micrographs of eggshell from known, avian species local to Mývatn (though many are migratory and found in N. America and Eurasia as well). In addition to my aforementioned collaborators, Ægir Þór Pórsson operated the
Scanning Electron Microscope for a duration of the data collection, as did Lilja Leifsdóttir - both under the direction of Kesara Anamthawat-Jónsson.

The wild bird eggs we used to create the reference collection were gathered over decades of biological and ecological field research by Árni Einarsson. Preparation and initial observations under stereoscope was carried out by me and Árni Einarsson during the winter of 2013 with support from the NSF. We used a Leica MZ 12.5 stereo microscope, fitted with an ocular micrometer, calibrated to a separate stage micrometer scale, to measure eggshell thickness, observe pores, and to view and measure the cross sections, and to note morphology as much as possible. We noted eggshell thickness measurements for our reference collection and our archaeological collection. And at this point in the process, we assigned unique sample numbers to each individual fragment from our reference collection and our archaeological assemblage.

The labeled reference collection was then transferred to Kesara Anamthawat-Jónsson who worked with her two assisting graduate students to produce hundreds of micrographs of the eggshell at x50, x200 and x300 and x600. The SEM microscope used to generate the images by Anamthawat-Jónsson is of the type JSM-6610LA from JEOL Japan.

The reference images were derived from of the inner surfaces of eggshells as they are more topographically complex than the outer surfaces. From the innermost layer, there is the mammillary knob layer, the cone, palisade, vertical crystal layer, and the cuticle (Solomon, 2010). Figure 12 shows the internal surface of eggshell samples from domestic chicken (Gallus gallus) and a whooper swan (Cygnus cygnus).
Our reference collection documented 27 bird species and 20 of these are found nesting in the Mývatn area. For identifications, we centered on three characteristics: (1) the number of mammillae per area (spatial density) (2) the morphological features of the inner eggshell surface (3) the cross-section thickness of the eggshell fragments.

After the reference image were made, the three of us met at New York at Hunter College city University of New York, to create a schematic of morphological descriptions we then used to differences between eggshells of different species. In addition to this, I subsequently collected quantitative data from the x50 avian eggshell reference images and archaeological eggshell images. I then used the images, quantitative metrics, and visual morphology guides from the reference collection to identify the archaeological samples discussed in this dissertaiton.
Images at the same levels of magnification were then taken of the archaeological samples.

To create the data for the comparative collection used in this dissertation research, I used the x50 images and applied a metric grid for counting mammillae at 0.25 mm² (each grid 500x500 µm). The grid consisted of a digital image layer measured out to the desired area units placed it atop x50 SEM images in Adobe illustrator. I then made twelve counts, one in each grid square, on two images (totaling 24 counts from two images per species). The 24 counts from grid squares were then used to calculate the means and the standard deviation of mammillae density for each bird species (using the Student’s T-test).

During identification of the archaeological assemblage of bird egg shell, I concentrated on certain diagnostic zones and features. The thickness of the eggshell, the topography and morphology of the mammillae, as well as their spatial density, the shape and spatial density of pores. I additionally examined spaces in between mammillae –fissures- and the connections between the mammillae – sutures. In the forthcoming manual, our team’s descriptions share a similar vocabulary for morphological features to Jane Sidell (1993) but perhaps offer more detail in some categories and with regard to the number of species examined. As a final note, quantification of recovered eggshell fragments is not recommended because the number of fragments will be disproportionate to meaningful units present. Therefore, the resulting data from analysis of eggshell here are best interpreted as generally indicative of species targeted for egg collection. However, it may be
overzealous to consider the data as meaningful in terms of quantified proportions of species utilized.

The examination of archaeological eggshell in recent decades has mostly been carried out via Scanning Electron Microscopy (Beacham & Durand, 2007; Sidell, 1993) and has become increasingly feasible in recent years due to the development of diverse technical approaches. One example is the identification of bird eggshell using peptide markers identified via Mass Spectrometry (MS) (e.g. Presslee et al., 2018). One of the benefits of the method devised for this work is that it is relatively accessible to zooarchaeologists accustomed to working on a morphological and macro scale and it non-destructive. SEM micrographs such as those we rely on can be readily made from eggshell samples by technicians according to easily communicated standards (e.g. magnification levels). The samples and images can then be returned to the researcher or to the final institutional custodians and curators. Another advantage to this method is that it enables the inclusion of other observations such as mammillary reabsorption which can indicate incubation levels of the embryo at the time the egg was harvested (e.g. Beacham and Durand, 2007) this is information that Mass Spectrometry does not capture.
Chapter 6. The Skútustaðir Archaeofauna

This chapter focuses on the analysis of the archaeofaunal remains from Skútustaðir. The main purpose is to reconstruct how the farm used domesticated and wild species to provision themselves and to engage with shifting markets from the 17th century through to the early 20th century. That time span is represented by two phases in this analysis. The earlier phase – AD 1630-1717 - fits within the period of Danish colonial monopoly trade, and a second phase extending from 1850 to the early 20th century overlaps with beginnings of free trade in the region.

Archaeofaunal analysis provides vantages large and small including information about various species’ local life histories and how they were managed in the local environment. Osteological evidence of animals ages at death helps identify production-related demographic management strategies such as meat production or secondary product derivation from mature animals (e.g. milk, wool, traction). Evidence of butchery practices, carcass partitioning, and differential deposition patterns may point to either home-consumption of animals or the production and exchange of standardized, specialized meat products. In addition activities associated with household subsistence, what becomes visible is how people transformed animals from their local ecologies into fungible “things” and commodities – revealing how the rural household and their local ecologies were connected to and constituted broader economic contexts – specifically here, Danish colonial trade and emergent free trade capitalism.

As economic connectedness intensified over the early modern period in the Atlantic, European states increasingly devoted efforts toward extracting resources
and wealth to their centers (Koerner, 1999). During and after the mid 1750s, the Danish colonial administration became intensively focused on studying and administering Iceland’s economic improvement and commercial production (Karlsson, 2000, Róbertsdóttir, 2008). This was not only a top-down scenario. In addition to relying on certain goods like grain, timber, and cloth (Karlsson 2000), Icelanders increasingly modeled mainland European lifestyles through the purchase and use of imported exotic goods like tablewares and smoking paraphernalia just to name a few examples (Lucas, 2007; Lucas & Parigoris, 2013; Mehler 2002). Before the mid-19th century, the trade with Denmark was mostly barter and was sometimes precarious. Increasingly over the late 18th and early 19th centuries, Icelanders invested in agricultural improvements to boost economies toward for the Danish market.

After the mid 19th century there were critical changes to the economic system. After 1854, Icelandic producers gained legal access to free markets of the wider Atlantic world, beyond the Danish merchants and state. This fostered linkages between rural producers like the Mývatn community and the novel demands and earning opportunities. In 1882 Icelandic farmers formed the first Icelandic-run free-trade cooperative in the region of Þingeyjarsýsla including Mývatnssveit. During the last two decades of the 1800s, the social and labor composition of the Mývatn community seems to have changed in ways that were intimately intertwined with animal economies. The social legislation that produced the labor bondage system was dissolved allowing farmhand servants to register themselves as free laborers in villages on the coast to work in expanding fishing.
dock industries, and fish processing (Jónsson, 1993). Iceland’s animal economies—people and local ecologies did not merely transform along with the colonial and free trade capitalist economies but were at the foundation of this economic transformation. This chapter explores and documents this by looking at animal economies and how they were constituted at the household level during these times.

**The Archaeofaunal Assemblage**

Thanks to ongoing collaborative work with specialists in tephrochronology (Schmid et al., 2017; Sigurgeirsson, 2008) and material culture studies the site is chronologically well-understood. Table 4 below provides the counts of identified bone fragments (number of identified specimens, NISP) in each chronological phase as well as a count of fragments that could not be identified to a useful taxonomic level (TNF or total number of fragments). The divisions of these categories follow NABO convention to ensure comparability with other regional data sets. The 1630-1717 assemblage produced 7,465 NISP while the post-1850 assemblage produced 2,456 NISP. Both are well above the NABO standard minimum sample size of ca. 300 NISP for largely mammal collections and ca. 1000 NISP for collections rich in fish bones. This presentation will focus discussion first upon the domesticated mammals before turning to the wild species.
Table 4
*NISP and TNF of Identified Archaeofaunal Remains From Skútustaðir*

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>1630-1717</th>
<th>Post 1850</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Domesticated Mammals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cow <em>(Bos taurus domesticus)</em></td>
<td>168</td>
<td>52</td>
</tr>
<tr>
<td>Horse <em>(Equus caballus)</em></td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Sheep <em>(Ovis aries)</em></td>
<td>98</td>
<td>49</td>
</tr>
<tr>
<td>Caprines <em>(sheep or goat)</em></td>
<td>758</td>
<td>323</td>
</tr>
<tr>
<td>Goat <em>(Capra hircus)</em></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Dog <em>(Canis familiaris)</em></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Wild Mammals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arctic fox <em>(Vulpes lagopus)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mouse <em>(Mus musculus)</em></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Marine Mammals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harp seal <em>(Pagophilus groenlandicus)</em></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Seal indeterminate <em>(Phocid sp.)</em></td>
<td>23</td>
<td></td>
</tr>
<tr>
<td><strong>Birds</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mallard <em>(Anas platyrhynchos)</em></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Anatidae indeterminate</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Avian species indeterminate</td>
<td>116</td>
<td>107</td>
</tr>
<tr>
<td>Scaup <em>(Aythya marila)</em></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Aythya sp. <em>(scaup or tufted duck)</em></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Aythya fuligula <em>(tufted duck)</em></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Long tailed duck <em>(Clangula hyemalis)</em></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Swan <em>(Cygnus cygnus)</em></td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Gavia sp. <em>(Gavia immer or stellata)</em></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Ptarmigan <em>(Lagopus muta)</em></td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Slavonian Grebe <em>(Podiceps auritus)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scoter <em>(Melanitta nigra)</em></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Barrow’s Goldeneye <em>(Bucephala islandica)</em></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Gull <em>(Larus sp.)</em></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Plover <em>(Pluvialis apricaria)</em></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Anser sp <em>(A. platyrhynchos or A. anser)</em></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Fish</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arctic char <em>(Salvelinus alpinus)</em></td>
<td>840</td>
<td>310</td>
</tr>
<tr>
<td>Trout <em>(Salmo trutta)</em></td>
<td>46</td>
<td>6</td>
</tr>
<tr>
<td>Salmonidae <em>(S. salar, S. trutta, or S. alpinus)</em></td>
<td>711</td>
<td>385</td>
</tr>
<tr>
<td>Cod <em>(Gaddus morhua)</em></td>
<td>555</td>
<td>95</td>
</tr>
<tr>
<td>Haddock <em>(Melanogrammus aeglefinus)</em></td>
<td>58</td>
<td>36</td>
</tr>
<tr>
<td>Saithe <em>(Polachius virens)</em></td>
<td>61</td>
<td>12</td>
</tr>
<tr>
<td>Torsk <em>(Brosme brosme)</em></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Halibut <em>(Hippoglossus hippoglossus)</em></td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
The relative percentages of the domestic mammals from the two phases are presented in Figure 13. In both phases, caprines (a category inclusive of sheep or goats) are the most common animals present. Sheep bones dominate the caprines that could be identified to species level, as goats are represented by only a single bone. Horse and dog remains are present at trace levels, and (as in most post-medieval Icelandic archaeofauna) and pig bones are completely absent. Like most other early modern Icelandic archaeofauna, the Skútustaðir early modern collections indicate an Early Modern farming strategy centered on cattle and sheep raising. This is discussed in further detail in the next sections.
Figure 13. This graph shows the different percent NISP (Number of Identified Specimens) of each type of domesticated mammal identified in the archaeofauna.

**Cows**

Historically, Iceland’s milk cows were grazed outdoors during the summer for approximately three months and for the rest of the year they were provisioned with hay while kept in barns. Cows need to be provisioned with rich sources of hay in order to produce milk. On the other hand, sheep, goats, and horses could fare well on poorer land and in marginal grazing months. Vésteinsson et al. (2002) have argued that cows had a determinant role in landscape organization and farm status during the settlement period because Iceland’s first occupants maintained a strong cultural preference for tracts of land that could furnish cows with hay.

Cows and sheep were the foundational productive elements of an Icelandic farm since at least the Middle Ages; and cows were the measure of value against which all other livestock were comparatively expressed (see McCooey, 2017). This “legal cow value” specifically referred to milk cows at the productive age between 3 and 10 years old which were each the equivalent in value of six ewes (ibid).
Archaeologists have used the number of cattle compared to the number of sheep in archaeofaunal remains as metric for thinking about landscape characteristics, farm status, and economic focus. McGovern et al. note that while 9th and 10th century archaeofauna have mostly revealed a 1:5 cattle to caprine ratio, after the 11th century some smallholdings seem to adopt a specialized sheep herding orientation and those have nearly 10 or over 20 sheep bones per cow bone (McGovern et al., 2014). These households are hypothesized to be specialist farms in the production of surplus wool (ibid). By the early 18th century, this higher proportion of sheep when compared to cattle seems to be the norm across most farms and cattle were ubiquitously kept for dairy production. According to the mean data from the Járðabók, livestock census of 1703, an average farm might have 3 cows, 24 ewes and 16 wethers (Karlsson, 2000; Magnússon & Viðalín, 1973), but averages do not reflect range of variation and social inequalities among farms and subunit households, which was significant. The minimum legal requirement for an independent household was one cow and six ewes.

Throughout premodern history, the majority of farms in Iceland managed cows for dairy, with beef farming being a rare occupation of specialized or high-status farms. Although dairying would have been the most common management strategy in the past, archaeological research has illuminated how beef consumption was a socially meaningful and conspicuous display of wealth and status in premodern times (Hambrecht, 2011; Lucas & McGovern, 2008; McGovern et al., 2009). The ritual decapitation of cattle at the 10th to 11th century feasting hall
Hofstaðir in Mývatnssveit is one example of this (McGovern et al., 2009). Another is the unusually high levels of prime age beef production and consumption evident at in the Early modern faunal assemblage from Skálholt Bishopric (Hambrecht, 2011).

Cattle management strategies can be interpreted through evidence of age at death. Here, age at death is determined through the separation of cattle bones into categories according the progression of their epiphyseal fusion (the fusion of small, porous, and growing bones into whole, adult bones). Bones from very young animals less than three months old (neonatal) are identifiable by their rough and unformed surfaces in addition to their small size, and can be readily distinguished from bones of older sub-adult juvenile animals. I divided the cattle bone into three categories: adult, neonatal, and juvenile. Adult cattle bones were large, smooth, and had fused long bone ends. Neonatal cattle bones were small, porous, and un-fused. Juvenile cattle bones were large but still unfused or partially fused which indicates an animal that is approaching full body size an age of 1.5-2.5 years (Mulville et al., 2005) – not fully developed but not neonatal.
Figure 14. This chart displays the ages of death determined from individual cow bone specimens recovered in the early modern phase.

Figure 15. This chart displays the ages of death determined from individual cow bone specimens recovered in the post 1850 phase.

Where there was scarcity around grazing and winter fodder (as in much of the North Atlantic) young calves were regularly slaughtered soon after birth rather
than being allowed to compete with human consumers for milk or with adults for fodder (discussion in Harrison et al., 2008; Mulville et al., 2005). This practice tends to produce a cattle age at death profile with high numbers of very young animals (neonatal calves) and very old adults (worn out milking cows). By contrast, farmers intending to produce primarily beef will slaughter animals near the top of their growth curve (ca, 1.5-2.5 years) producing a harvest profile with many large, near-adult juveniles. Mulville et al. (2005) have reasoned that an animal bone assemblage containing at least 10% to 30% bone of neonatal cows (of all cows) is indicative of herd management and culling for dairying. This traditionally entails that the majority of the living cattle were reproductive females, bearing calves in order to continually produce milk.

Data concerning age at death of cattle from Skútustaðir’s 1630-1717 and post 1850s phase in Figures 14 and 15 would suggest that dairying was Skútustaðir’s primary herding strategy in both periods. A very small proportion of bovine bones were large and unfused which would denote “prime meat age” animals, either steers or heifers that were perhaps culled to maintain herd size, then consumed. The mature animals killed off most likely represent older milk cows that were consumed at the end of their productive dairying years.

Ólafsson and Pálsson’s Ferðabókin, (1975) written in 1751-2 provides additional rich general insight into how calves were bred and weaned for dairying in Iceland during the 18th century.

“The peasants take particular care to send the cows to the bull at certain times in order that they may give milk all winter” (p 32) “When a cow calves, the calf is left with the mother for a fortnight and she attends to it according to instinct...As soon as a calf has acquired a certain degree of strength, they dilute the
milk with water and add a little chopped hay: afterwards, they give it nothing but hay and water. A cow must be very good to give more than 20 pots of milk per day but in the northern and western parts of the isle they give more” (Ólafsson & Pálsson, 1975 p.33).

(one pot equals 966 ml or 2 Pt.)

Cow milk was probably the single most important staple food in early modern times. Cows provided milk year-round while ewes contributed during the summer (Karlsson, 2000). Cows were milked year-round except in summer when ewes were the main source of milk (ibid) and the use of sheep’s milk seems to have declined in the late 19th century (Jónsson 1968). Milk was consumed fresh, made into skyr (a yogurt-like cheese), and made into a firm cheese. According to Gunnar Karlsson (2000), in the 18th century about 50 % of Icelander’s average daily caloric intake was from milk, and 20% from fats, and ten percent from each of fish, grains, and meat. The authors of Ferðabókin, note that fresh milk was traditionally offered to guests and that there had even been a butter export economy before the time of their survey, but it was, by the late 18th c. no longer common (Ólafsson & Pálsson, 1975).

Beyond dairy and meat products, hides, and horn were commonly utilized materials from cows. Transparent cow gut membranes were used in place of window glass in some cases (Ólafsson & Pálsson, 1975). Cow bone was carved and used for net sinkers, toggles, and even ice-skates and other durable objects. The fact that the common farm household fully utilized cows’ bodies for everyday objects reminds that Iceland’s 17th and 18th century economy was- at its foundation- a subsistence-based economy with most foods and necessities produced within the home.

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The diversity of different cattle skeletal elements found in the middens at Skútustaðir show us that cows were raised, used, and consumed on the farm (Figures 16 & 17). Bones from every segment of the carcass are present indicating that the cows killed at Skútustaðir were consumed there and discarded into the middens nearby. The MAU graphs represent normalized numbers of bones in the skeleton, so a whole skeleton would produce a graph with equal bars. Ribs and vertebrae are not identified to species under the present methods and so they are absent, skulls are slightly overrepresented due to the fact that one cranium is made up of several identifiable regions (which fragment easily). The results displayed in Figures 16 and 17 would suggest there was no specialized production of butchered beef on the farm.

Figure 16. This graph presents proportions of normalized counts (%MAU) of cow bones in the early modern assemblage.
Additional evidence of cow management after the mid 19th century confirms dairying as a central occupation. The district accounting for Skútustaðahreppur (Hreppsbók) of 1884-1885 confirms the osteological evidence that milk cows were the dominant demographic of cattle kept in the 19th century. In that year in the Mývatn region (of which Skútustaðir’s municipality was approximately half) a total of 51 milk cows were owned (unevenly) between 51 total holders (36 heads of household and 15 laborers (Icel. bánlar)). Beyond milk cows, there were only 8 newborn calves and 2 castrated male steer (geldneyti) alive at the time of the inventory. In my previous research on late 19th century livestock management (Hicks, 2014), I found that each head of household in the Mývatn region claimed at
most 3 cows, while some laborers/servants claimed as few as 0 or $\frac{1}{2}$ of a cow—denoting a shared cow (Hicks, 2014).

It seems that cattle herding was mainly focused on dairying and was not radically transformed from its premodern character over the 19th century. What probably did transform over the long term was the cultural centrality of cows as the main benchmarks of value within the Icelandic farming economy, as the importance of sheep farming grew and sheep numbers rapidly ascended during the 19th century. As I will expand upon in the following section, the proportion of cows to sheep fell. Later, major changes did come to cow dairying during the first half of the 20th century as centralized dairy operations emerged to supply a growing market of urban consumers without their own land (Jónsson, 2013.) Skútustaðir, with its expansive, rich hayfields participated in that market and does to this day.

**Caprines – Sheep and Goats**

Throughout Icelandic premodern history, sheep farming involved keeping mixed herds for milk, wool, and meat production (Harrison, 2013; McGovern et al., 2009; McGovern et al., 2014). Wool was a steadily desired surplus item and so was mutton, to some degree, in the context of Danish Trade (Róbertsdóttir, 2008). During the 19th century, Icelandic sheep farming and the types of sheep products in demand underwent significant transformation, especially after 1850. Skútustaðir’s archaeofaunal remains and archives contribute an important story about sheep economy and its role Iceland’s economic modernization. I present the basic contours in this section and elaborate further in Chapter 8.
Caprines are the most numerous domesticated mammal represented in this archaeofauna (Figure 13). Archaeological and historical evidence together confirm that they are almost entirely sheep. However, due to the difficulty in differentiating sheep from goats on several osseous elements, many sheep here are represented here under the larger heading of caprines (inclusive of sheep and goats). In addition to the evidence from early modern Skútustaðir, previous zooarchaeological research as well as historical evidence suggests that by the early modern period, excluded goats almost entirely (see McGovern et al. 2014).

Sheep management was strongly seasonal throughout Iceland’s history. Ewes were impregnated so that all lambs were born in May. Sheep were foddered in barns over the harshest parts of the winter with hay that was hand-collected from cultivated hayfields between June and August. They could sometimes graze outside if the snow cover is not too severe. During the summer, farmers traditionally moved sheep not being milked into upland common grazing areas until September when they would take them down to farm-adjacent grazing areas before significant snowfall. In early modern times, the September gathering was also scheduled to bring sheep to sale before summer traders left (Ólafsson & Pálsson, 1975). Until the early 20th century farmers kept ewes and lambs close to the farm during summer for milking. Ewes were of course vital for meat and milk production. While wethers, castrated male sheep were, by the 18th century, widely considered best for textile production as they produced greater volumes of better-textured wool than other sheep (McCooey, 2017). Other categories of sheep included rams.
(uncastrated males) which were rare among flocks as well as leader sheep who provided guidance to the younger animals herded into the highlands in summer.

The emphasis on an array of secondary products meant that sheep were raised into maturity for milk production and wool production. Older sheep would have been killed off when they became barren or when their advanced age and soil ingestion cause their teeth wear down completely. The demography of herds, controlled by farmers, changed through time based upon shifting emphases on wool production, milk production, and meat production.

The age-at-death of caprine samples from Skútustaðir, presented in Table 5, were assessed by examination of the stage of eruption and the level of wear on the occlusal surfaces of mandibular teeth following Grant (1982). However, not all mandibles found were whole meaning they could not all be easily aged into these categories, which reduced the data set. Specimens identified as *Ovis aries* and the more general category of caprines are both included in Table 5.

<table>
<thead>
<tr>
<th>Age at death from caprine from mandibles</th>
<th>Icelandic term</th>
<th>Icelandic term translated into English</th>
<th>1630-1717 NISP</th>
<th>Post 1850 NISP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn - deciduous premolar 4 (dp4) is present and unworn</td>
<td>Lömb</td>
<td>Lamb</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>&lt;3 months – dp4 worn only</td>
<td>Lömb</td>
<td>Lamb</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5-6 months – dp4 + first molar (M1) are present</td>
<td>Lömb/dilkar</td>
<td>Lambs grazed or suckled for one summer</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>15-18 months – dp4 + M1 + second molar (M2) present</td>
<td>Veturgamlir</td>
<td>One winter-old</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>&gt;24-30 months – P4 or M3 (third molar) have erupted and have been worn</td>
<td>Ær And Tvaæveturgamlir sauðir</td>
<td>Ewes or wethers (two winters old)</td>
<td>12</td>
<td>8</td>
</tr>
</tbody>
</table>
The diversity of ages at death for sheep during the two phases presented at Skútustaðir corresponds to a mixed herding economy (Table 5). The most common age at death was over 2 years old, in other words mature sheep needed for an economy that was centered on secondary products: wool, meat, and milk. The archaeofaunal data (Table 5) suggest that a subset of lambs were killed off at 5-6 months old (which would correspond to October and November as they are born in May). This time of year is significant because animals were culled to reconcile animal numbers with fodder collected over the summer for overwintering. Autumn was also a time when meat was harvested for curing. Dairy production from ewes did not involve the killing off neonates (as with cows). Instead, newborn lambs were simply weaned or separated from their mothers using specialized pens (weaning folds, called stekkur).

Judging by longbone texture, size and fusion state, during the 1630-1717 phase, only 5% of the sheep killed off were neonatal. In a herding regime in which impregnation of ewes is planned, there is no clear reason to intentionally slaughter newborn lambs. The neonatal lamb deaths may reflect cold summers and perhaps starvation or stress on ewes brought on by sea ice incidences that commonly visited the north coast of Iceland during the early modern period. The early modern sheep assemblage from Svalbarð, which is on the far northeast coast of Iceland and directly adjacent to the harsh coastal sea ice conditions that could impede grass growth had a 15% sheep mortality in neonatal stage which shows that newborn sheep mortality could be a much more severe problem in other more vulnerable
parts of Iceland during this time (Amorosi, 1992).

<table>
<thead>
<tr>
<th>Jarðabók Livestock Counts from Skútustaðir</th>
<th>Cows</th>
<th>Ewes</th>
<th>Sheep 2 years old</th>
<th>Sheep 1 winter old</th>
<th>Lambs</th>
<th>Horses</th>
<th>Cow to Sheep Ratio including lambs</th>
<th>Cow to Sheep Ratio Reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmer 1</td>
<td>3</td>
<td>45</td>
<td>15</td>
<td>28</td>
<td>23</td>
<td>4</td>
<td>3:125</td>
<td>1:42</td>
</tr>
<tr>
<td>Farmer 2</td>
<td>3</td>
<td>20</td>
<td>3</td>
<td>14</td>
<td>14</td>
<td>2</td>
<td>3:63</td>
<td>1:21</td>
</tr>
<tr>
<td>1703 Iceland Average (Karlsson 2000)</td>
<td>3.5</td>
<td>24</td>
<td>16</td>
<td>3.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: source Magnússon & Vídalín, 1943

The best way to describe the use of sheep between 1630 and 1717 at Skútustaðir is that it was a mixed economy that also produced surplus wool—probably raw and as finished items. By Orri Vésteinsson’s calculation, 6 fleeces would have been necessary to supply basic wool needs for one person per year (see McGovern et al., 2014). Even if Farmer 1’s household included 10 people, they would have still been able to produce a surplus of 65 fleeces according to the information on total herd size from at Skútustaðir recorded in the Jarðabók farm survey (Magnússon & Vídalín, 1943) (Table 6). This does not take into account mutton, skins, and tallow which were also traded but not central concern of the export economy. This points to an argument by McGovern et al. (2014) that the ratios of cows to sheep that are argued to reflect a specialized wool producing household during the settlement age (around 1:20 and above), became
commonplace during the 18th century (McGovern et al. 2014).

During this same phase and the post 1850 phase, there is no evidence of carcass partitioning of sheep that might convey commercial production of butchered cuts being produced at the farm and then sent away to markets. Figures 18 and 19 demonstrate that sheep bones are somewhat evenly represented in the midden assemblages analyzed. This does not, however rule out mutton production and sale. Historical descriptions indicate that during the 18th century, sheep would have been slaughtered and prepared away from the farm at the trading location (Ólafsson & Pálsson, 1975) which, for Mývatn, would have likely been Húsavík. Bones of these sheep will thus would not appear on the home farm midden deposits.

**Figure 18.** This graph presents proportions of normalized counts (%MAU) of caprine bones in the early modern assemblage.
Two aspects of historical herding complicate interpretation of the shifting sheep economy at Skútustaðir through the use of faunal evidence. The first challenge is the fact that herding shifted rapidly within the years from 1850 to 1920. This means that the site phasing used here is does not provide the necessary resolution to see certain changes. The second issue, is that both, mutton production and the export of living sheep, which became common after the 1870s, leave no traces in the archaeofaunal record. To deal with these issues, I make use of primary sources in addition to the archaeological record to discuss changes in sheep herding strategies, herd demographic management, and commercial engagement.

Between 1800 and 1850 the numbers of sheep sharply increased as Icelanders expanded herds of wethers for surplus wool production (Karlsson,
As Figure 20 depicts, during the late 1850s, there was an aberration in the trend of growth due to a scab epidemic and poor weather, but the boom in sheep numbers was steadied again and in the late 1800s and reached roughly double what it had been in the first decades of the century. The material record of Skútustaðir reflects this change. The ratio of cow to sheep bones, shown in Table 7, shifts during the post 1850 period as the rural community was taking part in this sheep boom. Between 1830 and 1880, the trend in growth of herds was achieved through significant efforts reclaim to marginal vegetation zones and to thereby increase hay production (Hicks, 2014; Hicks et al., 2017; Karlsson, 2000).

<table>
<thead>
<tr>
<th>Cow to caprine ratio</th>
<th>1630-1717</th>
<th>Post 1850</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skútustaðir</td>
<td>1: 5.09</td>
<td>1: 7.1</td>
</tr>
</tbody>
</table>

Table 7
The Change in Cow to Caprine Ratios at Skútustaðir Through Time
After 1854, Iceland was open to trade with broader markets and not just as an outpost of the Danish state. In the 1870s a new market opened up for the export of Icelandic sheep to Britain (Hicks, 2014; Karlsson, 2000; Þórhallsdóttir et al., 2013). This was significant for two additional reasons. It was a new export economy centered on a novel agricultural product and second, Icelanders were sometimes compensated in cash which was not the case under Danish trade conditions.

Another significant economic innovation of the late 19th century was the growing availability of finance capital (Jónsson, 1993). In rural communities, this sometimes enabled tenants to apply for loans to buy farms. Systems of credit and investment also meant that people could initiate projects that were previously inaccessible. In 1882, Icelanders from Þingeyjarsýsla formed the first Icelandic free
trade cooperative with purchasing finance from Landsbankinn, the island's first national bank (Jónsson, 2013). The collective functioned as a purchasing society and connected Mývatn farmers to diverse buyers, with reportedly better prices than Danish traders had offered (Karlsson, 2000). In this context, the exchange of sheep products served as the main way for rural producers to access cash and purchasing credit. Sales of agricultural products within these venues also provided access to imported consumer goods which were increasingly becoming a part of everyday life for non-elite Icelanders (Lucas, 2007; Lucas & Parigoris, 2013).

While sheep were the central focus of the rural economy, cows seem to be comparatively marginal in late 19th century trade records in terms of items traded in for cash, credit, and goods. Although the live sheep market was important, it was somewhat ephemeral- it halted finally and permanently in 1897 (Jónsson, 1993) due to concerns over the spread of epizootic disease from Iceland to Britain. It seems at that point Mývatn farmers went toward mutton production, with wool as a second commonly sold item. Entries in local trade records tend to specify sláturfje (slaughtered sheep) after the end of the late 19th century (Archive E 1000 6).

Over the 19th century, live sheep and mutton eclipsed wool as the main trade items. The refocusing away from the wool economy may have been due to the fact that indentured servant laborers, who carried out much of the spinning and knitting, were freed from compulsory service and drawn to coastal production (Jónsson, 1993). Sheep dairying was similarly labor-intensive and may have declined after 1850 for the same reason. In this way, the late 19th century emphasis on live sheep
and then mutton was intimately intertwined with changing matters of personhood and citizenship.

Changes in the indentured labor system were not the only area of intersection between social status and sheep farming. Heads of households also experienced a shift in the way that their social status manifested. Over the 19th century Mývatn farmers were increasingly becoming owners rather than tenants (Teitsson, 1937). Their sale of sheep and products in new free markets meant that they were technically becoming “ranchers” (Chang & Koster, 2004)– and entering a growing global class of herders (with private property) integrated into the capitalist system. Further details of the sheep economy will be dealt with in subsequent chapters.

**Goats**

Goats were absent or minimally used at Skútustaðir during the 1630-1717 phase period and one goat element was identified in the post 1850 assemblage. This contributes to a picture of goat herding as a rare occupation into the early modern period. Based on archaeofaunal evidence, there was a notable decrease in goat keeping in Iceland during the High to late Middle Ages (McGovern et al., 2014). There would have been little reason keeping goats especially when sheep produced wool, dairy, and meat while goats only produced dairy and meat. However, evidence suggests that a few farms may have kept them because they were useful for dairy production on poor land.

By the mid to late 19th century, local municipal documents (hay portioning report) made in Mývatnssveit, do not note any goats (see also Hicks, 2014) but other
accounts from these same decades (ca 1850-1900) differ. One Mývatn area diarist, Jón Jónsson mentions having a few goats in the mid-1800s. Interestingly and perhaps very significantly, he resided on the eastern side of Mývatnssveit which has poorer vegetation – smaller hayfields and thin-soiled, brushy terrain dominated by birch and lava fields. In the 18th century, a few farms on the east side of lake Mývatn were recorded as having goats by the Jarðabók livestock census (Magnússon & Vídalín, 1943). Over the 1700s and 1800s, while goats were overall extremely rare in Iceland, they may have been a strategic choice in specific vegetation zones because they more effectively metabolize twigs and leaves when compared to sheep and cows. It seems that some of the Mývatn farmers may have kept small numbers of goats for dairying on land where it was difficult to provision milk cows, which require significant and good quality fodder.

Ólafsson and Pálsson’s mid 18th century account provides a broader geography of goats in Iceland (1975). They say in their travel book that goats are extremely rare although it was evident to them that they had been much more common in earlier times. The majority of goats in Iceland, they say, are to be found in a few valleys in the north (near Eyjafjörður and Mývatnssveit). It is safe to say that goats did not play a major role in Skútustaðir’s subsistence or market economy. But they probably helped farmers fill in gaps in their subsistence regimes and make use of different vegetation environments.

**Horses**

Very few horse bones were found in the archaeofauna in either phase. They made up .08% and .04% in the early modern and post 1850 assemblages
respectively. Horses were chiefly used for transport. However, the small number of horse bones present among food waste may indicate they were eaten occasionally.

Until the 20th century Iceland lacked roads suitable for wheeled carts and the transport of people and goods was always carried out using both saddle horses and pack horses. According to historical ethnographic sources, horses were particularly important during the summer months when traders came to Icelandic ports and farmers conveyed there goods to the ports. The herding of sheep to and from summer grazing rangelands also was made easier with horses.

Eating horse meat was, for a time, discouraged as contrary to Christian dietary restrictions, but apparently sometimes occurred out of necessity or perhaps frugality. Economically speaking, horsemeat is efficient to produce in Iceland. Due to their hardiness horses can graze outside for much of the winter even through the snow. In the 19th century certain voices actually called for reconsideration of the place of horsemeat in the diet and even promoted it publicly arguing that horsemeat was a decent and underutilized food resource (Ungi, 1893).

**Pigs**

No pig remains were found in either phase, which is what would be expected based on extant knowledge of customs over time in Iceland. The archaeological evidence for pigs shows decreasing relative numbers by the 11th century (McGovern et al., 2009, p. 242). Various threads of information indicate that pigs were difficult to manage in the Icelandic landscape in both a social and ecological sense. They differ from the other livestock in that they cannot subsist on grass alone. Left to their preferences, these omnivores forage for plants, fruits, insects, birds’ eggs,
carcasses, and when available, varied human refuse. When left uncontrolled, pigs ate things that then made them troublesome and culturally unacceptable as a source of food including dead horses and human corpses (Dennis, et al. 1993). Overall, it seems that pigs, which are difficult to keep penned, could have been more of a destructive and unruly force than a welcome addition on a Mývatn area farm.

Documentary evidence from the 13th century clarifies conventions for management of pigs between common and private space, suggesting difficulties and tensions (ibid). Swine herding in Iceland leaves little trace by the late Middle Ages and the stock of pigs originally brought over during the Viking Age, it seems, disappeared from Iceland after the early 16th century (Jónsson, 2013). Ólafsson and Pálsson’s 18th century Ferðabókin, mentions loose pigs in western Iceland but says that these are “company pigs” that have been let loose—likely referring to a Danish trading post (1975). Pigs were later re-introduced to Iceland for meat production in select regions after 1900 (Jónsson, 2013, Vol 4, P. 134-5). Given the sparse accounts, both material and textual for pigs in Iceland after the Middle Ages, it is not surprising that no pig bones were identified in these later phase assemblages from Skútustaðir.

**Seals**

Seals (Phocidae) constitute a relatively small percentage of identified specimens - well below 1% in each period. They probably did not make up a significant part of people’s diets on a daily basis. In the 1630-1717 phase, the 23 seal elements found included phalanges, carpals, ribs, and vertebral elements as well as parts of the skull. Seals were not likely coming to the inland farm as
specialized butchered segment, but either as diverse selected parts or whole carcasses. The seal-bones documented in this earlier phase were all recorded as indeterminate phocid species as they were not among the subset of seal bones that could reliably be identified to the level of species. Species identification of seal bones is challenging due to the fact that there is significant intraspecific variation; there are only a few diagnostic regions on the skeleton. In the post 1850 phase, there was one seal bone present in the archaeofaunal sample, a humerus identified as harp seal (*Pagophilus groenlandicus*).

![Figure 21. This graph presents counts of diverse seal elements recovered in the 1630 to 1717 phase which suggest utilization of whole seals.](image)

Seal bones may point us toward seeing environmental challenges and how Mývatn people were dealing with them. Harp seals, found on Iceland’s north and west coast, are associated with sea ice which is their preferred breeding habitat. Based on this correlation, the presence of seal bone in the archaeological record has been suggested as indicator of sea ice on a given coast in the past (Woolett et al.)
2000, McGovern et al., 2013). This evidence stands with the rich historical record of
sea ice and associated cold weather in Iceland (e.g. Ogilvie and Jónsdóttir, 2000)
including writings about its detrimental effects on Iceland’s subsistence base, even
for inland communities. It reduced hay growth, prevented fishing, and provided an
obstacle to trading and relief ships (ibid, Ogilvie et al., 2009). As sea ice impeded
basic subsistence activities it could and did cause food stress.

The seal bones in Skútustaðir’s midden may therefore point to the presence
of sea ice on the coast, and that its associated hazards periodically impacted the
community. The seal remains might also spotlight the ways in which residents of
this farm and community shifted their subsistence activities, accessing seal meat,
when sea ice brought stilted other modes of food production.

Other archaeological sites in North Iceland have turned up seal bones, and in
the case of the medieval Gásir trading post they suggest only occasional or
opportunistic use of seals (Harrison, 2013). One exception to this is Svalbarð, a high-
status farm in Northeast Iceland which appears to have heavily depended upon
seals as a seasonal subsistence base from the early modern period and onward
(Amorosi, 1992, 1996; Woollett et al. 2012, 2013). Although the seal bones are not
numerous in the Skútustaðir archaeofauna, they remind us of the often harsh
climatic conditions that were experienced by Icelandic farming households and they
also attest to the networked subsistence between the inland community and the
seacoast beyond fishing and trading.

**Birds**
Lake Mývatn is home to several species of migratory waterfowl. About fifteen species of waterfowl of the order Anatidae migrate to Mývatn and breed in the region. They are ground-nesting and breed and around lake while feeding on the vegetation and small invertebrates in the eutrophic spring-fed waters. In addition to several duck species, the population of waterbirds includes red-necked phalaropes, loons, horned grebes, whooper swans, two varieties of geese (Greylag and Pinkfooted geese), black-headed gulls, and arctic terns (Einarsson, 2004). Other local birds include the rock ptarmigan and the golden plover. Prior archaeological work by McGovern et al. (2006), reconstructed Mývatn people’s utilization of local birds during the Viking Age through the identification of bird bones, that represent hunted birds, and bird egg shell which represents collected eggs. They found that ptarmigan were widely hunted; their bones dominated the faunal assemblages of three Viking Age sites. At the same time, it seems waterfowl were rarely hunted, probably to protect their populations and leave them undisturbed for seasonal egg collection. According to the microscopy specialist who carried out the first iteration of this study, the eggshell fragments recovered from the same Viking Age midden deposits seemed to be mostly from waterfowl though she also identified seabirds and occasionally ptarmigan (McGovern et al. 2006). Narratives written by foreign travelers report community prohibitions on hunting nesting ducks during the 18th and 19th centuries- a millennium after the archaeological record indicating the same pattern, so this specific management of birds seemed to be a long term practice.

This dissertation builds on McGovern et al.’s (2006) study of differential conservation patterns in two ways. First, it looks beyond the Viking Age at the long-
term faunal assemblage from Skútustaðir for material evidence of bird use through time into the early modern period. Second this work improves upon the identification of bird eggshell through the development and application of a new method (described in the chapter before this one, see also Hicks et al., 2016). The results of the eggshell study are presented in the final chapter of this work. In this archaeofaunal analysis section, the bones are discussed as they represent hunted birds.

Bird bones (together) make up 3 percent of the total NISP of animal remains from Skútustaðir in the 1630-1717 phase and were all from waterbirds including Anatidae. The early modern phase included bird bones as 7.6 percent of the NISP and there were a significant number of ptarmigan bones in addition to waterfowl represented in the 19\textsuperscript{th}-20\textsuperscript{th} century phase. The species identified are represented in Figure 22.
Figure 22. This graph presents percent NISP (Number of Identified Specimen) counts of bird bones.

The species identified from bones in the 1630-1717 phase included whooper swan, scaup, long tailed duck, Barrow’s golden eye, and several specimens that could only be identified to “Anatidae”, as well as divers, gulls, and plover. Swan, geese and duck bones have been found in other contexts and phases and waterfowl appear in very low but steady numbers throughout the site phases (see also Hicks, 2010). This is interesting because the assemblage, though a very small percentage of overall consumption, is mostly composed of waterfowl where other bird assemblages from middens in the Mývatn region have been predominantly ptarmigan (McGovern et al. 2006). My suggestion is that it was not as logistically convenient for the residents of Skútustaðir to hunt ptarmigan, because there is not
heathland in the immediate farm environs. However, the farm is characterized by extensive waterway frontage as well as islands in the middle of the lake. In contrast, the Viking Age sites that were included in the first study, (Hofstaðir, Hrísheimar, and Sveigakot), were more proximal to heath environments where ptarmigan are commonly found.

Some of the waterfowl represented may have been killed in accidents. Bones of a loon were identified which are from either the common loon *Gavia immer* or *Gavia stellata*. Diving birds such as these, submerge themselves completely to feed and sometimes become snared in fishing nets set upright in the water to catch char and trout (Garðarsson, 1961). In such situations, it was apparently an accepted but unfortunate risk. Butchery marks on the loon ulna found in the early modern 1630-1717 assemblage would indicate it was eaten. Among other, more rare birds in the collection was one gull element and one plover and it seems unlikely that the gull and plover were intentionally hunted for food.

Evidence from the post 1850 layers includes mallard, scaup, tufted duck (which arrived in Mývatn in the late 19th c.), scoter, unidentifiable members of Anatidae order, and distinctly, ptarmigan. Half of all identified bird bones are in fact ptarmigan (n 13). While snaring ptarmigan in the heath would have been the historical means of capture, ptarmigan shooting became popular and fashionable during the 19th century (Nielsen & Pétursson, 1995). The appearance of ptarmigan bones in the midden during the late 19th century might speak to the growing market importance of hunting ptarmigan and selling them for cash or credit. An export trade in rock ptarmigan emerged in the late 19th century. The birds were hunted
from October through to December, sold to merchants and exported to Europe.

According to Nielsen and Pétursson, a total of 3.3 million ptarmigan were exported from Iceland between period 1864 through the early 20th century.

Documented evidence of ptarmigan sales in Mývatnssveit, collected by Edwald (2012b), indicate they were potentially the most numerous traded wild resource from Mývatn households. Edwald found that fish were mentioned about 1/3 as frequently as ptarmigan in trade books. Bird eggs were mentioned in trade books 1/12 as frequently as ptarmigan (Edwald, 2012b). In my subsequent investigations of Icelandic cooperative trade booklets from Mývatnssveit during the late 19th century, I found that ptarmigans were the fourth most commonly traded item after sheep, wool, and butter.

The ptarmigan trade provides another example of how commercial interaction with distant networks influenced the use, definition, and perception of local wild resources and the realization of commodities in Mývatnssveit. The treatment of ptarmigan starkly contrasts the treatment of waterfowl (Anatidae) in which were consistently protected from overexploitation by the local community. The result has been the conservation of one of the northern hemisphere’s most critical bird breeding grounds. More is written about the long term history and sustainable protection of waterfowl in Chapter 9.

**Foxes**

Arctic fox are represented by one element in the post 1850 phase of the site. They were hunted commonly as they posed a threat to lambs and to ground nesting birds in Mývatnssveit. Fox hunting is also listed in district records (along with road
building) as a type of labor that people contributed to the municipality. Foxes were clearly viewed as threats and pests but adult foxes, being wary, were challenging to hunt.

**Fish**

Fish including freshwater and marine species of Salmonidae and Gadidae make up 83% of the NISP in the 17th - early 18th century deposits and 76% of the NISP in the post 1850 deposits from Skútustaðir. However, when thinking about their contributions to local diet it is important to keep in mind that domesticated mammals are larger bodied and also contribute many times their weight in dairy, so fewer specimens of mammals represent proportionally more edible mass or use-value equivalent per individual.

**Salmonidae**

Fish of the Salmonidae order are abundant in Mývatn and are considered to be a distinguishing and unique feature of the landscape and the community in the past and today. The eutrophic water and abundant insect fauna of the region support a population of fish that is unusual in Iceland. Local, native fish species in Mývatnssveit include the arctic char (*Salvelinus alpinus*), brown trout (*Salmo trutta*), and the three-spined stickleback (*Gasterosteus aculeatus*). Char have large-bodied and small-bodied interbreeding subpopulations, and have historically outnumbered trout in the lake (Aðalsteinsson, 1979). Brown trout and migratory salmon (*Salmo salar*) are found in the rivers, though the range of the anadramous salmon is blocked by a waterfall in the mid- Laxá river about 25 kilometers north of Mývatn. In addition to living in the lake and rivers, char inhabit smaller water features like
springs and caves. Gill netting was a common method of catching fish, making use of nets set upright in the water using (wood or cork) floats and (bone or stone) sinkers while seine-netting was also practiced by hand-dragging the netting through shallow water toward the shore. Salmonidae were also fished with hooks and lines (Ólafsson & Pálsson, 1975), though hook fishing had drawbacks because fishers could not prevent young and small fish from being hooked while, in contrast net gauges could be adjusted to let smaller fish pass through. People fished Salmonidae in Mývatn in all seasons, fishing through the ice in the winter. They apparently abstained from fishing on Sundays and holy days (Edwald, 2012b).

Char and trout fishing rights have been managed by the community for at least three centuries (Magnússon & Víðalin, 1973). Farms with frontage on the water had private fishing zones that extended into the lake but the lake center was considered common. The Jarðabók land survey of 1712 notes that farms ringing the lake (Grænavatn, Grímsstaðir, Kálfaströnd, Geiteyjarströnd, Vogar, Reykjahlíð, Ytri Neslönd, Haganes, Garður, Geirastaðir, Skútustaðir, Brjámsnes, Fagranes and Vindbelgur) and on the Laxá (Arnarvatn and Hofstaðir) had explicit fishing access and those ringing the Framengjar to the south were not noted as having fishing access (Gautlönd, Baldursheimur and Sveinsströnd,) (see McGovern et al. 2006 p. 201). The central zone of the lake was considered a common resource was apparently accessible to others, especially during the winter when people could simply walk across the ice and fish through holes. As char and trout were desirable staple foods, it was most likely the case that farms not having official access in the area would have somehow worked out access to fishing rights or fish caught by
The overwhelming majority of the Salmonidae fish identified from Skustustaðir’s archaeofauna, are arctic char. Trout were present in the assemblage but only very few specimens. Ambiguous bone fragments were recorded to the more general category of Salmonidae, though based upon the proportions present of identified species, the Salmonidae (“SMD”) fragments are overwhelmingly char.

![Salmonidae NISP](image)

**Figure 23.** This graph presents different NISP (Number of Identified Fragments) data for different species of Salmonidae in both phases of the archaeofauna.

In both phases studied, cranial elements (bones of the head) are more common in the archaeofaunal assemblages than postcranial elements (bones of the body) based on normalized %MAU counts. This might be indicative of a butchery and trade activity, whereby the fish heads were removed and discarded on site and fillets traded or sold away. But first, this pattern requires further scrutiny. Due to the fact that fish vertebrae are smaller than most cranial bones, they might be able to fall through sieve mesh during excavation. This could mean that the absence of
some vertebrae in the archaeological record is due to their not being recovered from the sieve as thoroughly as larger, flat, cranial elements.

This possibility of problematic sieve sampling was ruled out by looking at proportions of vertebrae alone as shown in Figures 26 and 29. When vertebrae are examined on their own in Figures 26 and 29, a disproportionately high number of thoracic vertebrae (the first few below the skull) were identified and present when compared to caudal vertebrae (those in the body or fillet). These results support that archaeological sampling is not the source of differential representation, but past human activity (butchery and trade) is likely the explanation. It seems then, that some fillets, containing caudal vertebrae were being sent and consumed away from the place of production, while, as we can see additionally in Figures 24 and 27, cranial bones and thoracic vertebrae were discarded at the farm.

Figure 24. This graph presents counts of Salmonidae cranial elements versus axial elements in the 1630-1717 phase.
Figure 25. This graph depicts normalized bone counts (MAU%) of Salmonidae in the 1630-1717 phase.
Figure 26. This graph depicts percentages of vertebral specimens of Salmonidae in the 1630-1717 phase categorized by vertebral region.

The evidence for trading away of a prepared product is not surprising because today Mývatn is known for its smokehouses maintained and run by farm households. Today these smoke houses sell cured fillets to retailers around Iceland as well as visitors to the region. In contemporary times, before the char and trout are smoked, they are butchered, gutted, the heads are removed. After that the fillets are hung from smokehouse rafters. Mývatn people smoke the fish by burning taða, the compressed and trodden dung from sheep barns which is first cut into rough blocks and dried outdoors. Árni Einarsson, a biologist and ecologist at the Mývatn Research Station has interviewed several local farmers regarding their fishing traditions in the past and has learned that traditional butchery for smoking entails removing the head, but leaving the fillets attached by means of leaving the caudal
vertebral column intact. This would mean, as may be reflected in the archaeological evidence, that caudal vertebral elements would travel with the finished fillet product.

Although the fillets were the prepared final product, people historically did not waste the heads, instead they ate them stewed. The travel book written by Ólafsson and Pálsson in the mid 1700s relates that Mývatn people regularly consumed trout and char (silungur) in both fresh and smoked (1975, p. 68).

Figure 27. This graph displays counts of Salmonidae specimens and compares cranial elements versus axial elements Post 1850.
Figure 28. This graph depicts normalized bone counts (MAU%) of Salmonidae in the 1850 phase.
This graph depicts percentages of vertebral specimens of Salmonidae in the post 1850 phase categorized by vertebral region.

The smoked or dried fillets may have been traded regionally, used as payments, or potentially exported. A handwritten manuscript about community affairs during between 1850 and 1900 written by Jón Gauti Pétursson, describes the regular sale of char and trout by Mývatn people to Icelanders from neighboring valleys. However, there was apparently much variability in fish catches. Jón reported that trout fishing was above average in some years during 1860s and 1880s and people from surrounding districts travelled to fish in Mývatn. However, in 1875 the community reportedly had such bad catches they resorted to purchasing herring from coastal suppliers to supplement their basic food needs. Another notable poor fishing year was 1880. In 1886 international trade was disrupted, reducing food imports like grain. During this crisis, Icelanders from other
rural districts actually depended on Mývatn’s fish as a dietary resource. These available accounts and the zooarchaeological record demonstrate that trout and char were likely commercial resource since at least the 17th century and a dietary mainstay, yet the Salmonidae fisheries were interannually highly variable.

**Marine Fishing**

Skútustaðir’s archeafaunal remains narrate a significant transformation in the relationship of inland farms to coastal fishing from the 17th through early 20th centuries. Large scale, specialized Gadid fishing developed early in Iceland and was of central importance to subsistence and trade through the Middle Ages an into the modern period (Hambrecht, 2012; Perdikaris & McGovern, 2007). It is immense subject in Icelandic history and would be impossible to capture here in this section especially because ongoing archaeological work continues to extend timelines and detail regarding initial formations (Harrison, 2014; McGovern et al. 2006) proto industrial development (Feeley, 2018) as well as its importance to Iceland’s modernization (Lucas & Hreiðarsdóttir, 2012). What is important in the 1630-1717 and post 1850 archeofaunal assemblages is that cod fishing was ubiquitous and gadid fish products circulated over the entire country as a staple food product but were also a main export during the Trade Monopoly period. It is estimated that 67 percent of cod stayed in the country during the 18th century (Karlsson, 2000). The main output of cod fishing during the early modern period was skreið, a headless, wind-dried fillet product.

During the early modern period, inland Skútustaðir was connected to coastal cod fisheries by centuries-old social system that called servant laborers and tenant
farmers to the coast in the late winter. The cod fishing season in the south of Iceland extended from February until the middle of May (Magnússon, 2010) but included late spring and summer months in the north as cod shifted their spawning grounds. During these times, farmhands would travel from more inland farms and camp at fishing stations, provide labor on boats and on shores and return to the farms at which they were employed at the end of the fishing season to participate in seasonal late spring tasks like lamb birthing, milking, and a little later, haymaking. However this seasonal mobile labor pattern began to change in the late 19th and early century when free labor became increasingly legal and coastal villages grew with investment in year round fisheries work. The material remains from Skútustaðir tell this story and illuminate the material ramifications of change at the household scale.

As is the case at almost every other site in Iceland, cod (Gadus morhua) are the most numerous in the archaeofauna, followed by haddock (Melanogrammus aeglefinus). There are fewer specimens of saithe (Polachius virens) and only traces of torsk (Brosme brosme) and ling (Molva molva) in the assemblages and both are by-catches of cod fishing. Torsk are present in the early modern period represented by just a few elements as are halibut (Hippoglossus hippoglossus) for a presentation of Icelandic comparatives).
Table 8

Marine Fish Number of Identified Specimens

<table>
<thead>
<tr>
<th>Species</th>
<th>1630-1717</th>
<th>Post 1850</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cod (Gadus morhua)</td>
<td>555</td>
<td>95</td>
</tr>
<tr>
<td>Haddock (Melanogrammus aeglefinus)</td>
<td>58</td>
<td>36</td>
</tr>
<tr>
<td>Saithe (Polachius virens)</td>
<td>61</td>
<td>12</td>
</tr>
<tr>
<td>Torsk (Brosme brosme)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Halibut (Hippoglossus hippoglossus)</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Gadid species indeterminate</td>
<td>1333</td>
<td>193</td>
</tr>
</tbody>
</table>

This discussion focuses on cod which dominates the assemblage. There is a revealing pattern of carcass partitioning and other taphonomic clues pointing to specific consumable transportable products and commodities. However, a careful consideration reveals that cod were brought in from the coast to Skútustaðir, not exclusively as dried fillets. In Skútustaðir’s early modern period (phase 1630-1717), among all cod parts, there is a preponderance of cod cranial elements, which seems unexpected for what was is clearly not a coastal production site. The presence of ample head elements would tempt one to suggest that a proportion of cod were coming in fresh, with their heads attached to their bodies. However, the possibility of the transport of fresh fish is contradicted by two lines of evidence. First, mid-18th century historical sources indicate that cod were never eaten by Icelanders in an uncured state (Ólafsson & Pálsson, 1975). Second, while analyzing the archaeofaunal remains I observed that the majority of the caudal vertebrae (tails) present were crushed and flattened, almost certainly by a fish hammer (no other bones in the assemblage were as crushed). Tenderization of the tough skreið using a fish hammer was a common mode of preparation and, present the best explanation
for crushed vertebrae. This suggests that fillets came to the site dried and headless.

But to be more precise, it seems that cod were brought to Skútustaðir in two distinct cured forms: as dried fillets (skreið) and as an abundance of dried cod heads which are mentioned more rarely in historical narratives.

*Figure 30.* This graph compares specimen counts (NISP) of cod cranial elements versus axial elements in the 1630-1717 phase.
Figure 31. The normalized element counts (%MAU) of cod bones displayed in this graph also suggest more cod heads than "tails" coming to Skútustaðir in 1630-1717.
Figure 32. In this graph, normalized counts (%MAU) of cod vertebra from the 1630-1717 phase are categorized by vertebral region. More caudal vertebra were found than any other category.

I suggest that these dried heads represent not a prime product, but a by-product used for the payment of tenant farmers or servant farmhands from Skútustaðir for their seasonal labor in coastal fisheries. The proportionally large number of heads represented by the data in Figure 30 suggests they brought more dried heads that skreið home to Skútustaðir at the end of the fishing season (in February-May). The fact that seasonal workers were compensated chiefly in a by-product rather than the probably more desirable, larger, and more and meaty skreið fillets, might be telling of uneven access to the final products of their labor.

Mobility of inland Icelanders to work in the coastal fisheries is supported by the historical research of Lúðvík Kristjánsson who documented northern Icelander’s past travel across the island to participate in coastal fishing in Íslenzkir Sjávarhættir
Kristjánsson explains that northerners including Mývatn people traversed routes across the Icelandic central highlands and posits that people from northern Iceland went to Suðurnes and Snæfellsness to fish as early as the 13th century (p. 381 Vol 2). By 1551 there is firm data indicating that 300 people from northern Iceland fished in the south, in Suðurnes. In 1685, 60 northerners drowned there; fishing in small open, rowed boats was an incredibly dangerous occupation. A 1729 text mentions people from Þingeyjarðarsýsla (which includes Mývatnssveit) in Suðurnes. And references to highland roads include paths to Höfn in Hornafjörður and Hálsós in Suðursveit, including roads that may have been truncated due to expanding glaciers in the 1600s and 1700s (p. 384-5). These travelling fisherfolk would have been tenant farmers and farmhands, rather than wealthy farmers or landowners.

Kristjánsson’s historical research supports my suggestion that cod heads arriving at Skútustaðir in the 18th century were not a traded good but paid in kind to laboring fisherfolk who were camping and working far from home. This view also enables us to understand the material implications of Skútustaðir as blended residence of tenant farmers and servant farmhands during the 17th through early 18th centuries as represented by the labor and foodways reflected in fish remains from the AD 1630-1717 phase.

During the late 19th century, the organization of coastal fishing and rural households both changed. Investment capital brought decked vessels to Iceland which could travel further out to sea, extending the fishing seasons and providing a basis for larger operations with more steady labor demand both at sea and on land (Jónsson, 1993). Permanent fishing villages began to replace seasonal fishing
stations to accommodate year-round fishing and fish processing on a larger scale. The centrality of marine fisheries to the development of capitalism of Iceland can’t be exaggerated (Jónsson, 2004; Karlsson, 2000; Lucas & Hreiðarsdóttir, 2012). And in the late 19th century, these fishing villages pulled laborers from land-based production toward the coast (Karlsson, 2000).

The shift in cod remains found at Skútustaðir after 1850 at Skútustaðir might may illuminate this change in legal labor arrangements and settlement from the perspective of fish consumers in rural places. In the 19th century archaeofauna there are proportionally more tail elements (of the fillet rather) than cranial bones. This apparent shift to consumption of mostly fillets (seen in Figure 33) might suggest one of two scenarios. It is possible that laborers were no longer traveling seasonally to participate in fishing, or they were being compensated with different products. I would suggest the former, and further would argue that Skútustaðir possibly became more of a classic consumer site during the late 19th and early 20th century – meaning that they acquired and ate mostly cod fillets. No longer were they consuming mostly dried heads in exchange for mobile labor as was the arrangement in the 17th and 18th centuries.
Figure 33. This graph compares specimen counts (NISP) of cod cranial elements versus axial elements in the post 1850 phase.

Figure 34. Normalized counts (%MAU) of cod bones are compared and the data suggest more “tails” than heads were discarded on site post 1850.
Figure 35. In this graph, normalized counts (%MAU) of cod vertebra from the post 1850 phase are categorized by vertebral region. Caudal vertebra and thoracic vertebra are both well represented.

**Mollusks**

Mollusk shells from marine species of bivalves and gastropods, form a very small part of these archaeofaunal assemblages from Skútustaðir; all together they make up less than one percent of the faunal remains in each phase. Mollusks were not commonly eaten in Iceland’s past though they may have served at times as a famine-food or more commonly as bait. While they may have been a part of diets of Skútustaðir’s residents, this seems not the most likely explanation based on the small numbers in which they were recovered in the assemblage. It may be that these species were transported inadvertently seaweed which had several practical uses on Icelandic farms in preindustrial times (Mooney, 2018). Of the species identified and listed here in Table 9, most depend upon seaweed in some way. Mussels and scallops anchor themselves to seaweed and rocks in shallow waters, while periwinkles and whelks, graze on seaweed.
Table 9

Mollusk Specimens Identified from Skútustaðir’s Two Phases

<table>
<thead>
<tr>
<th>MOLLUSKS</th>
<th>A.D 1630-1717 NISP</th>
<th>%NISP</th>
<th>Post A.D. 1850 NISP</th>
<th>%NISP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clam (Arctica islandica)</td>
<td>6</td>
<td>.08%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whelk (Buccinum undatum)</td>
<td></td>
<td></td>
<td>1</td>
<td>.04%</td>
</tr>
<tr>
<td>Periwinkel (Littorina littorea)</td>
<td></td>
<td></td>
<td>1</td>
<td>.04%</td>
</tr>
<tr>
<td>Mussel (Mytilus edulis or Modiolus modiolus)</td>
<td>12</td>
<td>.16%</td>
<td>2</td>
<td>.08%</td>
</tr>
<tr>
<td>Scallop (Chlamys islandica)</td>
<td>1</td>
<td>.01%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mollusk species indeterminate</td>
<td>16</td>
<td>.21%</td>
<td>17</td>
<td>.68%</td>
</tr>
<tr>
<td>TOTAL NISP</td>
<td>35</td>
<td>.46%</td>
<td>21</td>
<td>.84%</td>
</tr>
</tbody>
</table>

Seaweed is abundant on the Icelandic coasts and was commonly collected and used as soil fertilizer, as sheep fodder supplement (Magnússon & Vídalín 1943). It was also burned to produce an impure type of salt called black salt used for preservation and as a condiment. It has been recorded as a fuel source although it was inefficient in terms of the volume needed to produce a minimal heat output (Mooney, 2018). It therefore seems reasonable that the scallops, clams, periwinkels, and whelks in this assemblage may have been brought to the farm as passengers on seaweed. Additionally, scallops may have been used as scoops.

Summary

Certain aspects of Skútustaðir’s archaeofaunal data from 1630 to 1717 phase demonstrate that the farm’s engagements production were influenced by the economic system organized by Icelandic elites and which functioned to create surplus goods and move them into Denmark’s cameral system via the Trade
Monopoly. Archaeofaunal evidence of the inland farm's participation in coastal cod fishing, probably through mobile laborers, is perhaps the strongest example of this. Additionally, the sheep-focused herd management strategy, which included the keeping of older animals, likely yielded surplus wool for the Danish Monopoly Trade.

Other aspects of the archaeofaunal data from this phase suggest that subsistence production distributed among a few variable ecosystems was of critical importance and that most of what was produced on the farm was consumed by the farm or in local networks. Cow and sheep butchery and carcas partitioning evidence suggest that the meat products of farming household were geared at self-provisioning.

As for local Salmonidae fishing, during the 17th and 18th centuries, there is very strong evidence for the production of dried and/or smoked char being exchanged away or used as payment, though at this stage in research it remains unclear whether this would have reached only regional consumers or more distant, overseas consumers.

While a subset of Skútustaðir’s farm production during the 17th and 18th centuries were surely influenced by the commercial ambitions of Icelandic elites and colonial merchants, the seasonally variable production strategies balanced labor, productivity, and risk, across a number of ecosystems which were all variable. Fishing, haymaking, and birding could each fail due to climatic variation. In the case of Salmonidae, both foodweb dynamics and human practices likely contributed to the variability in catches which was significant (Aðalsteinsson, 1979). Complete
specialization by a farm or settlement in any one mode of production, would have left Icelanders extremely vulnerable to subsistence failure. The 17th and 18th century archaeological remains point to some engagement with markets and in addition to a strong emphasis on local, diverse approaches to securing subsistence. 

Over the late 19th century, the ways in which Skútustaðir residents used animal resources seems to have become increasingly responsive, and perhaps more rapidly responsive, to market opportunities which were broadening. The intensification of sheep herding (between 1810 and 1855), preceded this and can be attributed to engagements between household production the Danish wool market (Karlsson, 2000). After the legalization of free trade in 1855, Icelanders engaged in the 1870s cash trade for live sheep. Then the formation of local free trade associations seem to have also emphasized live sheep. When viewed from a long term perspective, these may represent rapid and significant shifts in the management and commodification of livestock. Wool and milk eventually became less important to the export economy during the late 19th century and early 20th century.

The 19th century shift in cod consumption at Skútustaðir might be indicative of a larger change in the household, and in the relationship between inland households and the coast. During the late 19th and early 20th centuries, Skútustaðir was mostly owner occupied. And also, an increasing number of laborers, servants and generally landless people moved permanently to the coast to participate in booming cod fisheries. Some emigrated from the 1870s onward and these circumstances were part of the shrinking of the servant farmhand class in rural
places and its related labor systems. Either a change away from tenancy or the
disruption of the servitude system may be the reason why the 19th century
Skútustaðir household was no longer being supplied with cod byproducts (heads)
as it was in the 1630-1717 phase but instead was potentially purchasing or
acquiring the classic consumer product (fillets). In this way, the change in fish
consumption seems to be narrating a change in the social entanglement of
household members within the larger economic system.

The local freshwater char and trout fishing has its own unique history. The
archaeological record suggests that local char and trout were mostly produced and
consumed as a cured product from at least the 17th century. The arcaheofuana
consistently shows the same pattern in the 19th century but in addition to this,
available textual sources also suggest intensification of freshwater fishing, especially
during the late 19th century. Two instances are noted of intense periods of harvest
and selling and both following the legalization of free trade in Iceland. Records of
17th and 18th century trade could not be scoured for the present work, but what has
been found thus far raises the question of whether open trade and cash exchange
intensified local fishing of char and trout. Another local wild resource represented in
Skútustaðir’s archaeofauna in the 19th century, Ptarmigan, was commodified and
was exported en masse (Neilsen & Pétursson, 1995).

This chapter has contributed zooarchaeological evidence to reconstruct how
animals were utilized, managed, and commodified at the level of the rural
household. It has drawn connections between the archaeofaunal evidence and
broader economic, political changes over Iceland’s 17th through 19th centuries. The
next chapter investigates the cultures of natural knowledge that also played a role in the commodification of Iceland's rural ecologies.
Chapter 7. Ways of Knowing

This chapter connects commodification and standardization practices in Mývatn’s rural animal economies to the economic cultures and worldviews entering Iceland through Denmark in the 18th and 19th centuries. Beginning in the 1750s, Danish and Icelandic officials intensified large scale policy and information projects as an approach to improving the Icelandic economy, normalizing production, and increasing profitability (Róbertsdóttir, 2008; Karlsson, 2000). Experts and scientists studied plants, animals, and landscapes as potential economic resources and people as potential labor. These new sciences along with written information and statistics were integral to conveying knowledge within a new kind of economic administration, signaling the influence of the Danish “enlightenment” in Iceland. Here I describe the 18th century escalation of scientific knowledge production and as a threshold in the commodification of nature (Mrozowski, 1999) in Iceland - an innovation that would inform and augment the growth of market-focused production.

After the 18th century introduction of these practices, rural communities increasingly adopted the use of information science around local organized intensification efforts in the 19th century. This, in addition to policy shifts, produced unprecedented growth in some areas of production (in terms of quantities and volumes of animal and products) (Hicks, 2019; Karlsson, 2000). I suggest, following Anna Tsing and James Scott that we consider these kinds of knowledge practices not just cultural shifts but also technological (Scott, 1989; Tsing, 2014). This understanding broadens debates about Iceland’s shift toward a “modernized”
economy and capitalism which often cite decked fishing vessels and fertilizers as some of the significant technological avenues of change (Eggertsson, 1996).

Iceland’s nature was classified, brought under control, and commodified – first in a colonial context by Danish knowledge projects, and then as communities in the late 19th century organized production for free markets and rural capitalism. And over the 18th and 19th centuries, the island’s ecologies and people were more firmly entrenched as producers and consumers in large-scale Atlantic markets.

18th Century Enlightenment Science and Resource Management

The 18th century saw several European state and merchant conglomerates crafting hegemonies that spanned the Atlantic (Wolf, 1982). Citizens, their labor, and natural resources in outlying territories (and within) came to be viewed as sources of state wealth and enrichment for merchants and elites through institutions like land rent, taxation, and trade monopolies. Two main economic philosophies were juxtaposed: classical economists argued for a liberal political order and the primacy of market efficiency, while on the opposite side, Romantics argued for the preservation of the sovereignty of local elites (Koerner, 1999). A third school of economic thought, “cameralism” originated a century earlier in Germany and ran through this era. Cameralists sought to invigorate and diversify state economies while balancing and synchronizing various aspects of production and markets within their territories (ibid). Cameralism - not a liberalized economic schematic - describes how Iceland was actively situated and managed within the larger Danish context (Róbertsdóttir, 2008) and this was increasingly through the work of experts and scientists.
In mercantile and cameral systems, states’ envisioning and treatment of natural resources and people toward economic gains, would not have been possible without the creation of overviews via the use of recordkeeping, sciences, and statistical information and a systematic, simplified, and abstract understanding of landscapes, people, and biota. For this reason, scientists, medical doctors, and various other experts assumed an increasingly important role in 18th century government advisory. Neil Smith has noted Francis Bacon, Lord Chancellor of England as an early example (in Anglo/European context) of an expert who sought to develop science as tool for economic extension (1984). Bacon used science to abstract and communicate properties of plants, animals, and minerals as well as transformative labor processes (ibid). Karl Linnaeus, as Elizabeth Koerner argues, is particularly exemplary of this 18th century ascension of science in governance (1999). Linnaeus is remembered as a naturalist though he was just as much a high-level economist involved in planning Sweden’s agriculture and production toward cameralist organizational goals and the enrichment of the state. Linnaeus identified, translated, and described resources available within Sweden and made recommendations for the integration of these economic resources (including imported biota) into a vision of the state economy. Linneus’ career is demonstrative of how economic administrators relied upon emerging science and information collected at a large spatial scale in order to see, comprehend, and manage people and natural resources – and that sometimes the roles of scientists and administrators were conflated.
In Denmark and Iceland formally-trained polymaths and scientists shared a broadening role in governance. In the late 18th century in Denmark Johann Friedrich Struensee (a doctor of Cambridge), was appointed as the physician of King Christian VII and assumed significant political influence in official roles next to the sovereign who, was suffering from mental illness (Schioldan, 2013). Struensee, held power from 1770-1772 as State Councilor, Royal Advisor and acted in the role of the King. He received and approved reports from all sectors of government including policy in Norway and Iceland. In a span of fewer than 2 years, Struensee instituted well over 1000 social reforms consistent with enlightenment ‘modern’ economic ideas including a reduction of feudal privileges for aristocrats, “improvements” in farming and manufacture, freedom of the press, and the abolishment of unfree labor (in Denmark), censorship, and corruption (Laursen, 2000). Struensee was unequivocally and explicitly striving to bring the enlightenment to Denmark and this included, among other things, the incorporation of specialists and scientists into an increasingly bureaucratized government. This government also reached into Iceland.

Danish governance actively expanded in Iceland during late 18th century. During the previous 17th century it was important to Danish merchants to schedule regular trade of fish, wool, and mutton from established harbors in Iceland and this was not radically different from 16th Hansa century trade, which used more or less the same harbors. But during the late 18th century, after a particularly bad famine the Danish crown formally took over administration of trade from merchants (Karlsson, 2000) and administrators increased efforts to understand and improve
production and other conditions in Iceland (Róbertsdóttir, 2008). The Danish state began to study and analyze Iceland and during the 18th century in order to subsequently re-tool policy and enact reforms.

At this time Iceland’s agricultural and fishing surpluses were extracted through land rent paired with high rates of tenancy and undercompensated servant labor (Jónsson, 1993). Tenant farmers and their families constituted 59% of the Icelandic population (including subtenants) and 95% of all households were tenant farms in 1703 (Karlsson, 2000). Rents were extracted in fish, butter, livestock, and related labor. Servant farmhands, both women and men, who boarded and worked on farms and were 19% of the Icelandic population (Karlsson, 2000 via Magnússon & Vídalín; 1943). These non-renting and non-owning servant/farmhands were bound by annual contracts to dedicate themselves to terrestrial production (e.g. hay collection, weaving, knitting, herding, and dairying) apart from a few winter months when some would head to the coast and participate in gadid fishing for both subsistence and commerce. Servant laborers were legally prohibited from forming landless fishing households on the coast because landowners and tenant farmers feared that they would desert land-based production permanently. Most goods in Iceland were produced in the household rather than in central places of manufacture (Róbertsdóttir, 2008)

The above-described economic organization suppressed fishing to be a secondary activity. However, some contemporary scholars have suggested that early modern fisheries could not have have expanded for foundational ecological reasons including that catches could be extremely variable from year to year.
(Ogilvie & Jónsdóttir, 2000). Part of the suppression of fishing included that price fixing undercompensated Icelanders for fish. Danish economic policies including price fixing supported land-based production and thus tended to support the Icelandic elite. But Danish merchants also may not have needed fish as they had access to trade with Norway’s fisheries (Eggertsson, 1996). As part of Denmark’s cameral administrators attempted to better integrate Icelandic agricultural surpluses and fishing into the interests of the Icelandic elites and the Danish state, they strove to ascertain an ever clearer and analytical view of Iceland’s people and resources.

**Seeing Like a State**

Danish economic administration in Iceland during the 18th century needed to see the populations and resources in order to legislate around production, which they accomplished through increasing use of censuses, nature surveys, and statistical information. During the 18th century, and especially after the mid-18th century, knowledge production around Iceland’s natural resources and citizenry was expanded by the Danish administration (Róbertsdóttir, 2008). Notable among these are those are surveys by the Danish lawyer Niels Horrebow, and another aformentioned nature survey by Eggert Ólafsson and Bjarnar Pálsson. These economic reports of the 18th century were admittedly not the earliest or first documents to collect broad economic information from the Island for administrative purposes. However, it is apparent that after the 1750s written informational tools and modalities for planning became regular business. Information production was an intentional process through which Danish economic governance and vision was
extended over the island. In addition to creating synthetic viewsheds for
governance, these literatures made use of abstractions and metrics and used these
to convert “natural resources” and labor into shared values for the management,
commerce, and profit.

James Scott, in his treatise on modern economic governance and nature
“Seeing Like a State” (1998) says:

The premodern state was in many respects blind. It knew little of its subjects and It
lacked for the most part, a measure, a metric that would allow it to translate what it
knew into a common standard necessary for a synoptic view (Scott, 1998 XXX).

Scott elucidates the diverse functionalities and side effects of information sciences -
they simplify, parse, and combine views of complex assemblages and ecosystems.
Where Scott identifies modern states’ agentic synopses of nature, Foucault has
characterized similar interventions as biopolitics - strategies for governing that take
an interest in diverse aspects of (human) life- as foundational to state economics
(1978). He saw this knowledge production as form of power emergent in early
modern Europe as states began to study and regulate lives and bodies, viewing their
populations as resources, as objects of scrutiny, and as a realm for economic
improvement. Hart and Negri (2000) have further clarified that the achievement of
large-scale vision and administration, described by Foucault (1978), was and is
inseparable from the goals of surplus production and accumulation. Biopolitics
taken up recently extend its definition to thinking about how it is inclusive in the
defining conditions of human and the nonhuman forms of life (Povenelli, 2016;
Rabinow & Rose 2006; Wolfe, 2013).
Scientific knowledge production enabled the acceleration of political and economic agency across the Atlantic, increasingly as European states staked their claim on territories to the west. Scholars including Sylvia Wynter have pointed out that colonialism enabled the ascension of science as a dominant mode of re-framing the world just as much as scientific knowledge enabled colonialism (2003). Iceland was one of many places being scientifically “discovered” via 18th century scientific expeditions and simultaneously re-defined and re-imagined in a colonial context (see Oslund, 2011).

An early example of these synoptic knowledge projects is the 1703 human and animal censuses and the 1702-1712 Jarðabók land survey commissioned by the Danish king as an inventory and a foundation for crafting plans for economic improvements. The 1703 census included the names, demographic information and location of residence of every individual on the island. These surveys and censuses accomplished the most basic preconditions for economic supervision. To use Scott’s terms these documents created legibility or visibility of people, animals, and other resources. Through the creation of quantitative information that could be aggregated or dissagregated, the 1703 census and Jarðabók created an understanding of individuals as populations (what Foucault calls massification). Through extensive documentation and enumeration, the work made visible, real, and comprehensible the units and the categories (main farms, subsidiary farms, nonfarming households, labroeres, owners, tenants,) which would be take as subjects of policy. Although these censuses and land surveys of the first decade of the 18th century were apparently not widely used in the coming years, they are an
early example of a potent geographical knowledge. They did not simply document
land, people, resources and tenure, but created an avenue for subsequent
intervention.

Ólafsson and Pálsson’s Ferðabókin (The Travel Book) is considered the first
scientific literature produced about Iceland. Some would describe it as a nature
survey or a natural history as it includes definition and exploration of potential
resources as well as economic descriptions of peasant production of a proto-
ethnographic quality. The work was at the outset, explicitly intended to inform
economic redevelopment. And like the work discussed above, it increased legibility
and visibility of Iceland’s economic assemblage for Danish administration. Through
the use of scientific naming conventions, in the style of Linnaeus; the authors
translated Icelandic natural resources from their local common names into latinate
names which were becoming a shared technical language in Europe for the purpose
of translating nature. Around roughly the same time as the creation of Ólafsson and
Pálsson’s work - the mid-18th century – Karl Linnaeus offered a system of latinate
binomial nomenclature, though similar naming systems were in use since the 17th
century. It is of course, no coincidence that a new widespread naming system for
living things was invented for use during the “age of exploration” in the 17th and 18th
centuries - a high point in encounters between people from the east and unfamiliar
biota across oceans. The efforts to translate, name, and catalogue living and
nonliving things was part of the “exploration” of their economic potential.

Translation was not just a linguistic phenomenon, but an active conversion of
things from one sphere of interaction into another – from their origin into the
market context. This passage from *Ferðabókin* exemplifies the dense information and many types of translations it conveyed.

A sheep of four years old costs one rix-dollar in specie; and a vætt, or five lispund, of wool costs 40 álnir or eigh marks in specie. According to Jónsbók, a sheep ought to give at the time of shearing at least four pounds of wool. (p 33)

Like other late 18th century works, *Ferðabókin* gathered, translated, and relayed standardized information about animal products and related labor using quantitative measures of abstraction, which is part of the process of commodification. The relations between standardized dried fish, woolen commodities, their value, labor and time were densely described. Icelandic metrics of distance and time were related to Danish ones. Through quantitative translations, Eggert Ólafsson and Bjarni Pálsson made the processes behind commodity production both visible and co-measurable for Danish administrators. These modalities around information science were critical to the processes of objectification and commoditization.

Their work also transmitted normative economic attitudes. One example of this concerns the elite and the payment of laborers—specifically the text notes the opinion that annual compensation for contracted servant laborers should be kept comparatively very low. In light of this, it is necessary to understand these collections of knowledge not as neutral media, but as perspectivaly aligned with elites and extractive endeavors.

A domestic who is a good labourer, gains annually no more than four rix dollars and a female servant, half that sum...and all the ancient and modern regulations on this subject prove that the Icelanders think it contrary to the public good, and disadvantageous to every individual, to fix too high the value of a day’s labour. (Ólafsson & Pálsson, 1975, P.24)
Standardized labor and surrounding conditions are important to a shared understanding of commodities and the organization of markets. The discussion of labortime and value in a tome that might be considered to be a natural history, epitomizes the co-emergence of scientific expertise, economic planning, and industry in colonial early modern European contexts (see Smith, 1984). The abstraction of products and labor into measurements is also an step that allows intervention into each segment of a productive process for the purpose of scaling up of production. Knowledge-making projects like the Ferðabók, should therefore be considered attendant to the intensification and transitions to capitalism that would happen in Iceland the next century.

Both the Jarðabók and the Ferðabók created synoptic views, meaning that they captured information about diverse phenomena in way in that could be viewed together, as interdependent variables in considerations of productivity.

Economic studies intensified further during the late 18th century. Hrefna Robertsdóttir tells us that only a couple of decades after the Ferðabók, in the late 18th century a significant body of administrative accounting and regulation grew up around wool production and labor discipline. There were initiatives to improve the quality and cleanliness of raw wool, plans for breed improvement, initiatives to increase output of knitted goods by servants, and the use of workshops in Reykjavík. The workshops would be centralized places of supervised production and were planned to increase the uniformity and quality of woven woolen goods (2008). There were also experiments with sheep breeding programs. Woolen fabric, raw wool, and mutton were a central focus of monopoly period economic administration
and this intensified the economic sheep specialization that would influence a narrowing of commercial herding and intensification of sheep herding into the 19th century.

**The 19th Century**

The Danish ‘improvement’ project of the 18th century did not lead directly into economic boom-times, but I would suggest somewhat indirectly. This was due to complex social and environmental conditions in Iceland. Tenants, who made up most of households were disincentivized to improve and fertilize and improve the land and this hindered growth in agricultural production (Jónsson, 1993). Second, the maintenance of a servant class who could not marry or reproduce meant that population growth was limited (Jónsson, 1993; Vasey, 1996). These social institutions would not change until the late 19th century. In addition, there were natural disasters that unevenly impacted the stratified society of the 18th century. The cooling effect of sea ice frequently hindered livestock production in the mid-18th century even causing starvation and farm desertion in some areas. The immense Lakagígar volcanic eruptions in 1783-4 killed 9,000 to 10,000 people, killed half of all horses and cows, and killed more than half of ewes and wethers on the island. During such disasters aid from Denmark was often not sufficient (Karlsson, 2000). And due to the social rigidity of the Icelandic class system and environmental circumstances Denmark’s 18th century economic interventions did not lead immediately to radical transformation into growing market-focused economies.
While the influence of the Danish Enlightenment was markedly strong between 1750 and 1830, educated Icelanders were also actively involved in reforms. Skúli Magnússon, Iceland’s first treasurer, made some of the most progressive calls for improvement in agriculture and gained funding for the experiential weaving workshops and for investment in decked fishing vessels as early as the mid 18th century (Karlsson, 2000).

As part of inquiry into social improvement, Danes directly encouraged Icelandic literacy, which was on the rise during the 18th century. A study by traveling emissary Ludvig Harboe and Jón Þorkelsson completed in 1741 indicated a 20% to 50% literacy rate of of Icelanders living in various rural municipalities. Most farming households in Iceland did not make use of writing in daily interactions (Karlsson 2000 p 172). Literacy among individuals tended to vary with gender and social status. Following that survey, policies encouraged literacy at all levels of society via household-based learning across social standing. These specifically encouraged capable heads of household to instruct their children as well as farmhands and servants (Róbertsdóttir, 2008). Changes around literacy were undergided by related Lutheran pietist ideals that promoted religious teachings as the focal material and confirmation was contingent upon literacy. During the 19th century, paper became increasingly available (Magnússon, 2010) and this perhaps contributed the spread of writing and record keeping to the common rural household as well as the use of information and records in the management of economic resources in the local environment.
With these changes in literacy and economic culture, local communities were increasingly studying, recording, managing and planning around natural resources while thinking about increasing surplus production.

In the 19th century, the Mývatn community seems to become dedicated to information science and record keeping. I had the privilege of accessing archived 19th century materials in 2012 with the support of the Comparative Island Ecodynamics Grant, with funding from NSF Dissertation Improvement Grant in 2013-2014, and from 2014-the present with an interdisciplinary project on socio environmental change funded by NSF and RANNIS. Although the types of records are broad, I focused only on a small subset of records of animals, resource management, and economies. There are additionally records held by the National Museum, though due to time constraints, I was not able to survey those; I plan to explore them in future work. This discussion represents a beginning rather than a conclusion.

Three types of primary documents are discussed in the following section: Hay reports, trade account books, and writings about early fisheries management. Each example represents production and use of centralized, written information toward economic visibility, calculability, supervision, control, and planning.

**Hay Reports**

During the late 18th and early 19th centuries, Icelandic farmers increased their herd sizes of sheep significantly to engage with wool export markets. Since Iceland’s first century of settlement, farmers’ herds have been limited by how much hay they could collect over the summer months to feed their herds through winter.
If they overshot their number of animals, they would have to borrow hay or slaughter animals to adjust, sometimes needing to shrink their herds significantly (Eggertsson, 2005; Hicks, 2014). The variables governing herd size include space for growing hay, hayfield fertility, and weather – cold or excessive rain could damage the hay crop. Over optimistic farmers seeking to keep maximum sheep numbers through borrowing hay from neighbors or communal hay storage caused social strain. And the problem of fodder management was a long-term problem through the end of the 19th century (Eggertsson, 2005; Hicks, 2014; Dennis et al., 1993). According to Eggertsson, Danish administrators recommended centralized documentation of herd numbers and calculation of foddering practices so that communities could supervise farmers who exceeded common understandings of safe provisioning capacities (2005). This suggests that these types of reports may not have been used before the 18th century.

The Mývatn farming community seems to have implemented the use of hay reports to supervise farmers and make resource management and both visible and calculable during a time of growth in sheep production which was oriented toward markets rather than subsistence production. As seen elsewhere in Iceland, over the late 18th through the mid-19th centuries, Mývatn people doubled the numbers of sheep kept on their farms. At the same time they intensified the use of the local landscape for hay production (Hicks et al., 2017). The sheep farming households had had just been impacted by a particularly bad crisis. During the late 1850s Iceland was struck with a sheep epidemic in the south followed by several years of cold weather caused by the persistence of the sea Ice on the North coast. As had
happened over many centuries and in other times, cooling temperatures on land reduced the hay available for overwinter fodder as well as shortening the growing season for grazing (Ogilvie & Jónsdóttir, 2000). Farmers suffered catastrophic shortages of fodder toward the end of spring, and this caused them to have to slaughter starving animals in the late spring (Jónsson, 1968). In this way, sea ice’s reduction of fodder disrupted their normal system of keeping a large base of ewes for lamb production and wethers for wool - and it also reduced expected farm productivity. The hay inspection reports were thus attempting to standardize foddering and production practices within the context of expanding market opportunities and variable weather of the 19th century.

The creation of hay reports from 1863 and onward involved two male head of household farmers who volunteered or were selected to be inspectors by the hreppur administration. They visited each farm in the hreppur in the autumn and sometimes at the end of spring during which they recorded the weights of hay that farmers had stored during the summer for the purpose of overwintering their precise reported number of animals. This information assembled in the form of data tables included the names of heads of household in a left-hand column, the numbers of animals they owned in autumn inclusive of sheep, cows, horses (no goats were included). In the final columns they listed the weights of hay intended for the overwintering of each livestock category. Hay reports were early data tables. While the supervision and monitoring of hay use among farmers in the commune was not new, the written and numerical innovations made supervision more effective, and connected this clear information to the local hreppur administration.
Using hay reports, the community produced their own centralized dense geographic and statistical information which made foddering practices and total regional farm production visible and hence legible to local community leaders (to return to Scott’s (1998) terminologies). The populations of animals and the quantities of hay harvested (tallied by household) could be understood in aggregated (community) or disaggregated (household) units. The hay reports were certainly not the only documents in which dense data was produced, gathered, and combined to manage local environments and production related to commercial endeavors though they demonstrate how the Mývatn community, and probably Icelanders more broadly, began to use scientific practices and dense information in conjunction with supervision to deal standardization, growth, and productive variability around their most important commodity—sheep.

**Freshwater Fisheries**

Freshwater fishing of trout and char was a central part of the Mývatn community’s subsistence and during times of abundance it seems to have yielded commercial gains. Local fishing for char and trout was also a site of variability that could become a hindrance to both subsistence and commerce. The writings of local farmer Jón Gauti Pétursson about the years AD 1850-1900 tell of community record keeping that was just beginning to centralize. Jón began to assemble information on fisheries from personal logs kept by his neighbors at Skútustaðir, Geiteyarströnd, and Kálfaströnd but there was apparently no centralized documentation kept elsewhere. He notes however, that older community members recalled fisheries
conditions from the early 19th century, suggesting that knowledge was shared conversationally.

Jón Gauti Pétursson’s 19th century writings knitted together accounts from several farms of annual catches and discussed interannual fluctuations and poor fishing years that were problematic. He gathered, for example, that Skútustaðir fished about 7000 salmonids per year at maximum. One year of notable abundance was in 1867. During some years of the the 1860s and 1880s Jón reported that trout fishing was above average and so abundant that people from surrounding districts came to Mývatn to fish. However in 1875 his neighbors reportedly had such bad catches that they resorted to purchasing herring from coastal suppliers to supplement their family’s basic food needs. Regarding another notable poor fishing year, 1880, Jón and the community posited that the warm summer killed off some of the population of Salmonidae in Mývatn. The reasons for variability were not totally understood at this time, though according to Jón, elders observed that good fishing and bad fishing alternated in 7 year cycles attributed to the timing of trout hatches and growth to adulthood.

In 1886 international trade was disrupted by sea ice, reducing food imports like grain. Icelanders from other rural districts actually depended on Mývatn’s fish as a dietary resource. Jón notes that Mývatn people generally sold ungutted and unprocessed char and trout to neighboring district inhabitants for a modest price, he thought, at 8 aurar per kilogram. Other sources indicate brief periods of commodification of Salmonidae- they were exported during the 1860s and in salted
form during the 1920s (Einarsson pers. comm.). Reports of export suggest it was ephemeral.

The last decades of the 19th century and first of the 20th century may represent the beginning of centralized, scientific knowledge practices around Salmonidae fishing in Mývatn. According to research by Edwald (2012b), a lively written debate emerged around fishing management in the 1890s. At that time, there were no regulations concerning how to fish responsibly in terms of method and schedule (ibid). In 1905, a fisheries association was formed in Mývatnssveit - the Veðifjelag - which was a platform for the discussion of guidelines, limits, and fishing methods. They began to collect, centralize, and report data on fish catches. This data has become a valuable source of statistical information then and today for scientists studying lake ecology.

The fact that a discourse and centralized information practices began to materialize around fishing during the 1880s may be linked to an uptick or change in commercial interactions. As described above, there was significant variability during these years and there may have been heightened market incentive. Given that a market had emerged during the 1860s in the context of cash and increasing free trade, it may be that the community was even more inspired to fish intensively. Variability would have challenged local commerce. Breeding initiatives of the early 20th c further indicate a desire to think collectively about ways in which they could encourage a stable or improved catch.

In 1913 Bjarni Sæmundsson encouraged Mývatn people to start hatcheries in the lake (Edwald, 2012b) to increase or stabilize fishing productivity and he
published perhaps the first scientific treatment of lake fishing. Scientists working in the area have subsequently continued to study the char population. Ádalsteinsson has found that the age structure of char in the lake has shifted significantly over the 20th century. Where 5-7 year old char were commonly found in the 1930s, by the 1970s, the older lake specimens were 5 years old (1979). Debates concerning the core reasons for population variability are ongoing through to the present day. So-called “bottom-up” conditions like food availability seem to have a significant impact (Ádalsteinsson, 1979; Bartrons et al., 2015) though the effects of fishing pressures are also debated. Shifts in netting technology during the 20th c. may be partially to blame (Ádalsteinsson, 1979). Recently, one of the most polarizing issues around fishing has concerned the effects on the lake’s ecology contemporary diatomite mining from the lake bed.

**Trade Books**

German Hansa and then Danish merchants (who displaced Hansa merchants in the late 16th to early 17th centuries) used trade books to document trade transactions at seasonal harbors. During the Danish Trade Monopoly period, price fixing compensated Icelandic producers for wool and mutton in a way that was believed to support a farm-based social organization, while price of fish paid to Icelanders was apparently low and intended to suppress fishing (Eggertsson, 1996). The ways in which Danes valued Icelandic commodities impacted local economic organization – where valuing was a repetitive act both inscribed in and communicated by the documentation of trade.
The conditions of the Danish trade maintained Icelanders as producers of cheap bulk goods with comparatively little purchasing power. Icelanders were never compensated in cash and were clearly at the extraction end of the economic scene. The overwhelming majority of Icelanders did not have agency in determining these relations. It goes without saying that the typical Icelandic farmer had significantly less vision and control over the overall trade arena when compared to the Danish merchants who were supported by the crown and a broad economic vision. Even after the end of the period of monopoly trade in 1787, Danish firms continued to dominate trade exclusively. Then, with the legalization of free trade in 1855 and the contact of the British sheep market after 1870, conditions began to shift for Icelandic farmers including, eventually, trade organized by Icelanders.

Information produced and transmitted at points of exchange is an active part of the commodification process. Values are ascribed or reconfirmed and negotiations over goods and compensation dictate levels of empowerment and prosperity. In exchange situations, materials and living things are moved across transformative thresholds from their local ecological and productive contexts into a broader world in which they are related to other objects and values (Tsing, 2014). Commodities are not pre-existing, rather commodification is an active process which includes physical production techniques but also the transmission, the negotiation, and sharing of information that lends definition to the commodity.

Then when the Mývatn community formed their own free trade association in 1882, the Kaupfélag Pingeyinga, they began to administer their own trade in books which are now archived by the Húsavík Museum and Culture house. The
small booklets documented trade within the cooperative system and entries were organized by household. Household information was grouped into divisions (called deildar plural) which seem to correspond to an influential household and about 5 households around it. For example, there was the Skútadeild around Skútustaðir and the Gautadeild around Gautlönd. Each division kept a small booklet of trade transactions carried out by each head of household and booklets usually covered a span of 1-3 years, normally with one page per head of household per year. On this page, the farm name and head of household formed a header, while there were columns for lists of goods traded in and goods received and their prices. The columns were balanced to reflect total credit or debt outstanding.

The local organization of trade through the keeping of trade booklets meant that exchange was being administered from within the community and this would include the assignment of compensatory values as an important part of the commodification process.

It is powerful to consider that the takeover by the Mývatn community in the administration of trade, and local documentation, was happening at the same time as the community made efforts aimed to stabilize, and normalize sheep herding and freshwater fishing and thereby to stabilize and standardize the production of these potential commodities. The fishing and farming associations were in fact, organized close alliance with the trade cooperative. This would suggest that decisions about how to mobilize local resources for markets and on what terms to engage with merchants would have been made increasingly at the level of the hreppur or the rural municipality, and less so by external agencies like Danish Merchants. Through
these new modes of organization and information practices Mývatn people exercised significant oversight over local ecologies as well as the passage of animals from localized ecologies into commercial interactions.

**Discussion**

As this chapter details, enlightenment, colonial cultures of economic governance, including scientific knowledge production and extensive record keeping entered Iceland via the Danish colonial economy during the 18th century and contributed to a shift how people envisioned and managed natural resources. These knowledge practices were instrumental and had material results. With them, people crafted synoptic understandings of variables involved in production and also transmitted understandings of the values of commodified labor and products. These views afforded the ability to interject adjustments and change. During the 19th century, as Icelandic literacy increased, and commercial orientation increased, these ways of knowing, were taken up from Danes by Icelanders. Over the 19th century the rural community in Mývatn began to collect, centralize, and mobilize information about local resources, variability, and productivity in an increasingly frequent and detailed fashion. Reports of overwinter foddering practices created visibility and standardized practices among sheep farmers in the context of rapid growth of the herding economy in a limiting landscape. Community members centralized information about local freshwater char and trout fisheries, attempting to create visibility around fish catches and populations as variability was often disruptive to subsistence and commerce. The emergence of local trade administration by Icelanders was additionally a locus where they mediated commodification through
information practices. These newly introduced cultures of information and natural knowledge were not neutral ways of knowing but inherently tied to the organization of production and the exchange of local resources as products and commodities.
Chapter 8. Sheep, the Environment, and Capitalism

The intensification of sheep production during Iceland’s late 18th and 19th centuries was constitutive of a broader orientation toward a market-based colonial economy and was later foundational to the emergent capitalist economy. This chapter assesses archaeofaunal and documentary records to investigate the expansion of herding in the Mývatn community and the use of local ecologies for growing and changing markets. It also traces how these markets shifted away from Danish cameral arrangements toward free market capitalism. The formation of the first Icelandic free trade association in the northeast of Iceland punctuated this transition, with Mývatnssveit as a key hinterland. This case study of shifts in husbandry, local ecologies, and marketplace politics shines light upon the early organization of capitalism in Mývatnssveit while at the same time touching on some trends and events that were general to Iceland.

The expansion of sheep production is generally known from historical writings and statistical sources (e.g. Karlsson, 2000; Þórhallsdóttir et al., 2013), but this study uses several local primary sources to craft a detailed, localized understanding. Mývatnssveit farmers expanded pastoral production in particular ways and as they did so they encountered certain kinds of limits in the variable and cold climatic conditions of the 19th century. These climatic issues could make herd maintenance, let alone intensification, difficult. The growth of sheep production emerged not only with growing market opportunities for sheep products but
additionally in the way that people supervised and administered local resources and ecologies.

**Background**

Throughout Iceland’s history, sheep have been the most numerous animal in herds. Zooarchaeological study of long term herding practices suggests some shared patterns across space and throughout time. The majority of farms historically maintained a mixed management strategy for sheep where milk, meat and wool were derived respectively from mixed herds of ewes, lambs, and wethers (McGovern et al., 2009). Archaeological evidence indicates that cows, which are expensive to raise in terms of fodder, were generally kept for dairying rather than beef production between settlement and the 19th century, except in ceremonial and high-status contexts (Hambrecht 2009; McGovern et al., 2009).

Beyond sheep and cows, horses have been predominantly utilized for transportation but were eaten occasionally - perhaps more commonly into the 19th century (Ungi 1893). Pigs and goats arrived with the first settlers to Iceland, but became rare over time (McGovern et al., 2009). Icelanders stopped raising pigs around the 16th century (Jónsson, 2013) and Icelandic goats dwindled during the early modern period, regaining some popularity during the 19th century, but today exist only in the hundreds island-wide.

The stocky, Icelandic sheep arrived with the first settlers and is related to the Norwegian Spelsau sheep and is cold-hardy. Sheep have been historically favored when compared to other livestock in Iceland due to their relative resilience in the cold and because herds provide several necessary products at once: meat, milk and
wool. Iceland’s external market contacts, since at least the 13th century, have
desired woven woolens and mutton and archaeologists have demonstrated that this
has certainly been influential on country-wide patterns of livestock keeping (see
Harrison, 2013; McGovern et al., 2009; McGovern et al., 2014).

The ratios of cattle to sheep kept on different farms at different periods has
been subject of research using both documentary and zooarchaeological data (see
McCooey, 2017 for a general discussion of the written sources and McGovern et al.,
2014 for a review of the zooarchaeological evidence to 2013). While there was
clearly much variability in the cattle to caprine stock ratio by region, period, farm
wealth, and changing farming objectives, Viking Age and Medieval cattle to sheep /
caprine ratios tended to range between 1:3 and 1:10 with some exceptions as high
as 1:20 (McGovern et al., 2014 see figure 36), The Icelandic archaeofauna are nearly
all sheep after ca 1200 CE, while the Greenlandic “Caprine” group is usually nearly
half goat (Smiarowski et al. 2017).
These ratios suggest that some smaller Icelandic farms like Skuggi in Hörgárdalur and Steinbogi in Mývatnssveit may have focused heavily on sheep and probably specialized in wool production. A key issue addressed in prior NABO Viking Age to Medieval caprine management investigations has been the interpretation of such ratios in terms of potential for producing a surplus of wool beyond the needs of the farm household. Vésteinsson (pers. comm.) and Þorláksson (1991) have done considerable documentary research on medieval Icelandic sheep raising, consulting law codes, sagas, and later management literature to address some of these key questions about production and consumption of woolen cloth. This research provides a consistent estimate of about three to six fleeces worth of...
sheep wool per year to adequately clothe an individual and provide some allowance for bedding and other fabric needs.

McGovern et al. (2014) concluded that for the medieval period, wool production and extractive relationships differentiated rural sites.

Large manors with low caprine (especially sheep) to cattle ratios (much below the 1:5 or 1:6 level) were not provisioning their households with the production of their demesne holding alone. Wool was being brought in from other sources to maintain these households and they were unlikely to be producing surplus wool themselves. For all farm classes, caprine to cattle ratios in the 1.5–1:10 range were probably aimed at providing for household wool consumption needs rather than surplus generation (especially if the caprines were a mix of sheep and goats). Small farms with caprine to cattle ratios substantially above 1:10 with a strong predominance of sheep over goats were potentially producing a wool surplus. Caprine to cattle ratios above 1:15 (especially when caprines are mostly sheep) were very likely associated with wool surplus production efforts for any farm class. (McGovern et al. 2014: 138)

The Skútustaðir farm household may have fit into this rubric in the earlier phase analyzed in this dissertation. In the early 18th century, Skútustaðir was a tenancy and may have paid rent in wool products among others. Rents were also commonly extracted in butter and in fishing labor. Sheep and wool production at Skútustaðir in the Mývatn community underwent dramatic change during the 19th century. It seems that the above suggested model of surplus production was replaced as economic and social institutions underwent transformation; specifically the tenancy system, the servitude system, and Danish-led trade which prioritized wool.

Despite apparent difficulties encountered in growing the 18th century terrestrial economy (Róbertsdóttir, 2008), the numbers of sheep in Iceland were doubled during the 19th century and reached totals never attained before. It would be tempting to link this increase in sheep numbers to the mild climate during a few
decades or to a growing Icelandic population in need of more food, but Karlsson finds that initially, in the early 19th century, the majority of the increase in sheep numbers was in the category of wethers, mature castrated male sheep, which provide wool. This indicates that intensification was geared toward market interactions with Danish merchants (Karlsson, 2000). This research finds that specific market incentives would shift over the 19th century and so to would herd compositions, production strategies, primary trade products, contexts of trade, and social definitions and experiences within the herding community.

**Sheep Farming and Limiting Factors**

Farming households in Iceland have historically organized production through distinct seasonal activities, within a mosaic of haymaking and grazing landscapes. Sheep were (and are still) sent to higher altitude heathlands to graze during the summers. Meanwhile, winter fodder was grown and collected in enriched hayfields (*tún*) in summer. These cultivated hayfields are perhaps the oldest anthropogenic features continually used in Iceland. Winter fodder production also involved the gathering of sedges (*carex* spp.) from outfield wetmeadows (*engjar*) during the summer. Fodder collected in summer was mostly to be dried and used as feed during the winter.

Sheep were and are still brought down from highland pastures in early September. While sheep were near to the farms in the autumn and the early summer, they were placed on outfield grazing areas relatively close to farms (*úthagar*). Common grazing areas outside the landed property belonging to each of the farms (*afréttur*) were used for grazing animals in the winter when there wasn’t
deep snow. During the winter, livestock were mostly kept in barns within the main farm areas which tend to be located at lower elevations (normally below 300m asl). Dairy cows were kept indoors all but three months of the year and were provisioned with hand-collected hay. Sheep were supplemented with hay but were sometimes let graze when the weather allowed (See Ross et al., 2016).

These different types of areas, shaped by infrastructures of boundaries, commons, private barns, and community corrals, have changed through the 1100 and more years of pastoralism in Iceland (see discussions Aldred, 2013; Einarsson, 2015). What is important about hay production is that hay accessed and collected by each farming household, during the summer was used to keep animals fed through the winter when minimal or no grazing was possible. The widespread practice of overwintering cows, sheep, and horses on saved fodder from October through May, has therefore been a central preoccupation of Icelandic pastoral communities from the settlement through to the 20th century because it is a site of deterministic intersections between landscape productivity and labor and it defines the productive output of the farm in terms of resultant animals and their products.

The onset of autumn and winter marked and annual event when farmers culled their herds according to their winter hay supplies which were assessed in the fall. At this time of year, throughout Icelandic history, pastoralists reconciled their animal populations with the overall productivity of the foddering landscape of each farm. Hay production and strategic provisioning is therefore a critical subject that was dealt with in historic and modern law codes, in personal records, and in contemporary works of economic history (Eggertsson, 2005).
The size of a given farm’s winter fodder production area, the soil quality, and climatic factors all impacted grass production and livestock numbers and the historicity of these factors has been investigated through archaeological and paleoenvironmental research (e.g. Adderly et al., 2008; Ogilvie, 1984; Thompson & Simpson, 2007) and by economic historians (Eggertsson, 2005). These variables influenced farm values as well as the relative economic status of farms/farmers in terms of subsistence products and exchange values (Thompson & Simpson, 2007; for discussion of grazing, see Simpson et al., 2004; Órhalldóttir et al., 2013; but also Vésteinsson et al., 2002).

**Early Modern Climate Impacts**

Climate historian Astrid Ogilvie has extensively documented Iceland’s cold years through investigation of primary archives and has compared these with proxy climate data. Her work suggests we consider the “Little Ice Age” not as a uniform climatic period, but as a duration of marked variability, cold, and instances of severe cold anomalies (but also see White, 2014). Iceland’s cold periods often corresponded to a shift in the Greenland Sea Current which could bring sea ice southward to Iceland’s northern coast, and occasionally the southern coast (Ogilvie & Jónsdóttir, 2000). This had multiple impacts on Icelandic life and economy. Ethnohistorical sources relate that sea ice produced cold weather on land which could dramatically reduce hay production. Cold air delayed the onset of grass growth in the spring/summer which lengthened time that animals needed to be provisioned. Cold summers caused by sea ice also reduced the amount of fodder that farmers could collect during summer for overwintering. In addition to reducing
grass growth, sea ice could make waterways impassable for fishing boats and prevented the arrival of trading vessels, thus cutting off access to imports including food relief (Magnússon, 1882; Ogilvie, 1984; Ogilvie & Jónsdottir 2000).

Ogilvie’s investigations report marked cold periods from the 12th century and onward. Cold affected Iceland during the beginning and end of the 17th century. The 1690s, 1730s, 1740s and 1750s were cold with extreme bouts during the 1780s, at the same time as the catastrophic volcanic eruption at Lakagígar (Ogilvie & Jónsdóttir, 2000). The 1810s, 1830s, late 1850s and 1880s were also uncommonly frigid. And the years 1855 to 1860 were particularly cold. The 1880s, which were especially difficult and from the 1890s onward, sea ice incidences reduced and the attendant cold weather was less common than it had been during previous centuries.

Despite the general resilience of sheep in Iceland’s climate and landscape, the variable cold conditions of the Little Ice Age periodically made it a challenge to rear sheep and other livestock in a predictable way. Emergent 19th opportunities of trade, including cash and exchange credit at the same time incentivized the maximization of herds, which might explain why local farmers seem to encounter environmental limits of livestock production under their contemporary technologies under these variable conditions.

**Ranching in the Cold, First Hand Accounts**

Jón Jónsson (1829–1866), a farmer and self-taught bilingual author in Mývatnssveit during the mid 19th century recorded an emotive diaristic account of his life including description of his experience farming during particularly cold
years. The time covered by this narrative was one of the known cold periods of the 19th century and culminated in what has been described as the coldest year in Icelandic history: the *Bloodwinter* of 1859 (Jónsson, 1968; Karlsson, 2000; Report E28 1). Jón Jónsson's text is presented here verbatim from his published autobiography because it is both evocative and contains valuable information about farmers' experiences, prerogatives, strategies, and collective actions in the 19th century.

In the spring (1855) I lost some of my sheep for wanting of provender, which is a most lamentable accident that befalls the Iclandish [sic] farmer, to see his most usefull [sic] animals starving... But nobody can help it when all the hay is consumed and there is nothing to do but kill the animals. This occurs almost annuall [sic] in the sever winters and springs which now successively visit Icland [sic]. Wherefore the wealth and possession of sheep gradually diminish among the inhabitans of our starving country. It is now a custom that some farmers compare the number of sheep and bagga or cvantum of hay in the autumn in every farmhouse in order that they do not risk to keep more sheep or cows than they have enough food for. (Jónsson, 1968, p. 101)

Sea ice and cool temperatures on land persisted for four years, and in AD 1858 there was an outbreak of the sheep disease called scab (*Presoptis ovis*), which necessitated the killing of 40 percent to 85 percent of the sheep in some districts and the subsequent charitable redistribution of sheep donated from unaffected districts including the Mývatn region (Karlsson, 2000, p. 230; Jónsson 1968, p. 107–8). These years were bookended by what was perhaps the coldest year.

But in the spring of AD 1859, the weather would not be merciful on the poorly supplied farmers. Although every farmer could clearly see that they had too little hay for their sheep herd if the winter grew so severe that they were compelled to wintering of their flock, they, or we, as I was inclusive, put to hazard, and butchered far too few sheep... on the 24th of April, 1859, and to increase our mischief and calamities in this tremendous winter, the ice (Greenland Ice) surrounded the whole north, east, and west part of our island, and covered the ocean as far as one could see from the hilltops adjacent to the seashore. Of course we were obliged to feed our beasts as long as we had food in possession, but it was rather too early consumed,
for early in March, many of the farmers had no hay left but for their cows. Some of them, therefore, drew their hungry sheep to the benevolent farmers that had enough food yet... I wandered every day to the bushes, and carried on my back great bundles of the small branches trying to support my remanent [sic] flock, but it could not help them, I lost them every day, and when this ever memorable winter was ended, I had lost 65 sheep and goats and owned yet 25. (Jónsson, 1968, p. 109–10)

Jón Jónsson’s version of events conveys the conflicting incentives of herders: to keep their flocks as large as possible through winter to maximize production, but to also feed them sufficiently on limited fodder supplies. By his account, approximately three quarters of his family’s sheep were lost that year and thus significant wealth. Critically, Jónsson also notes that his was a loss of capital and trade value but did not mean, in that year, that his family might starve (1968, p. 110). During severe cold in the 1880s however, many Icelanders did starve and many others emigrated to North America (Edwald, 2012a). Jón Jónsson’s account epitomizes how farmers in Mývatnssveit, and surely in Iceland more broadly were challenged with growing their herds in pursuit of prosperity while dealing with local environmental conditions that could be limiting for some people and fatal for others.

It is evident that sheep herd maximization in an unpredictable climate created risk of losses that could rapidly intensify. Farmers culled their sheep in the fall to adjust for the amount of had they had for overwintering. The more sheep that were overwintered in relation to available hay, the more likely it would be that the farmer would run out of hay if a long winter followed. Keeping large numbers of sheep was good for the contemporary trade economy and allowed farmers to acquire cash as well as an expanding range of imported goods. But maximization was risky and created instability. At this time, farmers in the district innovated
strategies to manage the social and ecological complexities of hay use.

**Managing Hay and People**

In his writings, Jónsson mentions two community strategies around the overwinter foddering predicament. One was the lending of hay by benevolent farmers which suggests some degree of community solidarity and possibly the use of common hay stores as a buffer; this was not a new practice. Jónsson also mentions a new custom by which farmers, representing the community, inspected livestock numbers at the hreppur’s farms and compared herd sizes to precise measurements of hay in storage. These inspections and the resulting reports seem to signal a new approach to the management of production within the community. These fodder inspection records are additionally interesting owing to the fact that they represent a site of intersection of economic intensification, shifting social institutions, and the environment.

These records of hay and animals produced in the Skútustaðir district after the mid-1800s were called hay portioning reports (*Hey Ásetning Skýrslur*) or fodder inspection reports. Two inspectors, farmers selected from the among community, typically made rounds and documented the precise livestock holdings of each farmer. In many cases, a few heads of households were in residence at one farm. The inspectors documented their mass of hay in storage meant for overwinter feeding (units used were Vættir where 1 equaled 80 pounds). Amid this period of apparent risk taking in winter foddering practices for potential economic gains, the hay portioning reports were created to encourage farmers to cull their herds and plan their winters of foddering according to perceived norms.
The hay reports represent a combination of traditional knowledge practices and legal structures (responsible property and commons management, and communal mitigation of individual misfortunes) dating back to early medieval times fused with newly introduced knowledge production systems of the enlightenment-era: systematic recording, measurement, and synthesis. These were a part of novel natural knowledge practices and record-keeping in post 18th century Iceland aided by increasing literacy and widely available paper replacing expensive vellum (Magnússon, 2010). My archival research on the documentation of these records indicates that this practice was a supervisory innovation and community-wide. It seems that hay and livestock information for supervision was first set by the community, and then became a widespread law in Iceland. A label on the archived reports describes: “Hay Portioning Reports and other plans for devastating shortages in Skútustaðahreppur from 1863 and past the turn of the century before the legalizing of fodder inspections” (Reports E 87 6).

I reviewed archived fodder inspection reports as well as written trade records with kind permission of the Húsavík Museum and Culture House in August of 2012, and they are cited by their archive catalog numbers.

The hay reports were originally made in table form so that information could be understood on the level of the individual farmer (or farm) or added together to understand production at the level of the collective. The farm names are displayed here with resident farmers replaced by numbers, for example, there are two farmers residing at Garður, labeled as Garður 1 and Garður 2. The columns are labeled with various categories of owned animal and hay assets. Not all hay portioning reports
were organized in precisely the same manner. In addition to seeing how the community coped with a predicament, significant change in herding strategies can be observed through the consideration of the archaeological and archival record of past sheep management against the information in the fodder inspection reports.

Fodder inspection reports performed and embodied a new administrative function via the creation of visibility into each farmer’s practice. The technical documents conveyed information and opened possibilities for intervention, governance, or corrective action and thus their production inscribed a power difference between the agents of collective norms (the inspectors, community leaders) and individual (potentially divergent) farmers. But the social regulation of fodder usage and animal management was not always firm nor successful. There were documented instances that tell us that some farmers disagreed with such surveillance. One inspection report notes that a farmer declined the inspection (Report E 87 6 1889). Another inspector’s note tells us that sheep and hay were not always accurately countable and therefore they were forced to trust the farmers words regarding animals not seen (Report E 87 6 1896). These notes reflect two takes on the tensions between farmers and inspectors – that there was at least one dissenter who staunchly preferred to keep their autonomy and that ultimately inspectors declined to press the issue of verifiable information collection if it was perceived or regarded as invasive.

**Changing Livestock Management**

There are traces of the intensification of the sheep economy in the zooarchaeological record and archival records and these were more broadly
discussed in Chapter 6 dealing with archaeofaunal analysis. During the late 19th century, the sheep economy changed at an almost an inter-decadal scale. Hay reports and trade records, in addition to making evident the challenges and developments around sheep herding intensification, illuminate shifting herding strategies. This includes evidence of the reorganization of sheep production as foundational to contexts of trade and labor arrangements on farms.

The ratio of sheep bones to cow bones increases somewhat between the 17th-18th centuries and the post 1850 archaeological contexts. But there are some complications that make the material record potentially unrepresentative of total production. Live-sheep export to Britain became common by the 1870’s – a rupture in Danish trade (Karlsson 2000, 244), and one would expect this to leave no trace. So the written records of production become important in addition to the archaeofaunal record. Iceland’s statistical register (Tölfræðihandbók 1984, 70) (Figure 20 in Chapter 6) shows a dramatic increase in the number of sheep kept in the Northeast of Iceland: in AD 1703 there were 43,596, by AD 1821 there were 76,759, and AD 1900 there were 86,233 kept among the region’s farms. The fodder inspection reports convey slightly more detailed herd demography information which highlights production strategies in addition to foddering practices.

According to the 1882 fodder report, the Mývatn area mean cow to sheep ratio would have been 1:87. Ninety five percent of living domesticate livestock were sheep, 4 percent were horses and only 1 percent were cows. In some cases, reports mention fractions of cows owned among 2 or 3 poorer farmers or farmhands. This low emphasis on cows should probably be described as subsistence-level
production of milk, butter, and skyr (a yogurt-like cheese). In AD 1889, farmers in the district with the most cattle had a maximum number of five per household. Further, it appears that only Mývatn farmers who were generally flush with resources (seen in overall numbers) could afford to keep cattle other than milkers (and those more rare cattle were steers and calves). The popular farming strategy overwhelmingly prioritized sheep across the board and cattle were kept only after a certain number number of sheep were secured.

<table>
<thead>
<tr>
<th>Farm &amp; Occupant</th>
<th>Hay</th>
<th>Cow</th>
<th>Horse</th>
<th>Sheep</th>
<th>Hay</th>
<th>Cow</th>
<th>Horse</th>
<th>Sheep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geiteyarströnd 1</td>
<td>170.0</td>
<td>1.0</td>
<td>4.0</td>
<td>90.0</td>
<td>140.0</td>
<td>1.0</td>
<td>3.0</td>
<td>80.0</td>
</tr>
<tr>
<td>Geiteyarströnd 2</td>
<td>100.0</td>
<td>1.0</td>
<td>2.0</td>
<td>50.0</td>
<td>85.0</td>
<td>1.0</td>
<td>2.0</td>
<td>48.0</td>
</tr>
<tr>
<td>Geiteyarströnd 3</td>
<td>160.0</td>
<td>1.0</td>
<td>3.0</td>
<td>70.0</td>
<td>60.0</td>
<td>1.0</td>
<td>3.0</td>
<td>50.0</td>
</tr>
<tr>
<td>Geiteyarströnd 4</td>
<td>54.0</td>
<td>0.0</td>
<td>1.0</td>
<td>20.0</td>
<td>30.0</td>
<td>0.0</td>
<td>1.0</td>
<td>14.0</td>
</tr>
<tr>
<td>Kálfaströnd 1</td>
<td>650.0</td>
<td>3.5</td>
<td>5.0</td>
<td>260.0</td>
<td>400.0</td>
<td>3.0</td>
<td>5.0</td>
<td>230.0</td>
</tr>
<tr>
<td>Garður 1</td>
<td>630.0</td>
<td>3.0</td>
<td>9.0</td>
<td>220.0</td>
<td>380.0</td>
<td>2.0</td>
<td>8.0</td>
<td>220.0</td>
</tr>
<tr>
<td>Grænavatn 1</td>
<td>700.0</td>
<td>2.3</td>
<td>11.0</td>
<td>270.0</td>
<td>360.0</td>
<td>2.0</td>
<td>11.0</td>
<td>210.0</td>
</tr>
<tr>
<td>Grænavatn 2</td>
<td>366.0</td>
<td>1.3</td>
<td>5.0</td>
<td>128.0</td>
<td>220.0</td>
<td>2.0</td>
<td>5.0</td>
<td>86.0</td>
</tr>
<tr>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Grænavatn 4</td>
<td>130.0</td>
<td>1.3</td>
<td>3.0</td>
<td>60.0</td>
<td>95.0</td>
<td>0.0</td>
<td>3.0</td>
<td>50.0</td>
</tr>
<tr>
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<td>400.0</td>
<td>0.2</td>
<td>13.0</td>
<td>130.0</td>
<td>320.0</td>
<td>3.0</td>
<td>11.0</td>
<td>80.0</td>
</tr>
<tr>
<td>Skútustaðir 2</td>
<td>600.0</td>
<td>3.0</td>
<td>8.0</td>
<td>260.0</td>
<td>370.0</td>
<td>2.0</td>
<td>6.0</td>
<td>180.0</td>
</tr>
<tr>
<td>Álfagerði 1</td>
<td>240.0</td>
<td>1.3</td>
<td>4.0</td>
<td>100.0</td>
<td>130.0</td>
<td>1.0</td>
<td>3.0</td>
<td>65.0</td>
</tr>
<tr>
<td>District total</td>
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<td>68.0</td>
<td>1658.0</td>
<td>2590.0</td>
<td>18.0</td>
<td>61.0</td>
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</tr>
<tr>
<td>District mean</td>
<td>323.0</td>
<td>1.5</td>
<td>5.0</td>
<td>128.0</td>
<td>199.0</td>
<td>1.4</td>
<td>5.0</td>
<td>86.0</td>
</tr>
</tbody>
</table>

Note: Hay is measured in vættir (vt.), 1 vt. = 80 pounds.
Fodder Inspection Reports of Skútustaðir’s district (Icel. Hey Ásetning Skýrsla og Ásetning Skýrsla Skútustaðahreppur) Húsavík Museum and Culture House, Archive E 87 6 1882. Þingeyjarsýsla District Archives. Information reproduced with permission.
### Table 11

**Skútustaðir District 1889 Livestock Count and Hay Resources**

<table>
<thead>
<tr>
<th>1889</th>
<th>Livestock</th>
<th>Hay</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Milk Cows</td>
<td>Steer</td>
</tr>
<tr>
<td>Farm Name</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Garður 1</td>
<td>1.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Garður 2</td>
<td>1.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Grænavatn 1</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Grænavatn 2</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Grænavatn3</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Kálfaströnd</td>
<td>3.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Geiteyjarströnd 1</td>
<td>1.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Geiteyjarströnd 2</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Vogar 1</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Skútustaðir 1</td>
<td>2.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Skútustaðir 2</td>
<td>2.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Álftagerði 1</td>
<td>1.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Álftagerði 2</td>
<td>0.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Álftagerði 3</td>
<td>0.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Álftagerði 4</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>District Total</td>
<td>20.0</td>
<td>6.0</td>
</tr>
<tr>
<td>District Mean</td>
<td>1.3</td>
<td>.3</td>
</tr>
</tbody>
</table>

Note: Hay is measured in vættir (vt.), 1 vt. = 80 pounds. Information from the Fodder Inspection Reports of Skútustaðir’s district (icel. Hey Ásetning Skyrsla og Ásetning Skyrsla Skútustadæðarpreppur) Húsavík Museum and Culture House, Archive E 87 6 1889. Þingeyjarsýsla District Archives. Information reproduced with permission.

In the late 19th century, ewes were the majority of sheep, followed by lambs, then wethers (castrated males, which were kept for wool). Rams (reproductive males) were not noted and were likely extremely rare when compared to ewes, as they are often aggressive and difficult to manage. Ewes were utilized for milk and
for birthing lambs which were sold live, used for meat, skin and fat, or brought to maturity to replace aging adults for secondary production (dairy, textiles, and reproduction). In his diary, Jón Jónsson’s describes that ewes were milked in the Mývatn area still in the mid-1800s but the practice then died out in the late 19th century. Guðmundur Jónsson has suggested that a decline in servant farmhand labor partially explains a shift away from wool and milking to live sheep and mutton production during the late 19th century (1993).

The AD 1896 hay report reproduced in Table 12 includes information on proportional use of hay for various categories of livestock. Three columns note the hay amounts allotted for each species. Although sheep made up 96 percent of animals owned in the district, they were allocated only 79 percent of winter fodder in storage.
Table 12

Skútustaðir District 1896 Hay Count and Planned Distribution Per Livestock Type

<table>
<thead>
<tr>
<th>Farm Name</th>
<th>Infie ld</th>
<th>Outfie ld</th>
<th>Cattl e</th>
<th>Hors es</th>
<th>Shee p</th>
<th>Co ws</th>
<th>Ste er</th>
<th>hors es in use</th>
<th>yun g hors es</th>
<th>Full grown shee p</th>
<th>Lam bs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geiteyarstr önd 1</td>
<td>44.0</td>
<td>286.0</td>
<td>60.0</td>
<td>40.0</td>
<td>230.0</td>
<td>1.0</td>
<td>0.0</td>
<td>2.0</td>
<td>1.0</td>
<td>90.0</td>
<td>40.0</td>
</tr>
<tr>
<td>Geiteyarstr önd 2</td>
<td>40.0</td>
<td>320.0</td>
<td>80.0</td>
<td>60.0</td>
<td>220.0</td>
<td>1.0</td>
<td>1.0</td>
<td>3.0</td>
<td>1.0</td>
<td>79.0</td>
<td>58.0</td>
</tr>
<tr>
<td>Kálfaströnd</td>
<td>510.0</td>
<td>0.0</td>
<td>200.0</td>
<td>35.0</td>
<td>275.0</td>
<td>3.0</td>
<td>1.0</td>
<td>3.0</td>
<td>1.0</td>
<td>92.0</td>
<td>68.0</td>
</tr>
<tr>
<td>Garður 1</td>
<td>50.0</td>
<td>310.0</td>
<td>100.0</td>
<td>40.0</td>
<td>220.0</td>
<td>2.0</td>
<td>0.0</td>
<td>3.0</td>
<td>2.0</td>
<td>72.0</td>
<td>44.0</td>
</tr>
<tr>
<td>Garður 2</td>
<td>0.0</td>
<td>70.0</td>
<td>0.0</td>
<td>0.0</td>
<td>70.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>17.0</td>
<td>17.0</td>
</tr>
<tr>
<td>Garður 3</td>
<td>0.0</td>
<td>80.0</td>
<td>0.0</td>
<td>1.0</td>
<td>70.0</td>
<td>0.0</td>
<td>0.0</td>
<td>1.0</td>
<td>0.0</td>
<td>19.0</td>
<td>13.0</td>
</tr>
<tr>
<td>Grænavatn 1</td>
<td>70.0</td>
<td>860.0</td>
<td>160.0</td>
<td>140.0</td>
<td>630.0</td>
<td>2.0</td>
<td>2.0</td>
<td>6.0</td>
<td>2.0</td>
<td>175.0</td>
<td>115.0</td>
</tr>
<tr>
<td>Grænavatn 2</td>
<td>50.0</td>
<td>670.0</td>
<td>180.0</td>
<td>90.0</td>
<td>450.0</td>
<td>3.0</td>
<td>1.0</td>
<td>5.0</td>
<td>3.0</td>
<td>158.0</td>
<td>83.0</td>
</tr>
<tr>
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<td>0.0</td>
<td>180.0</td>
<td>0.0</td>
<td>28.0</td>
<td>150.0</td>
<td>0.0</td>
<td>0.0</td>
<td>1.0</td>
<td>1.0</td>
<td>42.0</td>
<td>34.0</td>
</tr>
<tr>
<td>Grænavatn 4</td>
<td>0.0</td>
<td>53.0</td>
<td>0.0</td>
<td>19.0</td>
<td>34.0</td>
<td>0.0</td>
<td>0.0</td>
<td>1.0</td>
<td>0.0</td>
<td>10.0</td>
<td>7.0</td>
</tr>
<tr>
<td>Skútustaðir 1</td>
<td>20.0</td>
<td>380.0</td>
<td>100.0</td>
<td>80.0</td>
<td>220.0</td>
<td>1.5</td>
<td>0.0</td>
<td>4.0</td>
<td>1.0</td>
<td>85.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Skútustaðir 2</td>
<td>40.0</td>
<td>520.0</td>
<td>110.0</td>
<td>50.0</td>
<td>400.0</td>
<td>2.0</td>
<td>0.0</td>
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<td>100.0</td>
<td>63.0</td>
</tr>
<tr>
<td>Skútustaðir 3</td>
<td>40.0</td>
<td>320.0</td>
<td>120.0</td>
<td>60.0</td>
<td>180.0</td>
<td>1.5</td>
<td>1.0</td>
<td>3.0</td>
<td>0.0</td>
<td>42.0</td>
<td>51.0</td>
</tr>
<tr>
<td>Skútustaðir 4</td>
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<td>70.0</td>
<td>0.0</td>
<td>0.0</td>
<td>70.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>19.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Álftagerði 1</td>
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<td>75.0</td>
<td>20.0</td>
<td>115.0</td>
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<td>0.0</td>
<td>1.0</td>
<td>0.0</td>
<td>40.0</td>
<td>19.0</td>
</tr>
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<td>142.0</td>
<td>0.0</td>
<td>40.0</td>
<td>110.0</td>
<td>0.0</td>
<td>0.0</td>
<td>2.0</td>
<td>1.0</td>
<td>36.0</td>
<td>25.0</td>
</tr>
<tr>
<td>Álftagerði 3</td>
<td>8.0</td>
<td>92.0</td>
<td>0.0</td>
<td>18.0</td>
<td>82.0</td>
<td>0.0</td>
<td>0.0</td>
<td>1.0</td>
<td>0.0</td>
<td>24.0</td>
<td>17.0</td>
</tr>
<tr>
<td>Háganes</td>
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<td>250.0</td>
<td>70.0</td>
<td>30.0</td>
<td>200.0</td>
<td>1.0</td>
<td>0.0</td>
<td>2.0</td>
<td>1.0</td>
<td>80.0</td>
<td>40.0</td>
</tr>
<tr>
<td>District Total</td>
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<td>4803.0</td>
<td>1255.0</td>
<td>751.0</td>
<td>3726.0</td>
<td>19.0</td>
<td>7.0</td>
<td>41.0</td>
<td>14.0</td>
<td>1180.0</td>
<td>721.0</td>
</tr>
<tr>
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<td>2.7</td>
<td>69.7</td>
<td>41.7</td>
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<td>1.0</td>
<td>.4</td>
<td>2.3</td>
<td>2.2</td>
<td>65.5</td>
<td>40.0</td>
</tr>
</tbody>
</table>

Around the farms (in non-upland areas) there were both enriched infield sources of hay (*taða*) as well as expansive hayfields on the outer fringes which were outfield hay sources (Icel. *úthey* and *engjahey*). The infield hay was carefully guarded. Jónsson remarks “the hay of these [fertilized infields] is solely appointed for winter food for the milk cows, as it is the best hay which the peasants can get in their barns” (1968, p. 102). However, it is clear that outfield hay was the more important hay source in terms of volume. The wealthiest farms in the region at this time were those rich in outfield hay. It was typical for this category of hay to be noted separately from others in farm valuations as it had direct implications for the economic potential of the farm. The two best-stocked farms, Grænavatn and Skútustaðir, were located directly on the expansive wetland hay meadows that extend to the south of Lake Mývatn. Due to their direct proximity, they perhaps had disproportionate rights to the land where reaping plots were carefully divided among farms. During the middle of the 19th century, the wetland meadows were opened up to all Mývatn farms, where they had previously only been used by the southern Mývatnssveit farms within the historical limits of Skútustaðahreppur (the southern municipality), many of which encircle the meadows.
Figure 37. Hay in storage by type in the district of Skútustaðir 1896. Hay is measured in vættir (vt.), 1 vt. = 80 pounds. The data are derived from the 1896 Fodder Inspection Report of Skútustaðir district (Icel. Heyásætning. Skýrsla og Ásætning. Skýrsla Skútustaðahreppur) Húsavík Museum and Culture House, Þingeyjarsýsla District Archives (Archive E 87 6 1896). The hay from Kálfaströnd is not specified by type due to refusal of inspection. Information was researched by the author (Hicks, 2014). Data reproduced and shared with permission of the Húsavík Museum and Culture House.

Subsequent collaborative investigations carried out after this initial research have uncovered details about the changing vegetation management that supported sheep increases. Research on hay infield sizes through time by Árni Daniel Júlíusson reveals that outfield hay production (in the wetlands) was responsible for productive increases rather than infield hay production- as infield haymaking areas maintained the same sizes roughly throughout this period. Research by Ragnhildur Sigurðardóttir has documented that framengjar wetland interventions like ditching and draining maintained particular types of desired sedges for fodder (See
Sigurðardóttir 2016; Hicks et al., 2017). Archaeological pollen analysis by Eileen Tisdall and Rebecca Barclay has found evidence for the expansion of wetland sedges and grass species in early modern times (see Barclay, 2016).

In the early 19th century increases in sheep seem to be in the category of wethers for wool production (Karlsson, 2000). However, later in the 19th century, herding practices were geared increasingly toward keeping ewes for the production of live sheep for sale and later mutton, while the keeping of wethers for wool apparently declined over the late 19th and early 20th centuries. Sheep milking also declined according to Jónsson (1968). It is possible that during the last three decades of the 19th century, the farming community experienced a drain on labor affecting Mývatnssveit and other rural, inland areas caused by coastal urbanization and changing laws that dissolved the mandatory servant labor system. Guðmundur Jónsson notes that rural Icelanders may have shifted production away from labor-intensive wool and milk production strategies toward less labor-intensive live sheep and mutton production strategies (Jónsson, 1993).

Beyond labor, the shifting social institutions around herding included new contexts of free trade. Cash compensation for animal products and commodities and free trade became common and feasible after 1855 along with increasing opportunities to mobilize cash and credit for a widening variety of imported goods and toward saving and lending (Jónsson, 1968, p. 108; Sigurðsson, 2002).

**Trade and Transformaiton**

Danish Trade Monopoly restrictions first were reduced in 1786, after the 1783 eruption of the Láki craters and subsequent severe famines that followed.
Following those years, the Danish Crown had no further economic interest in Iceland, but maintained a cultural interest as well as a need to demonstrate that it would not compromise on various territorial claims (Karlsson, 2000). In 1845 Iceland was allowed to form its own assembly representing the population of around 60,000 people, which was a significant assertion of growing separation from Denmark and part of a broader nationalist movement which included the appointment of Jón Sigurðsson as the island’s political leader. Then, in 1873 the Alþingi petitioned for an Icelandic constitution, though Iceland would remain part of the Danish state for another century.

Despite the easing of Danish royal authority over Iceland’s internal finances, Danish trade firms continued to run trade in Iceland almost exclusively and even by the late 1800s there were still no trade firms run by Icelanders (Karlsson, 2000, p. 244). In 1809 the British tried and failed, to secure regular trade with Iceland (Karlsson 2000, p. 195). In 1851-55 legislation allowed non-Danish traders access to Icelandic markets, and this legal shift was put into action in 1870 when live sheep trade with Britain began.

Another landmark event occurred when the first Icelandic trade cooperative was formed in Húsavík in 1882 - the trade port relevant to Mývatnssveit. The Kaupfélag Pingeyinga was led by Jacob Hálfdánarson of Grímsstaðir in Mývatnssveit and Benedikt Jónsson from Auðnir in Laxárdalur (a neighboring valley) who introduced the idea that trade in Iceland should not be a limited privilege governed by outsiders to the community (Karlsson, 200, p. 246). As the first Icelandic run trade firm it disrupted the hegemony Danish merchants in that harbor, while
promoting better rewards and organizing purchasing power to supply imported products such as grain, flour, coffee, sugar, tobacco, pipes, salt and lamp oil. The Icelandic Kaupfélag was apparently inspired by the Cooperative Movement in England spearheaded by Robert Owen, a pioneering utopian socialist industrialist. Owen had promoted the shift in power from wealthy industrial capitalists to rural collectives, believing the latter should have autonomy over production and purchasing. Owen implemented this social model through his own investments in early 19th century England, but the model had broad impacts, for example it became a touchstone of the socialist movement in North America. Owen’s ethos translated to Iceland in that the Kaupfélag Þingeyinga was guided by a committee of farmers, some from the Mývatn area who extended the benefits of collaborative purchasing (lending and financing) to the rural community. The Kaupfélag Þingeyinga (Purchase Association of Þingeyjarsveit) pursued international markets and agents for commodity exports including live sheep to Britain and offered cash and credit
where previously trade was limited to barter.

Figure 38. The building in the foreground is the storehouse of the first free trade association in Húsavík, Northern Iceland. The Kaupfélag Pingeyinga served the Mývatn region and other nearby municipalities. Photo taken in 1907-1910 by Eiríkur Þorbergsson.

In 2012, I reviewed Kaupfélag trade account booklets at Skútustaðir from AD 1893 and AD 1894 in order to better understand the forms of sheep commodities and products entering the market (Archive E 1000 12 1893–1897). They reveal that the live sheep export trade earned farmers the most cash and exchange credit, though wool and mutton were still commonly noted. Overall, sheep products dominated, while butter - probably from cows - rarely appears. Another rare but semi-regularly traded animal product was hunted ptarmigan.

In AD 1893 goods and services traded into the store by the wealthiest farmer in the district totaled 893.19 krónur for the year. Various wool products made up 40
percent of the traded goods, live sheep accounted for 44 percent and represent the most valuable exchange category. About 1 percent of the earnings were from butter and lambskin (the remaining portion of 15 percent represents services and illegible items). The 21 sheep he sold were valued at a total of 392.64 krónur, or 18.69 kronur per sheep. On the other side of the wealth spectrum in Skútustaðahreppur, a poorer farmer’s accounts in 1893 totaled 21.20 krónur of credited goods contributed to the cooperative. Meat accounted for 30 percent (6.44 krónur) of this amount, 47 percent for wool (10.16), 14 percent for fat (3.00), and the remaining amount, equivalent to less than one percent of a good or service that is illegible (1.60 krónur).

At some point between 1900 and 1920, sheep listed in the sales registers from the Skútustaðir division go from being listed as Sauðfjé (sheep) to Sláturffjé (slaughter-sheep) (e.g. Archive E 1000 6) which might indicate that the latter went to the slaughterhouse before export and thus signals a shift toward mutton rather than live sheep sales. Wool was still being sold into the cooperative at a lower total value than sheep for meat. Viewing the cash trade in live sheep, and other sheep products at a granular level especially under the Kaupfélag and new regimes of rural production helps contextualize the disruption of Danish trade at the transition to the free market capitalist system (see also Karlsson, 2000, p. 224; Report E885; Þórhallsdóttir et al., 2013).

Discussion

At its foundation, this chapter has detailed how household-level herding, specifically sheep production practices, and their local ecologies constituted an
important part of the transition from the Danish colonial system toward an early free market capitalist system over the 19th century. While doing so I have tried to center the agencies of the Mývatn community and transformation of their local ecologies in the transition to rural capitalism.

Despite significant climatic variability, the Mývatn community expanded sheep production over the first half of the 19th century and sustained the expansion throughout the century apart from a few years impacted epizootic disease and variable cool climate. Over the first decades of the 19th century sheep numbers were almost doubled as rural communities increasingly produced wool for markets (Karlsson, 2000). Then, increases were maintained from the 1870s onward and they likely supported both live sheep markets and mutton markets that replaced a focus on wool.

As the rural Mývatn community scaled up production, they encountered and negotiated the limits of the productive capacities of their local environment including the variability of the arctic climate and its impact on grass growth. Despite experiencing limitations, the farming community dramatically increased hay production and managed variability and social tensions through the application of new cultures of natural knowledge toward resource management and economic supervision. Hay reports reviewed in this chapter have informed in two ways. They provide detailed evidence of the booming sheep economy in the last half of the 19th century. Second, the reports themselves are symptomatic of changing ways of seeing and understanding nature. Hay reports mobilized traditional localized knowledge via the newly introduced forms of record keeping. They abstracted and synthesized
information used to scrutinize individual practices or collective productivity in the region. The reports were therefore were a potent informational modality (among many being used at that time) that would have been uncommonly applied by Icelanders before the late 18th and 19th centuries. The new scientific technical formats brought in to rural agricultural production in Iceland were adopted from Danish colonial enlightenment era economic culture and make evident one of the cultural and technological aspects of Iceland’s rural modernization.

Other important sociopolitical shifts were entangled with modernizing and intensifying rural sheep husbandry. The access to cash and the introduction of free trade manifested as live sheep sales to Britain, and the formation of the local free trade association. Additionally, the servant famhands who resided in the community may have increasingly decided to leave for towns or other countries as laws governing them relaxed suring the last two decades of the 19th century. This would have reduced available effort for the creation of labor-intensive commodities and products that were previously central including both wool and sheep’s milk, while at the same time live sheep and mutton for cash were ascending commodities.

This account of a rural transition to capitalism is not intended to be a simple story of progress, but instead to contribute complexity. Prosperity associated with the new system was not a uniform experience. As other scholars have noted, a new and growing class of urban free laborers went on to experience precarity in employment in new coastal enterprise in the ensuing decades (e.g. Lucas & Hreiðarsdóttir, 2012). On the other hand, well supplied households like Skútustaðir may have experienced an increase in self-determination due to the fact that trade
was now administered by peers—local representatives of the propertied farming class. This seems to have granted them direct access to markets and cash as well as some degree of local political determination of trade. As landowning herders, working from private property in a cash market, the Skútustaðir household and its community had ónsson

joined a growing global category of “ranchers” – herders within the capitalist system (Chang & Koster, 1994). Through the management and commodification of their local “natures” and the newly won access to direct exchange contexts, the Mývatn community and their local ecologies entered a rapidly changing and increasingly connected Atlantic capitalist scene.
Chapter 9. Humans and Birds in Mývatnssveit

In previous chapters, I have detailed how evidence for the use of livestock, birds, and fish at Skútustaðir shines light on the engagement of rural communities in Iceland’s colonial and capitalist economies between the 17th and early 20th centuries. As markets grew over the 19th century, Icelanders sought to intensify certain modes of production. Sheep and cod were central as commercial resources, but a look at regional scale practices reveals local responses to commercial incentives that extended to wild species like grouse and Salmonidae as well. The arrival of free markets, banking, cash, and credit involved significant reframing of animals, ecologies, and peoples’ labor. More and more Icelanders became urban free laborers and ranchers - farm-owning sellers of livestock products in free markets (Jónsson, 1993).

In this chapter, I present a contrasting case study of the use of wild resources local to Mývatn; waterfowl and their eggs did not become part of intensifying commercial interactions. Using archaeofaunal analysis, microscopy, and historical sources, I describe a bird conservation strategy governed by a millennium of dense local traditional knowledge. The relevance of this conservation-oriented system around waterfowl and their eggs lies in its contradiction to the practices of commodification in emerging capitalism. It is therefore useful for putting commodification into perspective as just one manner of “value-making” (Tsing, 2014) and not a universal logic. We can also see that commodification was not a total or uniform outcome of the economic transformations of Iceland’s rural places. There were parts of local communities and ecologies that resisted commodification.
and some local ecologies had inherent limitations that could be more powerful than potential economic incentives.

**Background**

The lake Mývatn and watershed is internationally known for the species diversity and number of birds it supports; especially waterfowl: ducks, geese, swans, phalaropes, and divers. Every summer, tens of thousands of waterfowl migrate to the Mývatn region to breed, most arriving in April and May. The dabbling ducks (*Anas* spp.), the long-tailed duck (*Clangula hyemalis*), and goosander (*Mergus merganser*) are early breeders, while the red-breasted merganser (*Mergus serrator*) is the last to begin nesting. These birds originate in Eurasia and North America, and travel thousands of miles annually to nest, mate, and then fledge their young. The aquatic birds are drawn by the shallow, eutrophic lakes’ food sources including plants, insects, and benthic crustaceans (Gudmundsson, 1979). The density of birds – especially waterfowl- make it an unusual ecology both globally and in Iceland. Owing to the globally-important bird breeding grounds and the diverse geology, the Mývatn watershed is a recommended UNESCO world heritage site.

While nesting in the Mývatn region, birds build nests in a variety of locations near the lake and rivers. Some prefer tall grasses at the water’s edges while other species prefer the islands in the lake. The Barrow’s Golden eye nests in holes in the lava or boxes and lean-tos built for them by farmers. The Anatidae species nest on the ground and several species nest colonially. As egg laying periods vary between species as well as between conspecifics the total harvesting season is about five weeks. In contemporary times, each nesting area is visited for egg collection by
members of households seven to eight times, at about four- to six-day intervals (Guðmundsson, 1979). The majority of waterfowl species leave in the autumn to return to Eurasia and North America and populate ecosystems there.

These globally-critical waterfowl habitats exist within the human social and economic environment. Since the first human settlement in the 9th century, people have enveloped birds’ nesting grounds within Mývatn’s farming landscapes, infrastructures, and their subsistence needs. It is estimated that around 10,000 eggs are harvested each spring, which is considerably less than was harvested in the mid-twentieth century (Garðarsson, 1979). Archaeological excavations in Mývatnssveit have turned up masses of crushed but well-preserved bird egg shell in midden deposits, indicating that intensive, seasonal collection of bird eggs took place regularly since the settlement period (McGovern et al., 2006).

The work presented here extends the timeline of previous studies. McGovern et al. (2006) focused on Viking Age archaeological material. This iteration introduces a new method for the identification of archaeological egg shell, and includes ethnohistorical and scientific information to uncover the local practices that conserved these wild bird populations. The discussion then places these practices into perspective.

Among other goals, this work presents an example of Local Traditional Knowledge. Local traditional knowledge (LTK) is produced by local communities of embedded practitioners, with a long-term relationship to a particular place. This definition of LTK provides a distinguishing but not overly binary contrast to
modern, western, scientific practice which is often exercised by people foreign to the ecosystems they formally study for comparatively short duration.

In recent decades, an increasing number of academics and applied scientists have prioritised joining their academic pursuits with LTK for the purpose of understanding environmental change and for achieving much more robust long-term perspectives on human and resource interactions. Considerable effort in the past decade has integrated professional and local efforts in the circumpolar north to bridge communication gaps and to share data (e.g. Gearheard et al., 2010; Krupnik and Jolly, 2002; Kruse et al., 2004; Pulsifer et al., 2012). But there is also much to be gained including the improvement of contemporary resource management strategies (Berkes et al., 2000; Peloquin and Berkes, 2009; Thornton & Maciejewski Scheer, 2012). Understanding critical environmental variables like sea ice thickness and changing animal migratory patterns requires an expansion of time-scales, lexicons, observational modes, and questions beyond western modalities (Cochran et al., 2013; Huntington et al., 2011). In Mývatnssveit, interdisciplinary work like this contributes to the understanding of how people and their subsistence modes, including dense knowledge systems, have conserved a globally-relevant bird breeding habitat.

**The Identification of Archaeological Bird Egg Shell**

As part of this research, a collaborative team was formed to develop a new and improved method for the identification of archaeological bird egg shell to the level of bird species (see Hicks et al. 2016). That method is summarised in the methodological chapter in addition, a more detailed, a manual style guide is
forthcoming. The research presented and discussed here is the result collaboration (2013-present) between the author, Dr. Árni Einarsson, who has led the ecological research of the Mývatn Science Station, and Dr. Kesara Anamthawat-Jónsson, professor of biology, and sponsor/director of the scanning electron microscopy (SEM) laboratory of the University of Iceland.

Identification of eggshell to the species level involves a detailed comparison of archaeological eggshell micromorphology to that of a reference collection. For this we created a reference collection of SEM micrographs of the inner surfaces of eggshells – showing the mammillary knobs and cones (as seen in Chapter 5, Figure 12), because the inner surfaces of the egg shell are more topographically complex that the outer surfaces. Images of the archaeological samples were compared to reference material at the same levels of magnification. For identifications, I centered on three characteristics: (1) the number of mammillae per area (spatial density) from SEM micrographs (2) the qualitative morphological features of the inner eggshell surface (3) the cross-section thickness of the eggshell fragments. The degree of visible mammillary absorption was also noted. Mammillary absorption refers to the uptake of material from the mammilla into the developing embryo and results in a pitted or concave appearance of mammillae. It corresponds to the development of bird embryo within the egg through the incubation period (see Beacham & Durand, 2007). Thoroughly absorbed mammillae denote eggs that were collected with developed embryos. In this study, mammillary absorption was scored 0-4 with zero indicating no visual evidence of absorption.

**Evidence from the Long-Term Archaeological Record of Skútustaðir**
The earliest radiocarbon dates from Skútustaðir attest to initial settlement in the ninth century and cultural deposits lie directly upon the AD c.871 landnám tephra layer. The uppermost midden deposits include both destruction debris of a late nineteenth-century turf farm house and early twentieth-century deposits (Edwald & McGovern, 2009; Hicks et al., 2013, 2014). The Skútustaðir midden deposits thus provide an unusual opportunity to document the full period of human occupation, including the use of wild resources in Mývatnssveit.

The densest layer of eggshell encountered in the Skútustaðir midden was a concentration of fragments extending approximately 2 by 0.5 metres and 1–3 centimetres thick. This was intermingled with animal bones, refuse, and the AD 940 tephra. These extensive eggshell scatters presumably represent seasonal concentrations of intensive egg harvest that correspond with the seasonal breeding in spring and early summer.

The archaeological samples from Skútustaðir are derived from three different archaeological layers. One set of samples (from deposit 161) is derived from directly on the AD 938 tephra and is likely to pertain to the period referred to as the Viking Age. The second sample was recovered from above the 938 tephra and below the 1108/1154 tephra—linking them to the Viking Age or early Middle Ages (deposit 317). The third set of samples (from deposit 167) was recovered between the 1477 tephra and 1717 tephra; this layer contained kaolin pipe stems and thus can be further refined to the early 16th century–1717 (following Mehler, 2002). These samples provide comparison between the Viking Age, and the seventeenth–
eighteenth centuries, which can themselves be compared to the ample record from the twentieth century.

The 10th century context 161 was not well-preserved, but nevertheless yielded diagnostic results. Due to the generally poor state of the specimens from this particular context, the author recommends conservative caution in viewing these results. Deposit 161 contained eggshell fragments of Barrow's golden eye (*Bucephala islandica*) and gadwall (*Anas strepera*), common Anatidae in the region. There were several fragments of Anatidae eggshell that were not identifiable to the level of species but to the level of order. One specimen appeared to be domestic duck (*Anas domestica*), however that named taxon includes members across a broad geography and with notable diversity. It is a species that is difficult to define, so this particular identification remains questionable. Beyond the Anatidae, there were eggs of oystercatcher (*Haematopus ostralegus*) of the order Charadriiformes (gull relatives) which nest commonly in the area. Finally, some examples of the seabird razorbill *Alca torda* were observed. These birds reside on the coast, nesting on rocky cliffs and feeding in the ocean surface, so the eggs will have traveled inland. Jane Sidell, who carried out the first egg shell study of Viking age remains in Mývatn also noted seabird eggs (McGovern et al., 2006). This assemblage of eggshell reveals the common use of Anatidae species, but also suggests that other kinds of wild fowl were used for eggs regularly during the Viking Age. The evidence also reconfirms subsistence connection between the coast and the inland region, also attested by fish bones and mollusk shells found in household middens.
All of the eggshells subsampled from context 161 showed signs of advanced mammillary erosion. None were in the category of 0-1, but all were classes as 2 and 3, the clearly eroded and most severely eroded. Fragments classed at level 3 were not identifiable.

Early middle-ages deposit context 317 contained a diversity of Anatidae. These included the loon (*Gavia stellata*), the Barrow’s golden eye, and the common eider (*Somateria mollisima*). Several fragments were identified as horned grebe (*Podiceps auritus*), another waterbird (of the order Podicipediformes). Horned grebes breed on the edges of small ponds and lakes, in the midst of sedges and grasses, near open water. The presence of grebe eggs in the midden remains speaks to the immediate environs of Skútustaðir farm, which is bordered by two bodies of water: the main basin of Mývatn (called Syðrifloi) and the wetlands to the south called the framengjar. There are a few small pools within the farm boundary as well. Perhaps controversially, one specimen from early Middle Ages context 317 was identified as the tufted duck (*Aythya fuligula*) which is not believed to have nested in Mývatn until the 18th century. Nevertheless, that species was the best match in terms of quantitative and qualitative assessments, though it remains highly questionable. The avian species represented in this context overall indicate a clear emphasis on egg collection from waterfowl in nearby habitats.

Early modern context 167 (17th-early 18th century) contains eggshells of swan (*Cygnus cygnus*) and the Barrow’s golden eye. Barrows golden eye prefer nests in natural cavities and sheltered indentations and have traditionally been enticed to nest in boxes built by farmers in Mývatn. These “nest boxes” may be lean-to type
structures, or bins that are set into the side of barns, homes, and outbuildings. Given this tradition, it is not surprising to see the species so well represented among the fragments from this early modern assemblage.

Also notable is that the mammillary absorption stage of the Barrow's golden eye eggshell fragments (in context 167) tended to be on the lower end, with a score of 0, 1, or 2 – meaning the mammillae are not very absorbed. While swan eggs in the same context exhibited a mammillary erosion of 0-3, denoting that some swan eggs were collected early and some were collected with an embryo inside at perhaps a somewhat advanced stage. Assuming that un-incubated eggs were most desirable, were these more easily gathered from the nests of Barrows golden eye that were known, visible, and easily accessible? Did farmers know when the Barrow's laid eggs, and could they access them at their convenience? Conversely, were swan’s eggs collected sporadically, due to their more reclusive nesting habits, meaning that the eggs might be collected at any stage of incubation? At this stage, these are merely questions not assertions, but the differences in incubation stage between swans and Barrow's golden eye eggs from this deposit might suggest that interactions were structured differently in a temporal sense, possibly as a result of the use of nesting boxes for the latter.

The majority of the identified eggshell fragments from Skútustaðir are from waterfowl. They are overwhelmingly of local species apart from razorbill eggs observed in the earliest deposit studied. There was no evidence of collection of eggs from ptarmigan, the common ground nesting-bird of the region related to grouse.
This emphasis on waterfowl eggs becomes important to understanding the complex, multipart conservation strategy of waterfowl in this region.

**Bird Bone Evidence**

The osteological evidence of killed birds tells a complementary story. Ducks were rarely hunted and this was the second part of a two-part conservation strategy for ensuring continued access to waterfowl eggs. On the other hand, ptarmigans were commonly hunted, and their bones make up the great majority of bird bones from most Mývatnssveit sites (shown in Table 13 below), including the Viking Age contexts at Hríshheimar (HRH), Sveigakot (SVK), and Hofstaðir (HST) (McGovern et al., 2006, McGovern et al., 2010), as well as samples from Skútustaðir (Hicks et al., 2010) extending into modern times. This dichotomy in bird predation patterns between non-migratory upland grouse and migratory lake side waterfowl is consistent throughout all periods, and suggests that these parallel forms of bird management are a fundamental feature of community land and resource use in the region.
As Table 13 indicates, bird bones make up a relatively small proportion of the Mývatnssveit archaeofauna, and on all sites except Skútustaðir the ptarmigan, a heath-nesting bird, was far more common than any other identified birds (unidentifiable fragments were virtually all in the ptarmigan size range). While some waterfowl bones do appear, they make up a very small fraction of the total NISP. These data from bones and eggshells taken together indicate that the hunting of waterfowl was reduced or suppressed in favour of maintaining populations for egg collection.

**Historical and Ethnographic Record**

Documentary sources relevant to wetlands and waterfowl management in Iceland extend back to the thirteenth century but become more common after 1700. These records include both formal administrative documents (law codes such as the 1712 *Jarðabók* farm register) and manuscript records by local farmers, including

### Table 13

*Bird Bone Specimens from Four Mývatnssveit Farms*

<table>
<thead>
<tr>
<th>Sites (all phases)</th>
<th>Waterfowl</th>
<th>Ptarmigan</th>
<th>Other identified bird sp.</th>
<th>Unidentified bird sp.</th>
<th>Total NISP</th>
<th>% bird</th>
<th>% waterfowl</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRH</td>
<td>7</td>
<td>230</td>
<td>0</td>
<td>109</td>
<td>2,782</td>
<td>12.44</td>
<td>0.25</td>
</tr>
<tr>
<td>SVK</td>
<td>22</td>
<td>697</td>
<td>6</td>
<td>462</td>
<td>17,816</td>
<td>6.66</td>
<td>0.12</td>
</tr>
<tr>
<td>HST</td>
<td>9</td>
<td>146</td>
<td>24</td>
<td>160</td>
<td>33,940</td>
<td>1</td>
<td>0.03</td>
</tr>
<tr>
<td>SKU (prelim.2010)</td>
<td>38</td>
<td>4</td>
<td>5</td>
<td>174</td>
<td>2,666</td>
<td>8.29</td>
<td>1.43</td>
</tr>
</tbody>
</table>

Note: Hrísheimar (HRH), Sveigakot (SVK), and Hofstaðir (HST) (McGovern et al., 2006, McGovern et al., 2010). as well as samples from Skútustaðir (Hicks et al., 2010) extending into modern times.
egg harvest counts by species, resolutions of collective management associations, and a wealth of diaries and unpublished poetry, newsletters. Some of these were surveyed by collaborator Águsta Edwald (2012b), and some of these findings are summarized here.

The first textual record in Icelandic legal codes postdates the significant Viking Age archaeological data. Egg collection by tenants and landowners was lawful, but ‘nesting birds [Icelandic: eggversfuglar], no man shall hunt’ says Jónsbók, the law code enacted for Iceland in 1281 and remaining in force until the eighteenth century (Halldórsson, 1904). Jónsbók elaborated earlier Grágás law code regulations which protected the rights of tenants and owners to hunt in their own bird colonies, even when these shared boundaries with neighbours or common land (Dennis et al., 1993; Finsen, 1852). Grágás and Jónsbók rules for bird utilization don’t particularly match the community regulation in Mývatnssveit which involved the killing of very few ducks relative to other animals. The formally-protected status of waterfowl in Mývatnssveit may even predate the known written laws, as suggested by the eggshell and bird bone patterns noted on the Viking Age sites datable to first settlement ca. 877 at Hrísheimar and Sveigakot (McGovern et al., 2006).

Beyond the limited hunting of waterfowl, additional rules guided egg collection. Egg collectors in Mývatnssveit were particularly careful about how many eggs were taken from each nest, in order to not disrupt the nesting or incubation. Incubating adults will abandon the nest if too many eggs are taken. This aspect of conservation is only detectable in the written record, rather than the archaeological
The general practice of collectors leaving several eggs in each nest for adult ducks to incubate is first mentioned in the area in 1862 (Shepherd, 1867), but self-imposed restrictions to harvesting are mentioned some 40 years earlier (Thienemann, 1827).

Twenty-first century scientific studies rediscovered that sensitivity to predation of nesting waterfowl differs according to the number of eggs removed and according to species (Ackerman et al., 2003). Dabbling ducks, for example, are more likely to desert the nest when only three to four eggs remain and less likely to desert when six to seven eggs remain (ibid). It is important to note that successfully nesting females tend to return to their previous nesting locale, whereas nest abandoning birds have a tendency to move to a new site in the following year (Dow & Fredga, 1983; Hepp & Kennamer, 1992). These observations accumulated over multiple seasons may have guided the careful collection of eggs among the Mývatn community, resulting in the development of a layered regulatory knowledge system for over a millennium.

The suppression of non-human predators seems to have also been part of the larger management system. Arctic fox bones are found in Mývatn archaeofaunas, and the find of newborn fox kit bones in contexts between the 877 Landnam and 938 tephra at Hrisheimar indicates that early settlers were attacking dens as well as trapping adults, going beyond fur collection to a program aimed at local eradication. Domestic dogs and pigs would also have had to be managed so as to avoid predation upon nesting birds and their eggs.
Humans and other predators are not the only potential influencers of bird reproduction. The survival of young after hatching is impacted by the availability of food in the lake (mainly midges, their larvae, and small crustaceans) and ducks in the Mývatn region produce fewer than four young per female a year on average (Einarsson & Garðarsson, 2004; Einarsson et al., 2006; Garðarsson, 1978–9; Garðarsson & Einarsson, 1997, 2002).

The earliest known centralized documentary source detailing egg harvesting specifically at Mývatn is the 1712 Jarðabók farm register, which records the value of the farm, the number of inhabitants, livestock, fishing rights, and egg harvesting. In total, 14 farms harvested eggs at Mývatn in the early eighteenth century. According to the register the farms which harvested the most duck eggs are Reykjahlíð (360 eggs per spring), Geirastaðir (360 eggs), Skútustaðir (120 eggs, though these benefits are said to have decreased in years recent to 1712), Garður (120 eggs), Kálfaströnd (1,200 eggs), Geiteyja rströnd (360 eggs), Vogar (360 eggs), and Grímsstaðir (900 eggs). In total, the register estimates the number of harvested eggs to be around 3,960 each spring (Magnússon and Vídalín, 1943).

People apparently did not collect eggs daily, but walked the nesting ground 7 or 8 times over the nesting period (Guðmundsson, 1979). Where farms housed more than one family or household, the total number of collected eggs would be counted and divided in proportion to the percentage of the farmland owned by each family.

In the same Jarðabók entry just mentioned, six farms (Arnarvatn, Syðri Neslönd, Ytri Neslönd, Grænavatn, Helluvað, and Hagenes) are recorded to have
some benefits from nesting birds, although estimations of the number of eggs harvested are not given. Guðmundsson (1979) has noted the relatively low count given of 4,000 eggs in the Jarðabók, compared to Guðmundsson’s own estimates of 41,000 in 1941. Regarding the low Jarðabók numbers, it is worth noting that the smallpox epidemic in the region during the early eighteenth century may have reduced the number of people relying on this resource. Alternatively, under reporting may have been a method of avoiding taxation.

These collection records approaching or sometimes exceeding 10000 per season, might initially sound overabundant in terms of local consumption. But if we consider, for example, Kálfaströnd, with the highest number of eggs collected in 1712 (1,200), and assume they were consumed over a period of two months—a reasonable assumption—the number consumed only averages to about 20 eggs per day for the household. If the farm was home to 5-10 people, that would mean they each consumed perhaps 2-4 eggs per day over the same span of time if the eggs were not preserved (which they sometimes were). On the other hand, if we take Guðmundssons 1941 estimation of 41000 eggs collected in Mývatnssveit, and divide it by the 14 farms that had historical collection rights, that would average 2928 eggs per farm over a 2 month laying season. Which would come to about 48 per day per listed household over 60 days. This supply could have certainly been stretched for consumption over a longer period. These numbers are within reason for local consumption especially considering that preindustrial diets tended to be rather monotonous and shifted seasonally. But these numbers could also have yielded small surpluses.
Formally trained scientists, both foreign and Icelandic, visited Mývatn and reported on egg harvesting during the 18th and 19th centuries (Guðmundsson, 1979). In these centuries sport hunting was growing in popularity as a prestige hobby in England, America, and mainland Europe as well as by gentry in many colonized places. From the early 18th century and onward, specialized, long barrelled, guns for bird hunting emerged and by the early 19th century, the smooth-bored, lightweight fowling piece became a recognized type of sporting firearm. According to Faber (1822) hunting was discouraged in the Mývatn waterfowl landscape during the nesting season due to the custom of protecting waterfowl for eggs and down (See also Edwald, 2012b and Hicks et al., 2016). Thienemann (1827) reported: ‘The ducks of Mývatn […] are very seldom shot at or disturbed by the natives, and their nests are never wholly robbed […] unless four or five eggs are left in a nest, they will not return to it’ (cited from Guðmundsson, 1979: 234).

In the late 19th century, Mývatn people formed hunting associations, lake fisheries associations, and water bird associations to regulate wild resource use. One of these was called the Veidjfellag (roughly, Hunters Association). This grew up alongside the emergence of the locally organized trade association, discussed elsewhere, that worked to organize exports from the region (the Kaupfélag Pingeyinga). However, it seems that waterfowl and their eggs were not subject to regular commercial use. Late 19th century trade records reviewed indicate that eggs were rarely traded into the exchange- and killed ducks were not mentioned in trade records. Previously, Edwald (2012b) found that eggs were mentioned rarely in trade. If there was extensive exchange of wild fowl eggs they were probably
exchanged between households rather than sold outside the community or exported (2012). In late 19th century trade records, the most commonly exchanged items, for cash and credit were live sheep and wool and these are present in every farmer’s trade accounts. Ptarmigans (heath nesting non-waterfowl) were noted in trade books and were exported en masse from Iceland in the 19th through 20th centuries; 3.3 million total birds were killed and exported from 1864 through the early 20th century (Neilsen & Pétursson, 1995).

A conservation-minded approach persists in the rural community today. The duck populations of Mývatn and Laxá have been monitored closely over half a century and have shown marked fluctuations (Einarsson et al., 2004; Garðarsson & Einarsson, 2004). The main contributing factor to population fluctuations is thought to be the availability of food resources—midges and blackflies—in the lake ecosystem rather than human impacts (Bengtson, 1971; Garðarsson, 2006; Garðarsson and Einarsson, 1997). In contemporary times, bird populations have adopted a different significance through over a century of growing tourism as an attractive component of Mývatn’s environment. Local households remain engaged in environmental concerns and debates, along with the Mývatn Research Station and international researchers. As circumstances change around the lake, and as new highly connected economies introduce globalized food markets and tourism booms, the long-term knowledge and interaction around birds will surely involve an ever-shifting set of practices.

Discussion
The long-term archaeological record demonstrates very little hunting of waterfowl through time but well-managed conservation of nesting adults combined with sustainable egg collection, extending from first settlement to the present. The interrelated practices that constituted this culture of avian conservation were underpinned by a system of dense, long term, local knowledge that significantly pre-dated modern science. Even as commercial markets grew for other resources in Mývatnssveit, the tens of thousands of seasonally available waterfowl and their eggs were not brought directly into commercial exchanges.

Academic discourse around conservation can at times be universalizing. For example, Hardin introduced the notion of the inevitability of a ‘tragedy of the commons’ (Hardin, 1968; Hardin & Baden, 1977), which portrayed common resource management as doomed to failure over the long term due to advantages taken by ‘cheaters’. This is a notion which has been widely criticized (see Agrawal, 2002; Hunn et al., 2003; McCay and Jentoft, 2010; Ostrom, 1990). When we ask questions about diverse agencies, for whom conservation is working and for what end goals (Agrawal 2002), conservation can come to light as a specific political economy rather than a universal moral imperative. A more critical literature (e.g. McCay and Jentoft, 2010: 211) concludes that collaborative resource management regimes need to be considered as place-specific approaches to addressing needs of different actors at different (but sometimes connected) scales—from the individual, to the community, to the large scale economic and political. Under close examination the, commons and conservation are socially complicated.
Was the avian fauna of Mývatnssveit collectively managed for shared use or they were managed by semi-private farm tenant households on their own land holdings? If some households had egg collection rights and others did not, is this a case of commons management or something else? The answer is multifaceted. As the birds alternatively moved about in the wider landscape they might be considered to be a common resource; they crossed boundaries of private or rented land. While they nested on bounded farm land, they were likely seen as a privately accessed resource. The creation of a safe nesting ground on a given farm, where birds were free of predators and safe from over-collection would have attracted them to nest repeatedly in that place. So the limitations on egg collection should perhaps not be described as commons management, but rather as a community level practice with shared norms around a local, limited resource. On the other hand, tradition of not hunting waterfowl (with some exceptions) shared in the region through time, is an example of long-term common resource management, as birds could have been hunted in diverse locations within the Mývatn environs, such as the middle of the lake, which is common property.

Non-human agency seems to be an important issue in understanding the conservation dynamics in this particular case study because birds in Mývatn were exercising significant agency through their habit of nest abandonment as a reaction to predation. Birds would shift their nesting grounds when predation exceeded certain limits. As one example, when minks were released into Mývatn, some species of ducks shifted to nest near to gulls, on elevated ridges and gulls would alert ducks to approaching predators (Garðarsson, 1979). And as discussed in the
body of this chapter, over-predation by humans would have influenced waterfowl to relocate to other nesting grounds. It was therefore in the best interest of farmers to ensure safe nesting grounds (safe from over predation by humans and others) in order to attract or retain nesting waterfowl. Considering this, means that we should credit not just community level rules as the only agencies but we should also fully account for how social regulations around egg collection were structured as a result of the preferences and actions of waterfowl.

Other inherent aspects of waterfowl ecology perhaps played a role in their conservation. The intensified commodification of sheep over the 19th century was amplified by the fact that sheep production could be scaled up, but waterfowl are apparently not a scalable resource. Scalability refers to the capacity for expansion of a resource without changing the basic assumptions, organization, and frameworks relevant to production. A classic example of scaling-up land clearance and preparation for the expansion of agro-industrial monoculture (Tsing, 2012). Anna Tsing has written on the central role of scalability in the expansion of mercantilism and capitalism. A scalable project, like industrial farming, may entail expansion of production, and often the transplantation of a production model from one region to another, including species, growing conditions (clearing of ecosystems to create acreage), transplantation or production of the same laboring conditions, and the use of the same technologies to process or transport a product. In essence, scalability is the capacity to make more of a desired thing through broadening of productive conditions. Scaling up is an ally of commodification. Tsing, however, points out that scalability is a dubious enterprise, as by definition, nature is never endlessly
scalable. Scaled-up projects like plantations, she says, are concerned with comparatively short term goals and leave behind wreckage and ruins (2012). This includes the destruction of antecedent ecosystems and people.

Birds in Mývatn were an especially non-scalable resource because of their negative response to intrusion in their life cycles - quite different from timber forest, a cane plantation, or Iceland’s sheep market. The non-scalability of bird populations along with careful harvest strategies may be perhaps counterintuitively, central to the successful preservation of populations for use by Mývatn households. It is also revealing that the community did not consider all of their local resources as fit for markets.

One trope of speaking about Iceland’s transformation into a „modern“ society is familiar to colonized places over the whole of the atlantic - that Icelanders, over the 18th and 19th centuries shed some of their traditional practices – economic, architectural, consumptive, and educational, and changed into a society and economy that was growing, liberalizing and was less „backward“ (see discussion in Lucas & Parigoris, 2013 and Oslund, 2011). These types of sweeping narratives about 19th century modernization implicitly valorize a shift toward market centered economies and a eurocentric aestheticization of daily life (Lucas & Parigoris, 2013). This case study offers a counternarrative to those themes and chance to more finely parse rural subsistence activities and view an example of a long term „traditional“ economy that persisted through this period of otherwise rather dramatic social, economic, and environmental change. Despite the adoption of economic modalities like commodification, cash trade, cooperative capitalism,
and ranching, discussed in previous chapters, this rural community continued to
maintain a bounded and distinct value system around waterfowl that favored
sustained productivity from an intact ecosystem.
Chapter 10. Conclusion

From the first settlement, Iceland’s communities and ecologies were connected to a broader economic world through the exchange of animal products (Frei et al., 2015). The influences of markets on the island’s economies intensified after the mid 18th century when Danish colonial economic policy connected more deliberately to Iceland through improvement initiatives backed by intensive information-gathering projects. The late 19th century then saw the integration of the mostly rural society into a capitalist industrial Atlantic system.

The central aim of this dissertation has been to contribute a vantage of conjoined contexts of socioeconomic and ecological change, mainly through reconstructing the shifting treatment of animals, people, and environments in a rural community. The archaefaunal record from Skútustaðir, a middle to upper status farm and its rural region Mývatnsseit, N Iceland have provided a useful and relevant focal point for this study. Skútustaðir is a central farm in one of the largest inland farming regions in Iceland. The Mývatnsseit community took part in the formation of Iceland’s first free trade cooperative movement in 1882 (the Kaupfélag Pingeyinga) and is a globally significant region for its arctic biodiversity. The diversity of species and ecosystems within Mývatnsseit and its early entry into free markets make it an ideal case study region for understanding how markets were ecologically consituted and socially transformative through the relational and use-histories of several domesticated and wild species.

Through the contribution of a study in archaeofaunal analysis toward the exploration of Iceland’s colonial economy and capitalism, this work has expanded a
space of overlap between the Historical Ecology (also Human ecodynamics) scholarship genre and Historical Archaeology research. This work also adds to the growing number of archaeological studies investigating the ecodynamics of postmedieval phenomena in Iceland and the North Atlantic (see Amorosi, 1996; Hambrecht, 2011; Hambrecht, 2015; Harrisson & Snæsdóttir, 2013; Hicks, 2014; Woollett, 2008).

Here, I will briefly summarize the main findings and contribute suggestions for further research and collaboration.

**Sheep and Modernity**

The Danish interest in woven and spun wool as an export commodity during the Trade Monopoly period (AD 1602-1787) led to a sustained effort to improve and expand sheep herding and wool production. As a result of the central place of sheep in trade over the late 18th and 19th century, farmers at Skútustaðir, in the Mývatn region, and over most of Iceland, doubled their sheep production, and engendered a radical shift from prior patterns of land-use and stock management. They did so through the intensification of their use of the foddering landscape, specifically reclaiming marginal zones like wet meadows (Hicks, 2014; Hicks et al. 2017; Karlsson, 2000). To manage fodder resources amidst intensification efforts, Mývatn farmers centralized and applied dense local traditional knowledge of fodder provisioning, land management and wetlands management. (see also Sigurðardóttir et al. *Forthcoming* regarding wetland management). This knowledge was gathered, circulated, and communicated in new scientific forms of written expression that enabled a synoptic view of resources. This social and technological
innovation was important to managing sheep and fodder resources near the maximum productivity under the then contemporary nonmechanized, pre-industrial regimes of the 19th century (before tractors and synthetic fertilizers). The maximization of the sheep economy set the scene for sheep products as central in the free trade cooperative movement.

Free trade opportunities offered cash for live sheep from the 1870’s onward a new export commodity and live sheep were the main product under the new Icelandic Free trade Association of Mývatn’s greater Þingeyjarsýsla region. Wool appears to have been secondary in terms of the generation of value in Skútustaðir and other farming households in the region. By the late 19th century, both wool sheep (wethers) and the practice of milking ewes declined in favor of a more focused meat economy, which was comparatively less labor intensive than wool preparation. In addition to contributing to new markets, this change in herding toward the production of live sheep and mutton may have happened because late 19th century social policy freed indentured laborers from inland farms, enabling them to emigrate or move to coastal fishing villages. From the angle of human animal relationships, the transition away from the Danish wool-for-barter trade system and toward live sheep and mutton, shows the entanglements of animals within in the broader socioeconomic system which first depended on indentured laborers for surplus production and then shifted to cash and free labor arrangements.

The intensification of 19th century sheep herding and the eventual organization of free trade from its surpluses were extensive political and ecological
negotiations. These changes necessitated entirely new ways of thinking about and managing local ecological systems, vegetation zones, human labor, and the age structures of herds of sheep regionally numbering in the thousands.

Although there were significant shifts in the use and keeping of sheep, the use of cows seems to have changed little between the 17th through the 19th centuries. Broadly speaking in Iceland through time there was a narrowing of what is sometimes termed the „livestock package“ – the assortment of domesticated stock brought to Iceland in the Viking Age. As discussed in Chapter 6, the reductions in goats and pigs over the Middle Ages and early modern period deserves attention to local environmental and ecological conditions like vegetation and interspecies interactions (see additionally McGovern et al. 2014, McGovern et al. 2009). On the other hand, the general reasons for the simplification of herds to include a stark and ever-increasing majority of sheep mostly had to do with the persistent relevance of sheep to both subsistence (as they provided meat, milk, and wool) and to interregional economies of scale. I think that further work is called-for regarding the development of Icelandic ranching system and its ties to emergent capitalism and market monocultures, as these connect to similar patterns developing in many places during the 19th century which transformed landscapes and societies (Anderson, 2002; Chang & Koster, 2004; Crosby, 2004).

**Freshwater Fish for Subsistence and Sale**

Local Mývatnssveit Salmonidae fish (char and trout) were not only important for local subsistence. The archaeofaunal remains from Skútustaðir demonstrate that the smoke-cured or air-dried filets, were traded out of the household since at least
the 17th century. The trade of cured char and trout for currency or credit may have intensified freshwater fishing in the late 19th century. Two periods of avid fishing and possibly export are mentioned in the documentary personal manuscripts of local farmer, Jón Gauti Pétursson who documented the community. Due to strong variability of Mývatn's foodweb and potentially also periodic waves of overfishing, the Salmonidae fishery was a variable source of food and income. By the late 19th century, Mývant residents became interested in stabilizing and maximizing freshwater fishing productivity through interventions including centralized supervision and experimental fish nurseries (Edwald, 2012b) but these did not permanently curb the strong variability in fish populations in the lake. Variability in the char fishery in the lake remains a contemporary concern and I intend that my future work include metrical analyses and other assessments that may provide insights into how fishing and fish populations in the lake have changed through time.

**Marine Fishing, Labor Mobilization, and Social Space**

The Skútustaðir household apparently underwent a shift in its social relationship to coastal cod fisheries between the 17th and late 19th centuries in ways that reveal changes in peoples social definition and enacted economic geographies. During the the 17th and 18th centuries it seems the farm sent indentured laborers or tenant farmers to coastal seasonal camps to fish for cod. These individuals brought home byproducts (dried fish heads) as payment for their seasonal labor. However, by the late 19th century, it seems that Skútustaðir was acquiring dried gadid fillets (the main product, not byproducts) and possibly doing so through trade. This
apparent shift in connectivity, participation, and consumption could be due to two possible shifts in household social organization. One possibility is that the farms change from a tenancy to an owner occupied household during the 19th century meant that there were no longer tenants participating in fishing as part of rent payment. Another possibility is that the abolition of indentured labor during the late 19th century (and the permanent move of many laborers to the coast) meant that there were no longer servants in the household bringing byproducts home from seasonal coastal fishing. In this way, the consumption of gadid parts traces larger social changes, shining light on the relationships between labor control, settlement, production and consumption. It also correlates, in broad strokes, to changes between the colonial system of the 17th and 18th centuries into increasing social liberalization (free labor, increasing owner occupancy, and possible increased exchange through purchase) over the 19th and early 20th centuries.

**Market Penetration and Local Knowledge**

Over the 19th century, Icelanders began to generally produce more goods, to export more, and to consume more (Karlsson, 2000). I have argued that the increases in production were facilitated and influenced by adoption of new attitudes, knowledge, and organizational practices around commodification. Specifically, these include such scientific knowledge practices of the enlightenment as information collection and synthesis of multiple information sources about productivity as a relationship between labor and „nature“. Neither the looms of the late 18th century nor the decked vessels of the 19th century were the only technologies involved in Iceland’s economic modernization. Writing, centralization
of information, and numerical record keeping were integral technical parts of projects that intensified the production of animals, ecologies, and people as economic resources.

Markets in the 18th-19th centuries seem to penetrate more thoroughly into Icelandic landscapes and waterways as I have documented through the investigation of herding and fishing intensification. However, market orientation was not an all-encompassing cultural shift and not all animal resources utilized by the Mývatn community were exposed to the the conditions and pressures of commercial exchange. Birds of the Anatidae order (ducks, geese, and swans) and other waterfowl were seemingly shielded from market contexts - not subject to commodification and attempts scaling-up. I suggest that this is due the birds’ innate breeding habits including their sensitivity to nest predation (which caused breeding-ground desertion). This immutable condition strongly limited hunting and egg collection. As a result of their sensitivity to exploitation, waterfowl were protected by a long term knowledge system guiding sustainable egg collection and by a shared community practice that largely forbade hunting. This preserved their breeding populations for long term use.

This case study concerning birds and people provides an example of cooperative commons management and points to the non-universality of commodification practices. It also illustrates how market economies may share spatial overlap with subsistence systems, or even rely on the economic foundations created by subsistence economies – the combination of the two in the same region can create „patchy“ (Tsing, 2014) zones of practice.
The example of sustained, restricted use of Anatidae demonstrates that while Iceland’s economy was “modernizing”, cultures and ecologies of modern commerce (like scaling up, and commodification) did not ablate or replace all long term, local practices and knowledge systems, but remained as another way of encountering nature that sometimes intertwined with local knowledge and sometimes stood in tension with it. Although the conservation of Anatidae stands in contrast to the main narrative of this thesis about broad economic change, the traditional use of Anatidae including hunting restrictions and precise, limited egg collection provides an important and revealing counternarrative to commercialization of nature on a “commodity frontier” amidst the many examples of local resources that became commodified.

Another area for future work would involve the application of newly-devised method archaeological eggshell identification toward the study of past avian management. This work is ongoing and should be expanded to other archaeological sites in the region. The method, which hinges on the assessment of morphological characteristics, using with widely-accessible technology, can also be transported to other regions of the globe. A manual is forthcoming.

**Complexities of Economic and Ecological Engagement**

It should be kept in mind that intensification of production for markets and major changes in relationships among humans and animals played out against a background of ongoing need to adjust for the challenges of survival in a sub-arctic environment subject to significant climate change impacts. The species diversity and evidence for consumption of a wide range of foods at Skútustaðir demonstrates
that although Icelandic society changed dramatically through the mid 19th century, by the end of the 19th century it still had a strong footing in subsistence production, likely producing for themselves most of the food that was consumed in the home (see Jónsson, 1998). Into the 19th century, Icelanders were still periodically experiencing variable cold spells that would interrupt arrival of trade vessels, interfere with fishing, and reduce fodder production and cause famine (Ogilvie & Jonsdottir, 2000). These hard years must have reconfirmed the importance of maintaining a generalized subsistence strategy, with a distribution of efforts among many seasonal activities that could provide resilience and flexibility against the harms of climatic variation. The intensification of various pillars of the economy at least through the 19th century, was always paralleled by an understanding that trade could vacillate and that subsistence production probably needed to be protected and prioritized.

**Looking Forward**

During the past four years, continuing collaborations have reconﬁrmed that there are several promising directions for future work. In 2014 and 2015, with the help of dear colleagues I completed an archaeological coring and trenching survey of eight farms in the Mývatn region. Two of the farms demonstrated excellent archaeological potential for the recovery of post-medieval archaeofaunal remains. Slightly larger archaeofaunal samples from one or two of these farms could produce a more detailed picture of post-medieval subsistence and economy in the Mývatn region, one which can comprehend the variability between household sites.
Beyond excavation, there is much work to do with archived documentary resources. Ongoing collaborations in archival research with colleagues from 2014-2019 under the MYCHANGE and MYSEAC projects (see http://www.svs.is/en/projects/myseac) have made it clear that the bounty of primary historical documents of the Mývatn region is significant; these include farmer’s diaries and municipal records of various matters from the 18th century and onward- many of which we have read and digitized. As Mývatn is an unusually biodiverse arctic region with a close knit, engaged community it would be beneficial to make publicly available some of these digitized primary resources so that they can be easily shared and preserved within the local community and if desired, with the academic community involved in interdisciplinary ecological and historical work.

This work is also part of ongoing collaboration with the NSF supported DataARC data management and visualization program (https://www.data-arc.org/) for dissemination and outreach.

This thesis project has been undertaken in collaboration with Icelandic scholars based in academic institutions and with local residents whose knowledge of places, events, and ecology represent a major resource. The limitations of this dissertation center on my status as a non-Icelander lacking native-speaker linguistic skills. While this thesis may contribute a set of technical skills and aid a broad interdisciplinary effort to integrate Icelandic and international capacities, its remains an outsider contribution. Looking forward, there is an opportunity to expand the already strong links between international contributors, Icelandic
scholars, and institutions, and the knowledge of local residents in an ever-more
complete and effective co-production of knowledge.

I hope that this dissertation has demonstrated how archaeofaunal analysis
can contribute to broader debates around the development and impacts of large-
scale colonial and capitalist economic systems and their interaction with local
communities and environments. I hope I have also furthered the argument that
colonialism and capitalism, in addition to setting off dramatic shifts in social
organization and daily life, involved radical changes in local ecologies and
understandings of “nature”. As the enticements of large-scale market economies
present social and environmental pressures and predicaments in contemporary
times, and are rooted in the not too distant past, it is all the more urgent that we
develop an interdisciplinary, shared understanding of their roots, specific cultures,
and a record of their outcomes. This dissertation is only a first step in that direction
and represents an initial contribution rather than an end.
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