Evidence of Environmental Change Events and Resulting Cultural Adaptations in the Archaeological Record of Iceland

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Abstract

Evidence of environmental change events can be seen in the archaeological record of Iceland. How populations adapted to these events, depended much upon their wealth status and resource availability. A faunal assemblage from the site of Skálholt was analyzed, revealing a meat-based economy. Since Skálholt's wealth status is unique in Iceland, it likely insulated the site from the negative impacts of the Little Ice Age. Comparative analysis with other sites across Iceland reveals different adaptation strategies, such as increased reliance on marine mammal hunting. Other environmental events like deforestation are also evident in the archaeological record of Iceland through palynological evidence.

Introduction

"Environmental change is arguably the most pressing and potentially disastrous problem facing the global community."- Carole Crumley, *Historical Ecology*

Historical ecology is an interdisciplinary theoretical framework that focuses on understanding past human-environment interactions in order to inform future environmental decisions and policy-making. Historical ecology draws from diverse fields such as ecology, archaeology, anthropology, climatology, history, and geography, among others. As the quote above explicitly states, environmental change is the most urgent crisis facing the modern world. Past societies, however, were not immune from environmental change, both causing and adapting to these events. Environmental change, for this paper, is defined as naturally occurring events that humans must adapt to and, additionally, anthropogenic events like modern post-industrial climate change, landscape change, and environmental degradation.

The North Atlantic island of Iceland provides a prime place for understanding complex human-environment interactions over time. The settlement time of the island is corroborated through historical records and the archaeological record. Tephra from frequent volcanic eruptions is commonly seen in soil stratigraphic levels, helping to provide a chronological context for the archaeological record (McGovern et al. 2007). Palynology and ice cores, help scientists recreate the paleoenvironmental record of the island and provide an environmental baseline. Iceland was considered a pristine, undisturbed location before humans arrived (Dugmore et al. 2005); changes to the landscape after settlement in the 9th century AD can be compared to the environmental baseline established and show just how much humans have altered the landscape.

Additionally, the recorded past climate change events known as the Medieval Warm Period and the Little Ice Age can be studied via the archaeological record. The Medieval Warm Period was an abnormally warm time period from around 800-1200 A.D. (estimates vary from study to study). This was the time period in which the Norse colonized Iceland, Greenland, and briefly Vinland (Hughes and Diaz 1994)(McGovern et. al 2007). The Little Ice Age occurred between approximately 1550 and 1850. During this time period, northern hemisphere temperatures dropped and glaciers, land ice, and sea ice attained a maximum not seen since the last Pleistocene glacial period (Ogilvie and Jonsson 2001). This anomalous climatic event was concurrent with the abandonment of the Norse Greenlandic settlement and is suspected to have been a catalyst for this abandonment (McGovern et. al 1988). Harsh wintry conditions of the Little Ice Age meant that the Icelandic people needed to adapt; if cultural practices were changed in order to deal with this climatic event, it should be evident in the archaeological record.

This paper compares the zooarchaeological record of a portion of the site of Skálholt, from southern Iceland, with other parts of the Skálholt site, the site of Finnbogastaðir in northwestern Iceland, Víðey, Nesstofa, and Bessastaðir near Reykjavik, and Svalbarð in the northeast in hopes of understanding how societies coped with and adapted to the Little Ice Age. These sites are all from the early modern period (17-18th century) and represent a diversity of wealth and subsistence strategies, as well as varying geographical locations. These later sites are also contrasted with data from the landnam (settlement; 9th century) period in Iceland in order to gain a deeper understanding of how humans changed the landscape of Iceland while also dealing with regional climate change and environmental events (both sudden and gradual).

Methods

Skálholt is one of the most important cultural and historic sites found in Iceland (Lucas 2009). It was the farm of the first Bishop in Iceland, dating back to the 11th century. In the late 11th/early 12th century is became one of two Episcopal seats in the country (Lucas 2009). Until the establishment of Reykjavik, Skálholt was one of the largest population centers, including a farm, cathedral, boys' school and other infrastructure (Hambrecht 2011).

The faunal data in this paper is from the late 17th- early 18th centuries. This falls between two major events at Skálholt: a fire destroyed most of the settlement in 1630, and the rebuilt community was again destroyed in 1784, this time by an earthquake (Lucas 2009). The site was excavated to help understand its significance in the history of Iceland and the coming of modernity in the North Atlantic region.

The zooarchaeological material analyzed by the author is from excavations done at Skálholt in 2007. The single context excavation method was used at Skálholt; contexts containing cultural material were sieved through an 8mm mesh (Hambrecht 2011).

Zooarchaeological analysis was carried out by six members of the Anthropology 341/641 class at the University of Maryland in Spring 2016, using the comparative collection of the Zooarchaeology Laboratory. Species were identified to the most specific taxonomic level possible; preservation of osteological material varied from unit to unit and so some remains were in better condition and more easily identifiable than others. Specimens were recorded following the NABONE Zooarchaeological Database, 9th edition. Generally, due to physiological similarities between sheep (*Ovis aries*) and goat (*Capra hircus*), remains were identified down to only indeterminate Caprinae (caprine). Similarly, if mammal specimens could only be broadly separated by size, they were listed as "large terrestrial mammal" or "medium terrestrial mammal" meaning horse/cow size and sheep/goat/large dog size respectively. Specimens identified as fish, but not able to be speciated were listed as members of the cod (Gadidae) family. "Unidentified mammal" and "unidentified" were used for a few specimens that were not confidently able to be placed in a more specific taxonomic category.

Once the taxonomy of specimens was recorded, the number of identifiable specimens (NISP) was determined (excluding the "unidentified"). When recording the data, along with species and element, side, end, fusion, age, burning, butchering, gnawing, and general size were also noted (though this often varied in completeness between analysts). Weight was also recorded for each taxonomic category and biomass calculated for the most taxonomically specific categories. One cow scapula was too large for the scale and was added in the data set with weight 200g. Minimum number of individuals (MNI) was calculated for the data. MNI was calculated first by counting the number of most specific repeated elements. This number was then added to the number of same, but unsided elements, divided by the number of times they are found in the skeleton of the species. For example, if there were four left distal caprine humeri and six unsided distal caprine humeri then the MNI would be calculated as seven.

Following calculation of MNI, a summary table, element distribution table, modification table, and fusion tables for caprine and cow (*Bos taurus*) were created. The element distribution highlights what part of the animal was used, though this can be biased by taphonomic processes. Fusion tables help to show the ages that the animals died based on known epiphyseal fusing times (Reitz and Wing 2008, pg. 72).

Results

The total NISP for the faunal remains analyzed from the site was 1099. The total MNI was 22; the majority (14) were caprine. Caprines had the highest weight as well, followed by cow and large terrestrial mammal. The MNI for fish was 5 and was represented by cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*)(Table 1). The element distribution for both sheep/goat and cow was equally distributed among the parts of the body with elements from the head (including teeth), forequarter, hindquarter, forefoot, hindfoot, vertebrae/ribs and the feet. However, for horse, only head and hindquarter elements were identified (Table 2).

The summary table (Table 3) shows that while the MNI for fish was a significant percent (22.7%) of the total individuals represented, the actual biomass represented by fish was only 2.2%, likely due to the small size of fish. A larger quantity of fish needs to be consumed in order to provide the same amount of meat as a whole sheep or goat. Caprine and large terrestrial mammals (horse/cow) make up 97.8% of the biomass.

The fusion tables allow for an understanding of age of death. The cattle remains express a kill-off pattern of individuals primarily between the ages of 42-48 months (Table 4). About half of the elements in the late-fusing stage were fused and the other half, unfused. There was one neo-natal caprine present, but most individuals analyzed died around the age of 36- 42 months as seen by many fused middle-fusing bones, and some later-stage bones still unfused (Table 5)(Reitz and Wing 2008, pg. 72). The ages when converted to years is 3.5-4 for cows and 3-3.5

for caprines; this is considered prime age for these animals and will be interpreted in the discussion section.

Few modifications were noted on the bones, but of those bones that were modified, chopping was the primary means of doing so. This was followed in numbers by burning, cut marks, and drilling (Table 6). There was also one case of gnawing and one case of biperforation. Biperforation is usually done in order to access the marrow inside the bone.

Discussion

The data from Skálholt contributes to a larger body of data from early-modern period Icelandic archaeological sites. When these sites are compared, the different adaptation strategies to the Little Ice Age are evident. Archaeological data also allows understanding of how human settlement altered the Icelandic landscape from its original state.

Prior to human settlement, Iceland was covered by forests of birch and willow (McGovern et al. 1988; Dugmore et al. 2005). Additionally, there are no native land mammals in Iceland except for the arctic fox and polar bear that came to the island via sea-ice. It is particularly important to note that no grazing mammals are native to the island (Dugmore et al. 2005). Domestic animals including pig, cow, and sheep were brought to Iceland when it was settled. The zooarchaeological record reflects especially high percentages of cow and pig during this time period (Dugmore et al. 2005). This is a notable difference from the sheep/goat dominated archaeological records of the early-modern period. Paleobotanical evidence shows that at the time of settlement, there was a drastic decrease in the amount of pollen from birch and willow trees, representing deforestation across much of the island (McGovern et al. 1988).

Skálholt

Skálholt, of greater wealth and prominence than other sites, tends not to follow the same archaeological patterns as other sites across Iceland (Hambrecht 2011). An example of this is seen in the type of subsistence that was practiced at the site. The age profiles of both cow and the caprines was anomalous compared to the usual pattern of larger quantities of neo-natals and older animals; rather, there were higher numbers of prime-age adults. When an economy is primarily dairy-based, the calves are culled in order to allow the milk to be used for human consumption (Mulville et al. 2002). Prime-age adults (2-5 years for cow, 1-4 years for sheep) in the archaeological record generally means that either the animals were farmed for meat or that as many animals as possible were killed in desperation during times of starvation. At Skálholt, the former is likely the case since they had a greater wealth status; this pattern is consistent with earlier excavations at Skálholt (Hambrecht 2011).

Finnbogastaðir

Finnbogastaðir was one of the poorer farms in Iceland and had only marginal farm land (Hambrecht 2011). In contrast to Skálholt, zooarchaeological evidence from Finnbogastaðir suggests an economy of the traditional Icelandic dairy strategy and fishing (Edvarsson et al. 2004). Fishing was especially important for this site in the north-western portion (see Figure 1) of the country because there was little pasture land for domesticates to forage on. Finnbogastaðir because of its higher latitude is also more vulnerable to changes in climate that can affect the duration of sea-ice; in fact, data from this time period shows that there were food shortages, indicating hardship (Hambrecht 2011; Edvarsson et al. 2004).

Víðey, Nesstofa, and Bessastaðir : Royal Administrative Centers Near Reykjavik

These sites are chosen for comparison because like Skálholt, they are located in the more southern portion of Iceland. Though they are royal administrative centers and would presumably be wealthier than many other farms, their subsistence pattern tended to be that of a dairy based economy, unlike Skálholt (Hambrecht 2011). The zooarchaeological data also shows presence of a strong fishing based economy. Interestingly, walrus and polar bear bones were found at the site; this corresponds chronologically with an increase in sea-ice presence due to climatic events (Hambrecht 2011).

Svalbarð

Svalbarð had a prime location to exploit both terrestrial and marine resources. The church farm owned a lot of land to be grazed by domestic animals like caprines and cows, while also close to the coast to exploit opportunities like seal-hunting and whale strandings; this is reflected in the zooarchaeological record (Hambrecht 2011). Around the early modern period, the zooarchaeological record shows an increase in the number of harp-seal bones. This is significant because harp-seals, along with bearded seals, walrus, and polar bears indicates greater reliance on hunting of animals that live on the sea-ice (Hambrecht 2011). This signifies that the residents of Svalbarð were facing greater environmental pressures than in previous times. An increase in the number of neo-natal sheep found over time suggests negative impacts from the harsher, colder climate of the time period (Hambrecht 2011).

Environmental Change

The archaeological record of Iceland provides evidence for both natural and anthropogenic environmental change events. The settlement of Iceland and introduction of domestic species led to the deforestation and overgrazing of native flora. This pattern of treeless North Atlantic landscapes has been referred to as being “ovigenic”(McGovern et al. 1988). When faced with later climatic events, this overgrazed land likely exacerbated the troubles faced by the people of Iceland. The land is already at the allowable climate threshold for agriculture, so when colder temperatures were combined with poor, degraded soil, the people of Iceland had to adapt to survive.

This adaptation is especially noticeable in archaeological sites like Svalbarð and the royal administrative centers near Reykjavik as they increased their dependence on marine resources, namely resources that were more available with greater sea-ice. At Skálholt though, it is not surprising that during the harsher climatic times they still had a meat-based economy since Skálholt was comparably wealthy to other sites and had greater access to external resources. Perhaps further excavations at Skálholt would reveal a difference in subsistence strategies from earlier times, but this has yet to be investigated.

In addition to gradual environmental changes like the Little Ice Age, Icelandic people are faced with sudden changes such as volcanic eruptions. The data from Skálholt, however, falls in between the two major eruptions (Katla volcano) of the early modern period (Smithsonian Institution Global Volcanism Program). Large amounts of tephra in the soil can lead to gritty conditions which prematurely leads to tooth wear in grazers (Hicks and Harrison 2008); unfortunately, however, a large enough sample of mandibles was not obtained from Skálholt to investigate this pattern. Additionally, many of the animals present at Skálholt may not have been raised locally since they were wealthy enough to import and thus would not exhibit tooth wear caused by local conditions.

Conclusion

Comparison of different archaeological sites from around Iceland contributes to the understanding of how people adapted to climate change events such as the Little Ice Age. Adaptation strategies may reflect variations in the traditional environmental knowledge of different regions. Greater need to adapt to climate events was also more evident in the less wealthy settlements of Iceland; Skálholt was seemingly immune from the resource stress brought on by the Little Ice Age.

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Figures

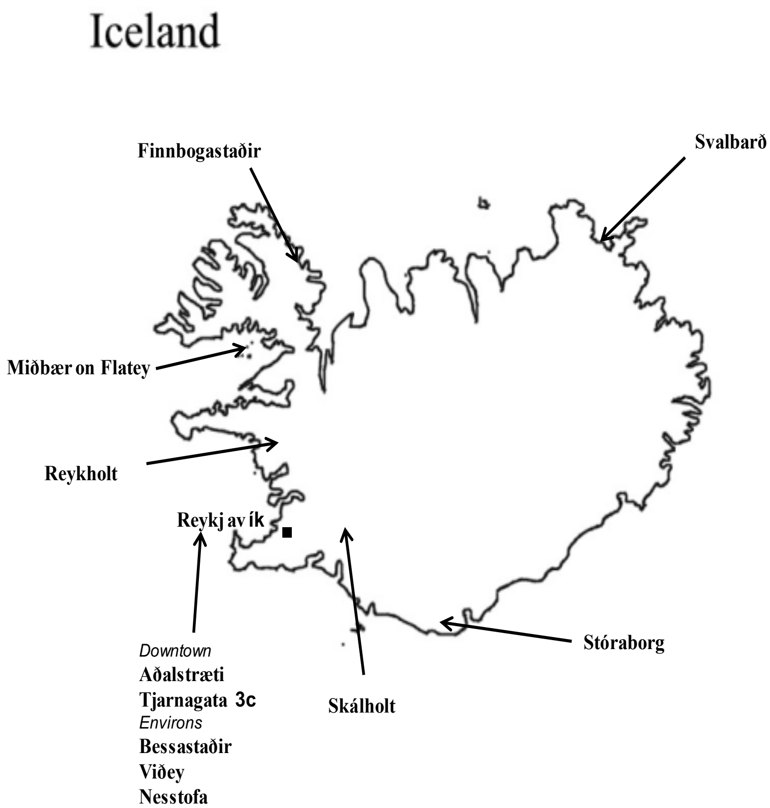

Figure 1: A map showing some Icelandic archaeological sites.

Tables

Table 1. Skálholt 07: Species List

NABO code	Taxa	NISP	MNI #	MNI %	Weight, g	Biomass, kg.
	Osteichthyes (Bony Fish)					
GAD	Gadidae Cod family	53			46.01	0.622
COD	*Gadus morhua* Cod	20	2	9.1	27.57	0.415
HAD	*Melanogrammus aeglefinus* Haddock	5	3	13.6	47.17	0.634
	Mammalia					
BOS	*Bos taurus** Cow	137			2962.82	35.039
EQU	*Equus* sp.* Horse	5			187.54	2.923
OVCA	Caprinae Indeterminate sheep/ goat	281	14	63.6	3719.04	42.993
LTM	Large Terrestrial Mammal	158	3	13.6	2251.54	27.368
MTM	Medium Terrestrial Mammal	66			470.82	6.692
UNIM	Unidentified Mammal	374			105.25	1.738
UNI	Unidentified				37.87	
	Total	1099	22	100%	9855.63	118.424

*MNI for *Bos taurus* is 2 and for *Equus* sp. is 1, but is not included in the total since this is less than LTM MNI

*one *Bos* scapula weighed >200g and was only added in as being 200g

Table 2. Skálholt 07: Element Distribution

	Sheep/Goat	Cow	Horse
Head	59	33	3
Vertebra/Rib	60	38	
Forequarter	53	15	
Hindquarter	53	16	2
Forefoot	12	2	
Hindfoot	29	4	
Foot	15	29	
Total	281	137	5

Table 3. Skálholt 07: Summary Table

	MNI		Biomass	
	#	%	kg	%
Sheep/Goat	14	63.6	43.00	59.7
Fishes	5	22.7	1.61	2.2
LTM	3	13.6	27.37	38.0
Total	22	100.0	71.98	100.0

Table 4. Skálholt 07: Epiphyseal Fusion for Cow (*Bos taurus*)

	Unfused	Fused	Total
Early Fusing:			
Humerus, distal		1	1
Scapula, distal			
Radius, proximal		2	2
Acetabulum			
Metapodials, proximal			
1st/2nd phalanx, proximal		11	11
Middle Fusing:			
Tibia, distal	1		1
Calcaneus, proximal			
Metapodials, distal			
Late Fusing:			
Humerus, proximal	1		1
Radius, distal	1	1	2
Ulna, proximal	1	1	2
Ulna, distal	1	1	2
Femur, proximal	2		2
Femur, distal			
Tibia, proximal			
Total	7	17	24

Table 5. Skálholt 07: Epiphyseal Fusion for Sheep/Goat (Caprinae)

	Unfused	Fused	Total
Early Fusing:			
Humerus, distal		10	10
Scapula, distal			
Radius, proximal	1	3	4
Acetabulum		1	1
Metapodials, proximal		13	13
1st/2nd phalanx, proximal		5	
Middle Fusing:			
Tibia, distal		15	15
Calcaneus, proximal	1	3	4
Metapodials, distal	3	13	16
Late Fusing:			
Humerus, proximal		1	1
Radius, distal	2	2	4
Ulna, proximal	2		2
Ulna, distal	2	1	3
Femur, proximal	2	3	5
Femur, distal		2	2
Tibia, proximal	1	2	3

Total			14	74	83

Table 6. Skálholt 07: Modifications

Taxon	Other gnawed	Drilled	Burned	Knifed	Chopped	Biperforated
Cow					3	
Sheep/Goat		2		1	1	1
LTM	1		1	1		
UNI			1			
Total	1	2	2	2	4	1

Appendix

Appendix A. Skálholt 07 Faunal Samples Studied

Analyst	Provenience	Description	Date
Hope Loiselle	2872	Floor of Bishop's Living Quarters	1700-1720
	2840	Floor of Boy's Lodge (servants?)	1670-1710
	2965	Floor of Meat Store	1670-1690
	2691	Floor of Bishop's Living Quarters	1700-1720
	2891	Floor of Meat Store	1690-1700
Sarah Noe	2727	Demolition Bishop's Living Quarters	1720
	2872	Floor of Bishop's Living Quarters	1700-1720
	2836	Floor of Boy's Lodge (servants?)	1670-1710
	2827	Floor of Boy's Lodge (servants?)	1670-1710
	2696	Floor of Bishop's Living Quarters	1700-1720
Conor Daly	2793	Floor of Boy's Lodge (servants?)	1670-1710
	2823	Floor of Boy's Lodge (servants?)	1670-1710
	2989	Floor of Meat Store	1670-1690
Rose Malone	2727	Demolition Bishop's Living Quarters	1720
	2982	Floor of Meat Store	1670-1690
Laurel Poolman	2693	Floor of Bishop's Living Quarters	1700-1720
	2695	Floor of Bishop's Living Quarters	1700-1720
	2813	Floor of Boy's Lodge (servants?)	1670-1710
Samuel Silverman	2844	Wall of Boys Lodge	1720
	2829	Floor of Boy's Lodge (servants?)	1670-1710
	2904	Floor of Bishop's Living Quarters	1700-1720