The Final Report on the Archaeofauna from Context 147 at the Medieval Fishing Station at Gufuskálar, Western Iceland.

Frank J. Feeley with Grace Cesario, Wendi Coleman, Kaitlin Crow, Alexander Huaylinos, Jason LeVasseur, Olha Lysa, Dorys Ojeda, Amber Rivers, Thomas Ryan

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Hunter College Zooarchaeology Laboratory
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ffeeley@gradcenter.cuny.edu

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Abstract: The 15th century commercial fishing station at Gufuskálar is anomalous among fishing stations in Iceland - at least those have been excavated thus far. Rich in imported artifacts and well-provisioned with expensive foods the fishers at Gufuskálar were clearly not only impoverished tenant farmer/fishers as was often the case in better documented early modern times. This report details the zooarchaeological analysis of one of the contexts excavated during the 2013 field season from a dense midden deposit dated to the early to mid-15th century CE. The large number of bones analyzed gives us a clear picture of the commercial processing of cod (*Gadus morhua*) as well as the provisioning of the fishers. Gufuskálar primarily produced the more desirable stockfish (large cod dried "in the round" or without being slit open and dried flat) and that the fishers were provisioned with choice cuts of sheep and probably dried haddock (*Melanogrammus aeglefinus*). Gufuskálar represents an important resource for understanding Icelandic fisheries history and for broader issues of North Atlantic Maritime Historical Ecology.

Keywords: Medieval Iceland, Commercial Fishing, Fishing Station, North Atlantic, Zooarchaeology

Background

Historic - The farm of Gufuskálar lies on the westernmost tip of the Snæfellsnes peninsula under the glacier known as Snæfellsjökull. While the farm likely dates to the Viking Age the site was home to a mysterious and intensive commercial fishing venture during the 15th century. A mid-15th century legal document mentioned fourteen fishing booths (seasonally occupied structures intended to house fishers) at the site, although we have not identified this many as they may have succumbed to coastal erosion or other destructive processes (Pálsdóttir 2011). The dried fish product they produced was likely transported back to continental Europe in connection with continental European merchants and/or fishers. The site is significant for its proto-industrial level of dried fish production. It is constructed just after Iceland's first brush with Bubonic Plague and may be a response to the effects of extreme depopulation. As chiefly/magnate/aristocratic power temporarily waned post-plague it may be that enterprising Icelandic fishers engaged in some sort of proto-capitalism in connection with the English merchants who wielded great influence in Iceland at the time.

Excavation – After reports of large scale erosion of archaeological deposits investigated by Minjastofnun Íslands (The Cultural Heritage Agency of Iceland), the site was test-trenched in 2008 by archaeologists from Fornleifastofnun Íslands (FSÍ), led by Lilja Pálsdóttir. They discovered excellently preserved faunal remains and structures at the rapidly eroding fishing station (Pálsdóttir 2009). From 2011-2015 in partnership with the City University of New York FSÍ continued excavations at the most critically endangered portions of the site including thick midden deposits (from which the material analyzed for this report comes from) and an entire fishing booth structure. We continue to informally monitor the site for further damage (Feeley 2016).

This report covers context 147 which was towards the bottom of the trench placed along the erosion face of the tall mound known as the *Drottningarhóll* or Queen's Mound (Trench 5). This section was roughly four meters deep and was comprised of thick midden deposits interspersed with structural material from the many phases of the construction and remodeling of fishing booths. Context 147 was a very dense concentration of midden with well-preserved organics including fish otoliths. Otoliths are likely to dissolve in soils that are not neutral in pH and are generally not found at Icelandic archaeological sites. Radiocarbon dating of this layer is forthcoming but a date from a stratigraphic layer above context 147 returned a 2-sigma radiocarbon result of 1420-1520CE. We may thus provisionally consider context 147 to date from the early to mid-15th century.

More information about the excavation of the site, as well as the history of the site, can be found in Pálsdóttir 2009, 2012, 2013, 2014, 2015, 2016. Additional information regarding the erosion of the site can be found in Feeley 2016. Additional preliminary zooarchaeological reports can be found in Feeley 2010 and Feeley 2011 and a broad overview of the site, as well as an account of our approach to community/public archaeology in the face of climate change, can be seen in Pálsdóttir & Feeley 2017.

Laboratory Methods

The archaeofauna from this context was analyzed at the NORSEC/Hunter College Zooarchaeological Laboratory directed by Dr. Thomas McGovern. In addition to our laboratory's comparative collection, identifications were aided by Schmid 1972, Hillson 2005, Cannon 1987, and Watt 1997. Bone measurements follow Von den Driesch 1976 for mammals and Morales 1979 for fish. Measurements were taken using a set of iGaging HAZM044625 calipers. The *Gadus morhua* (from now on referred to as 'cod') living size regression formulas are from Wheeler and Jones 1976 (premaxillae and dentaries) and Enghoff 1994 (atlas vertebrae). The data was entered into a Microsoft Access database and data crunching was performed in Microsoft Excel. we used the NABONE method of zooarchaeological data recording (McGovern 2009, http://www.nabohome.org/products/manuals/fishbone/nabo.htm). Ultimately, this collection will be returned to Iceland for long-term curation by the Icelandic National Museum and the raw data will be uploaded to the TDAR (The Digital Archaeological Record) data curation online application.

The daunting size of the archaeofauna from this context forced me to depart from our laboratory's usual method of analyzing fish remains. Normally, we would attempt to identify every fish bone to the most specific taxonomical position possible, but the 125 large bags of animal bones -weighing over 138 kilograms- that comprised this collection made a complete identification prohibitively time-consuming. Rather, I began by sorting the collection by broad taxonomic category (fish, mammals, birds, shells) with the help of undergraduate and graduate students. Fish were further separated into one of three categories: an unidentifiable category, bones from the gadid family of fish, and other fish species. The unidentifiable fish remains were quantified by counting a 1% sample of the total unidentifiable material, by weight, and projecting those numbers for the total unidentified category. For the gadid family of fish I targeted specific elements (vertebrae, vomers, dentaries, premaxillae, maxillae, otoliths, and cleithra) and set aside the rest of the identifiable gadid bones for potential further identification. I estimated the number of that last category by taking a 1% sample by weight and while I don't include this in the NISP or TNF count, they're estimated total is 22,100 bones. Non-gadid fish, mammals, and birds were identified to species level whenever possible. Fragmentary bones which eluded specific identification were placed in higher taxonomic levels.

Overview of Species Present

Table 1 is an overview of the species identified in context 147 and lists the scientific name, the English common name, the percentage of the total archaeofauna from context 147, and the percentage of the broad taxonomic group (fish, mammal, bird, etc.). The total number of fragments (TNF) from this context were 234,407 while the identifiable remains numbered 27,136. For reference, the NABO zooarchaeological standard states that for fish collections, an NISP of 1000 or above (for fishing sites) is suitable for comparative quantification (McGovern 2013). This single context thus represents one of the largest marine archaeofaunas from Iceland thus far.

Birds - The 35 bird bones identified roughly to species can be attributed to gulls, gannets, and guillemots (in order of frequency). There's no evidence for butchery on any of the bones, the lack of nearby fowling areas, and the low number of bones have led me to believe that they likely were not hunted for food. In the zooarchaeological report and associated article for the 15th century fishing station at Akurvík, Amundsen *at al* suggests that seabirds may be attracted to fish processing sites and may be killed if they interfere with the fish-drying process (2004, 2005). Seabirds are also often entangled in fishing lines when they strike baited hooks and would be considered bycatch (American Bird Conservancy 1992). There are many ways which these bird remains may have been incorporated into the middens at Gufuskálar.

Mollusks - It's also unlikely that the mollusk shells recovered on site were the result of the fisher's foodways. There aren't many shells, and these could have easily been incorporated into the midden material via fish guts or by other natural means. Most of the 436 shell fragments identified were heavily fragmented and delaminated so they likely represent only a handful of individual mollusks. In his discussion of the considerable number of mollusks from the Faroese site of Undir Junkarinsfløtti, Brewington mentioned the Scottish and Faroese traditional use of mollusks as bait for fishing (2006). The dearth of mollusk shells at Gufuskálar raises the question of what bait was used by the fishers at Gufuskálar.

MAMMALS		NISP	% total	% Domestic
DOMESTIC Mammals				
Bos taurus	Cattle	47	0.17	9.34
Canis familiaris	Dog	2	0.01	0.40
Equus caballus	Horse	1	0.00	0.20
Sus scrofa	Pig	1	0.00	0.20
Ovis aries	Sheep	116	0.43	23.06
Caprine	Sheep/Goat	336	1.24	66.80
total Caprine		452	1.67	89.86
total Domesticates		503	1.85	
WILD Mammals		**NISP**	**% total**	**% Wild**
Cetacea	Whale	8	0.03	100
	Total Mammals	511	1.88	
BIRDS		**NISP**	**% total**	**% Birds**
Larus species	Gull	16	0.06	13.45
Sula bassana	Gannet	13	0.05	10.92
Uria aalge	Guillemot	6	0.02	5.04
Aves sp. Indet.	Bird species	84	0.31	70.59
	total Birds	119	0.44	
FISH		**NISP**	**% total**	**% Gadidae**
Gadus morhua	Atlantic Cod	8240	30.37	35.40
Brosme brosme	Tusk/Cusk	1066	3.93	4.58
Melanogrammus aeglefinus	Haddock	10748	39.61	46.17
Molva molva	Ling	153	0.56	0.66
Pollachius virens	Pollock	875	3.22	3.76
Gadidae sp. Indet.	cod family	2195	8.09	9.43
All Gadidae total		23277	85.78	
FLATFISH		**NISP**	**% total**	**% Flatfish**
Hippoglossus hippoglossus	Halibut	2310	8.51	97.84
Pleuronectes platessa	Plaice	6	0.02	0.25
Pleuronectidae sp. Indet.	Flatfish	45	0.17	1.91
All Flatfish total		2361	8.70	
OTHER FISH		**NISP**	**% total**	**% Other Fish**
Anarhichas lupus	Atlantic Wolffish	351	1.29	81.25
Somniosus microcephalus	Greenland Shark	12	0.04	2.78
Squalus acanthias	Spiny Dogfish	69	0.25	15.97
All Other Fish total		432	1.66	
Total all fish		26,070	96.07	
MOLLUSKS		**NISP**	**% total**	**% Mollusks**
Mya species	Clam	1	0.00	0.23
Littorina species	Periwinkle	16	0.06	3.67
Buccinidae species	Whelk	2	0.01	0.46
Mollusca sp. Indet.		417	1.54	95.64
Total all Mollusks		436	1.61	
Total NISP		**27,136**		

Unidentifiable	UNI/UNIM/FISH	205945
Large Terrestrial Mammal	LTM	18
Medium Terrestrial Mammal	MTM	1308
Total Number of Fragments		234,407

Table 1: Species present in context 147.

Taphonomic Factors

While overall organic preservation was excellent, there was extensive fragmentation of the recovered bones. 11.58% of the total number of fragments could be identified to family or species. Mammal bones identified by broad taxonomic categories (large terrestrial mammals, medium terrestrial mammals) make up 0.57% of the collection and 87.86% were unidentifiable. This fragmentation rate may be due to the fragile nature of fish bones.

- **Gnawing**: There were no elements identified as having been gnawed on by animals.
- **Butchery**: Only 71 fragments from the total identified archaeofauna had definitive butchery marks. Most of these are on mammal bones and marks that are the result of fish processing are rare. Only three fish vertebrae exhibit knife marks likely related to butchery.
- **Burning:** Of the total number of fragments (TNF) there were 6209 fragments that were either scorched, burned black, or burned completely white, making up about 2.66% of the total number of fragments. 99.63% of these are from small fragment of unidentifiable material. Other contexts from Gufuskálar hover around 3% burned material. The fishing site of Akurvík in the Northwest of Iceland reports just under 1% burnt material overall. Throwing bones into a hearth may act as a convenient way of disposing of bones while helping to slightly extend a fire.

Bone Artifacts

Figure 2. Item is a few centimeters tall. This is likely a gaming piece carved from the cleithrum of a haddock.

While most of the artifacts from the site will not be discussed in this report I do want to make brief mention of some of the artifacts made from bone that came out of context 147. Many are gaming pieces which are rather frequent finds from the site. It's difficult to say which game these pieces come from, but many end up being called "chess pieces" despite there being more games than just chess in the medieval era. Figures 1 and 2 are examples of the types of small gaming pieces made from bone. **Figure 1** seems to be expediently carved from the end of a haddock's cleithrum bone. This element is sturdy enough to make small items out of and was a commonly used raw material for carvings. **Figure 2** is a disk expertly carved from a dense mammal bone (species unknown). The multiple ring and dot motif is a very common decorative element in the North Atlantic.

Figure 1: The dark blue boxes in the back are 1cmx1cm for scale. This is likely a gaming piece made from an unidentified mammal bone.

The whale bones listed in Table 1 consist of eight chips that seem to be the result of working whale bone. Whale bone is a common raw material for craft-work and the debitage from working whale bone is found at other fishing stations such as Akurvík in Iceland's northwest (Krivogorskaya *et al* 2005). This use of whale bone is not in itself evidence for the hunting of whales, however, as whales are often washed up on shore. In Iceland beached whales are interestingly called *hvalreki* or "whale-wrecks" and the term is now used to signify a windfall profit.

There are also eight mammal bones which have been sawn (one from cattle, six from caprines, and two are unidentifiable to species). Sawing wasn't a common method for butchering animals, so it's likely related to artifact-making. One of these is a metatarsal from a sheep which has grooves worn into it. Perhaps it was used as a bobbin for winding fishing line?

Discussion

Commercial fishing: A commercial fishing zooarchaeological signature identified by Dr. Sophia Perdikaris (1999, 2007) comprises a series of inter-related variables aimed at determining if a fishing operation was geared towards subsistence or commercial dried fish production. It may be useful to review these variables considering the data from context 147 at Gufuskálar.

- *A high volume of fish:* At Gufuskalar excavations of only a small part of the original site have generated over a ton of faunal material for analysis, most of which is from fish. For context 147 fish make up almost 96% of the overall identifiable archaeofauna. If the estimated number of unidentified gadid remains is included this number would probably reach 99%. This is like the results from the smaller fishing site at Akurvík (Amundsen et al. 2004) and is consistent with our previous results at Gufuskálar (Feeley 2011).

- *A concentration on a specific species of fish*: The gadid family of fish have relatively low levels of oil in their flesh making them ideal for air drying (without salt). Fish that are too oily will not dry enough during the Icelandic winter and will therefore rot before being fully cured. It's said that air-dried cod has a shelf-life of about seven years (Perdikaris 1996) and is traditionally the preferred export fish in Iceland. At a commercial fishing enterprise, we would expect gadids to dominate the fish category.

  The fish remains from context 147 can be divided broadly into three categories: Gadids (89.29% of total fish), Flatfish (9.05% of total fish), and Other Fish (1.65% of total fish). The gadids, due to their physiology, are presumed to be the fish meant to be dried. Flatfish are too oily to dry properly and are likely caught to feed the fishers. The other fish may be bycatch, fish caught accidentally while targeting another species, or fish caught as food meant for the fishers. In this data set the gadids dominate among the fish suggesting a focus on dryable fish. Interestingly, the "other" category includes a few elements from what is likely a Spiny Dogfish (a common commercial fish today but to my knowledge not before recognized at any medieval Icelandic fishing site) and a few vertebrae from what is likely a Greenland Shark which is the preferred species for the Icelandic delicacy of fermented shark (*Hákarl*). Both species are cartilaginous so all we can expect to find from them are vertebrae and teeth and are not easily identified to species. These may be the result of bycatch, though specialized shark fishing sites were known from later documentary records in the West Fjords.

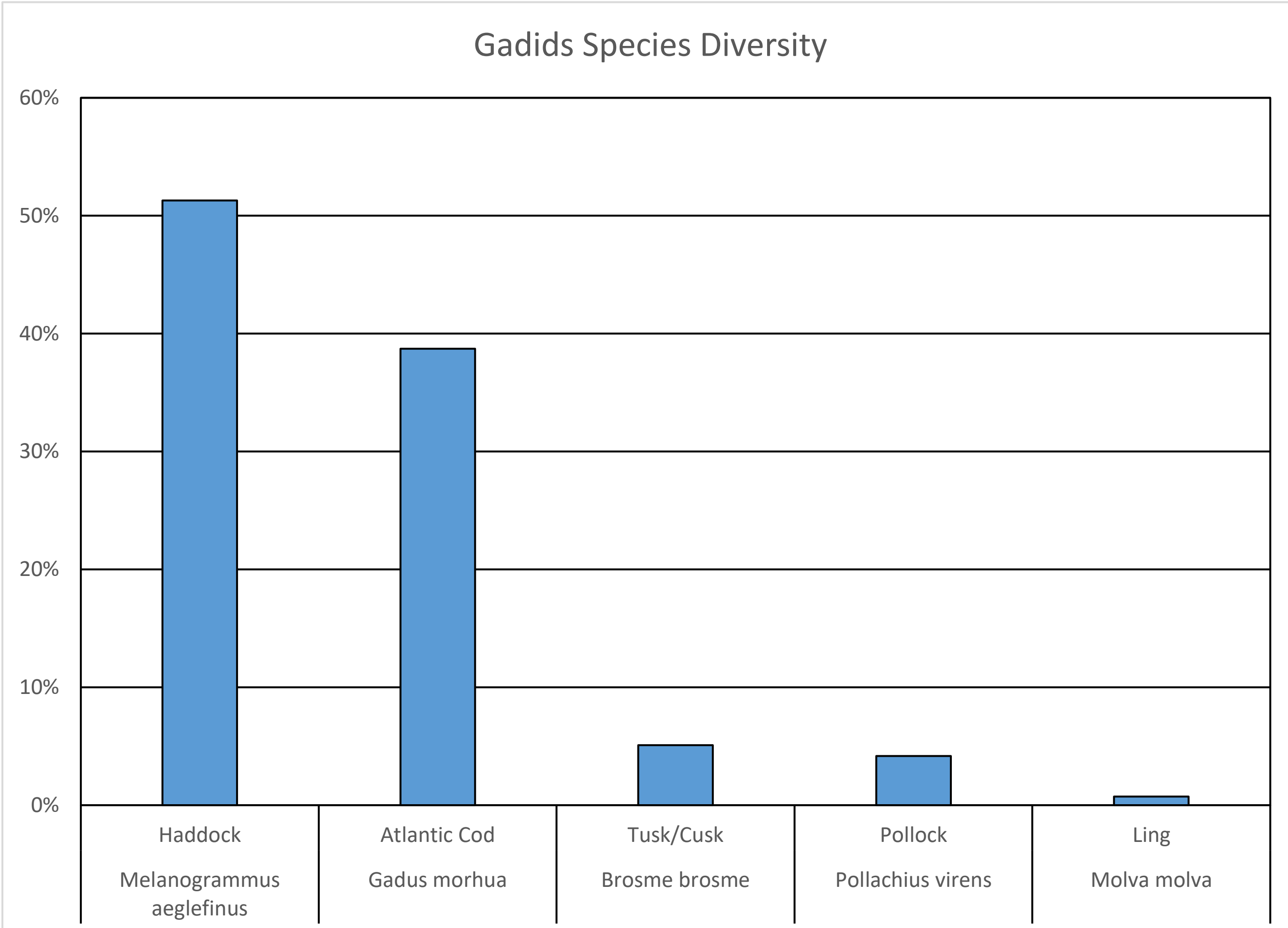

Figure 3 - Gadid species diversity. Haddock are discussed in the "Provisioning" section.

Within the gadid family of fish haddock are the most numerous, but their element distribution suggests that they were being caught and processed elsewhere, possibly coming to Gufuskálar as a dried product to provision the fishers there (more on this below in the discussion of provisioning). The “gadidae” category are elements that could be identified as belonging to a gadid, but further species identification was impossible. **Figure 3** graphs this distribution of gadid species. The *Brosme brosme, Pollachius virens,* and *Molva molva* are at a low enough frequency that they could certainly be the result of bycatch. At the small fishing station of Akurvík cod then haddock dominate the gadid category with the other gadid species making up less than 1% of the archaeofauna. Gufuskálar certainly looks different in terms of species diversity but cod are clearly still very important.

- *The elemental distribution of the targeted commercial species should favor cranial elements over those of the body of the fish at a production site*. Dried fish are produced by removing the head (along with some of the vertebrae) and removing the entrails. The cleithrum is left in the body of the fish to stiffen the opening. Depending on the desired product the fish may be split open along the belly and dried flat or left whole. As the body of the fish would eventually dry and then be sent elsewhere (taking a long with it the caudal vertebrae and cleithra trapped within the dried meat), we would expect to find a preponderance of cranial elements at a fish production site.

Figure 4 compares the number of selected cranial elements of cod to cleithra from context 147. Clearly cranial elements are favored in this collection. **Figure 4** uses the NABONE codes for fish elements. CLE are cleithra, DEN are dentaries, PMX are premaxillae, and VOM are vomers. These elements work well for this type of analysis as dentaries, premaxillae, and vomers are generally sturdy bones in gadids who can be confidently identified to species.

Additionally, we can look at the ratios of the three types of fish vertebrae found at the site. Going from the head to the tail fish have thoracic, pre-caudal, and caudal vertebrae. Depending on the desired dried fish product a fish's head would be removed along with their thoracic vertebrae. For the smaller flat dried product additional pre-caudal vertebrae would be removed. **Figure 5** shows the normalized numbers of each type of vertebrae found in context 147 for cod. At a site where the fish were processed and eaten each column would be even but here we see a relatively greater number of thoracic and pre-caudal vertebrae indicating that the caudal vertebrae had been sent away in a dried fish product. The slightly higher number of pre-caudal vertebrae suggest that at least some of the cod processed at Gufuskálar were either eaten on site or slit open and dried flat. As described in Krivogorskaya 2005 and Perdikaris 1999 flat-dried fish have more precaudal vertebrae removed than fish prepared using the stockfish method of just removing the head and thoracic vertebrae.

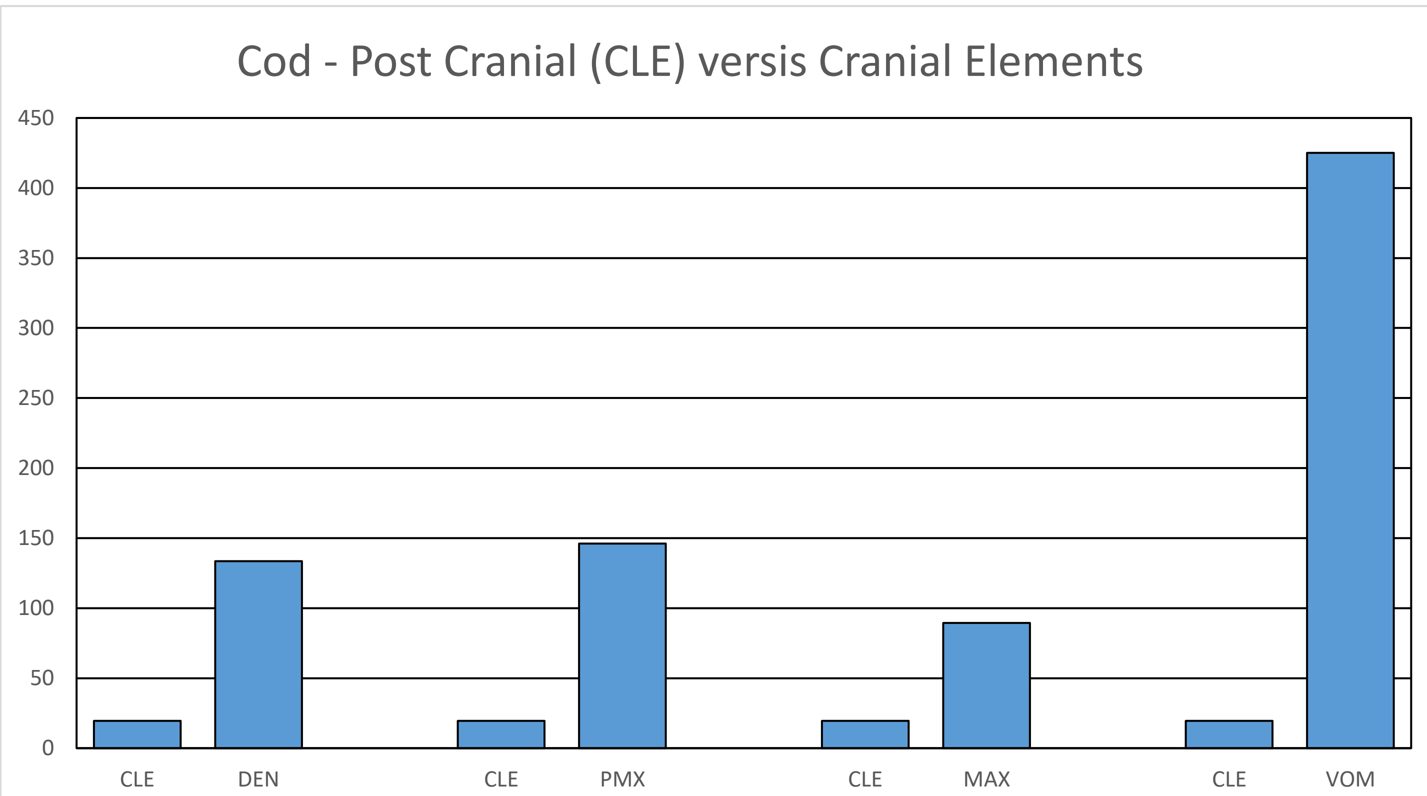

Figure 4 - Post cranial (cleithrum) to cranial elements (dentary, premaxillae, maxillae, vomers) from cod in context 147 using NABONE element codes. MAU stands for "minimum animal unit" and is a way to normalize body parts for comparison. For instance, a cod fish will have two cleithra but only one vomer.

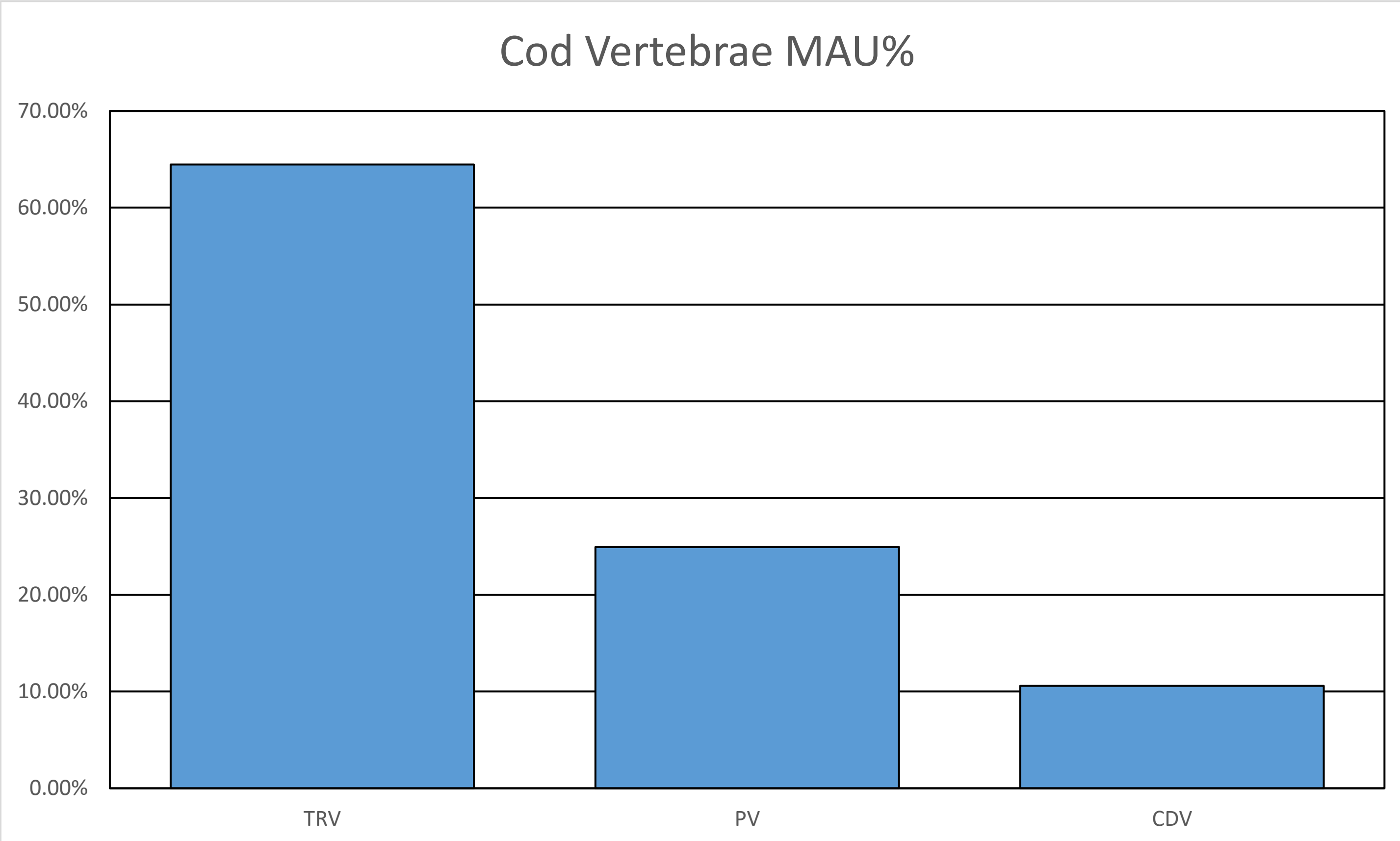

Figure 5 - Cod vertebrae from context 147 taking into account the varying number of each type of bone in the typical fish. Note the preponderance of thoracic vertebrae indicating that the caudal and some precaudal vertebrae have been shipped away in the dried fish product, leaving the thoracic vertebrae removed with the head during processing.

- *A commercial product tends to be standardized in size as a means of quality control. At a commercial fishing site, we expect to find fish of a specific size, depending on the specific fish product.* We recognize two dried cod products that are produced in medieval Iceland. Smaller fish within the 40-70cm range are generally split open before drying and are referred to as flat-dried fish. Larger fish within the 60-110cm range would not be slip open and rather “dried in the round” and are referred to as stockfish (Krivogorskaya 2005). Fish under 40cm tend to dry too quickly in the open air and the meat will suffer damage in a process somewhat like freezer burn. Fish larger than 110cm wouldn’t have enough time to fully dry out during the Icelandic winter and would rot. In other words, these aren’t arbitrary constraints on fish-size but rather the result of the practical concern over creating a product of consistent quality.

The living size of a fish can be reconstructed by taking measurements along certain landmarks of the three elements listed below and running those measurements through regression formulas specific to that element. For this size reconstruction I used cod premaxillae, dentaries, and atlas vertebrae. Bones that had any damage or wear along the measurement landmarks were not used. All measurements were taken three times and averaged. The regression formulas used came from Wheeler and Jones 1976 (premaxillae and dentaries) and Enghoff 1994 (atlas vertebrae). X is the measured variable and TL is the total length.

- Premaxilla: TL=(60.83*X)+10.35
- Dentary: TL=(80.14*X)+102.3
- Atlas: $TL=8.73172*X^{0.8260}$

Figure 6 contains the results of these measurements from context 147. While there were many dentaries identified as cod, only seven were suitable for measuring, so the data from such measurements isn't convincing. However, when compared with the more numerous atlases and premaxillae it follows the same trend. The premaxillae probably illustrate this trend the best. The measurements of the 113 premaxillae fall along a bell curve that runs within our "stockfish window" of 60-110cms. It's clear that Gufuskálar is a stockfish producing fishing station. However, the vertebrae data above suggests that some flat-dried cod was also produced. This may account for the smaller number of <60cm cod identified in Figure 6.

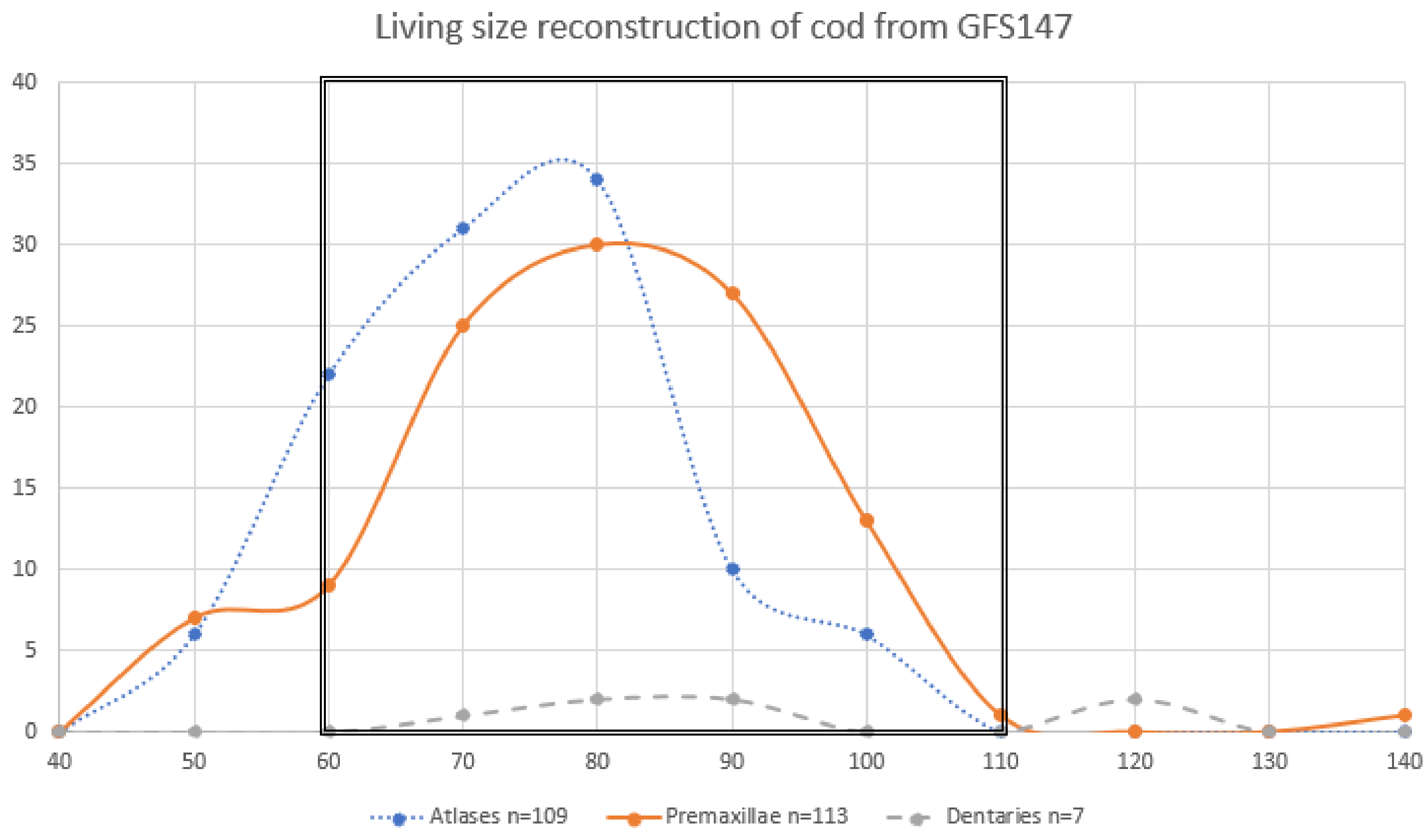

Figure 6 - Living-size reconstructions from cod. Size (in centimeters) along the X axis and number of elements falling within that size category along the Y axis. Atlases are the dotted line, premaxillae are the solid line, and dentaries are the dashed line. The double-lined box represents the "stockfish window". There's a clear spike in frequency in the "stockfish window" suggesting that stockfish was being produced at Gufuskalar.

Provisioning: The previous discussion involved what product the fishers at Gufuskálar made. Below is a discussion of what they ate. Particularly what foods were brought in from elsewhere to provision the fishers.

Fish: While it's certainly plausible that the commercial fishers would have caught fish for their own meals this would restrict the number of large cod fish that could be brought home to dry. Medieval Icelandic fishing boats were not large, and space may have been reserved for the commercial product. None-the-less a large percentage of the gadids found at the site are not from cod (the fish of commercial interest) but rather haddock (*Melanogrammus aeglefinus*). Today, when asked why Icelanders don't eat much cod and instead prefer haddock the traditional response is "We don't eat money." Haddock as a staple food seems to be the case at Gufuskálar as well. A closer examination of the haddock bones reveals a strong CONSUMER signature rather than PRODUCER signature. Comparing the post cranial to cranial elements demonstrates the reverse of what we see for the cod above. **Figure 7** compares the cleithrum (CLE) of haddock to the number of dentaries (DEN), premaxillae (PMX), maxillae (MAX), and vomers (VOM). Here we clearly see more cleithrum which would have been left in the meat of the fish to stiffen it for drying and would have been ultimately been deposited at the consumer site.

Figure 8 shows the distribution of haddock vertebrae. At a consumer site we expect to find a disproportionate number of caudal vertebrae to thoracic or pre-caudal vertebrae. At a site where people are catching and eating their haddock we would expect to see all the bars on the graph to be level. Like the cranial/post-cranial ratio among the haddock and cod we see the reverse of the vertebral pattern.

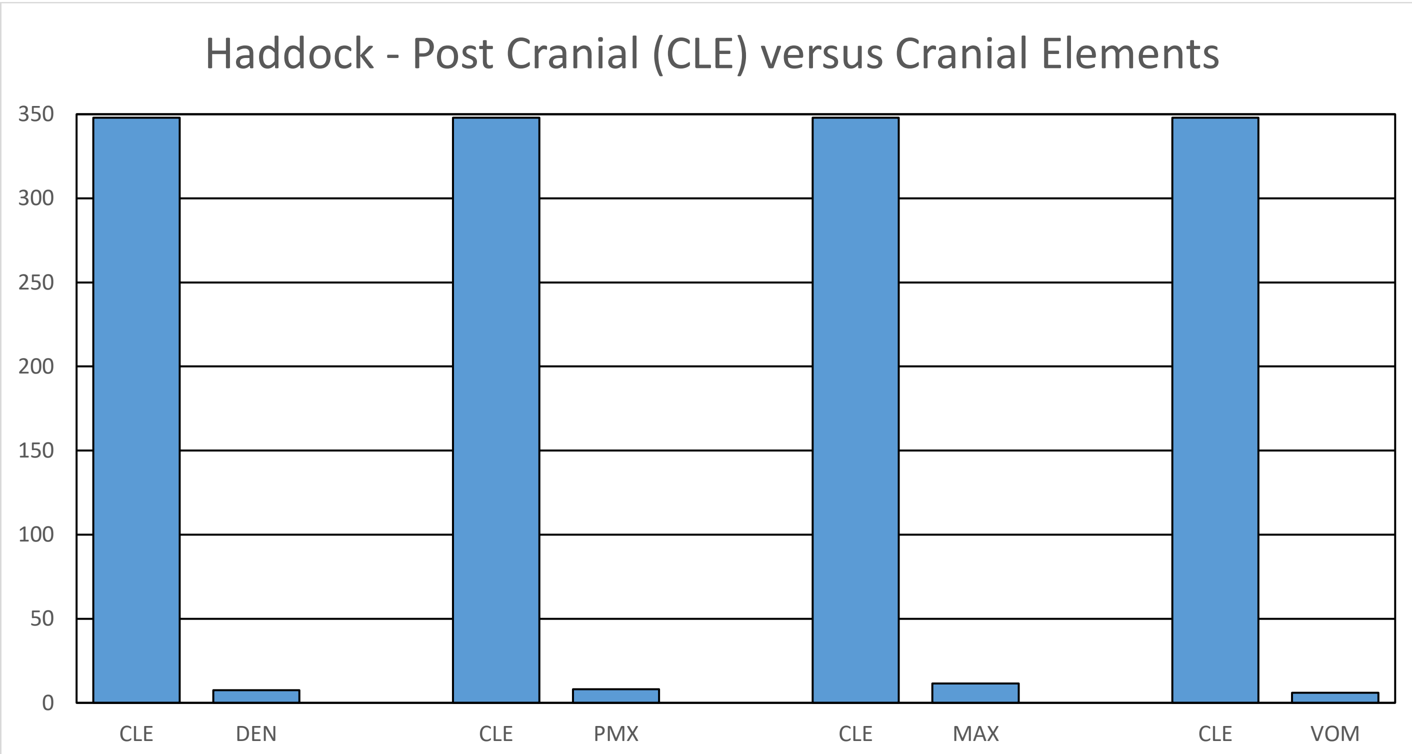

Figure 7 - Comparison of post-cranial (CLE or cleithrum) to cranial elements of haddock using the minimum animal unit to normalize the data for the number of elements in a fish. Here we have a strong consumer signature suggesting that the fishers at Gufuskálar are being provisioned with haddock produced elsewhere.

Flatfish: 8.53% of the overall faunal assemblage (and 9.91% of the total fish) comes from flatfish. These fish are very oily and cannot be dried, so they are not a commercial product. Flatfish are found in much smaller numbers at the contemporary site of Akurvík (Amundsen 2004) than they are at Gufuskálar. The high number of flatfish remains indicated that they may have been caught to provision the fishing station rather than as simply bycatch.

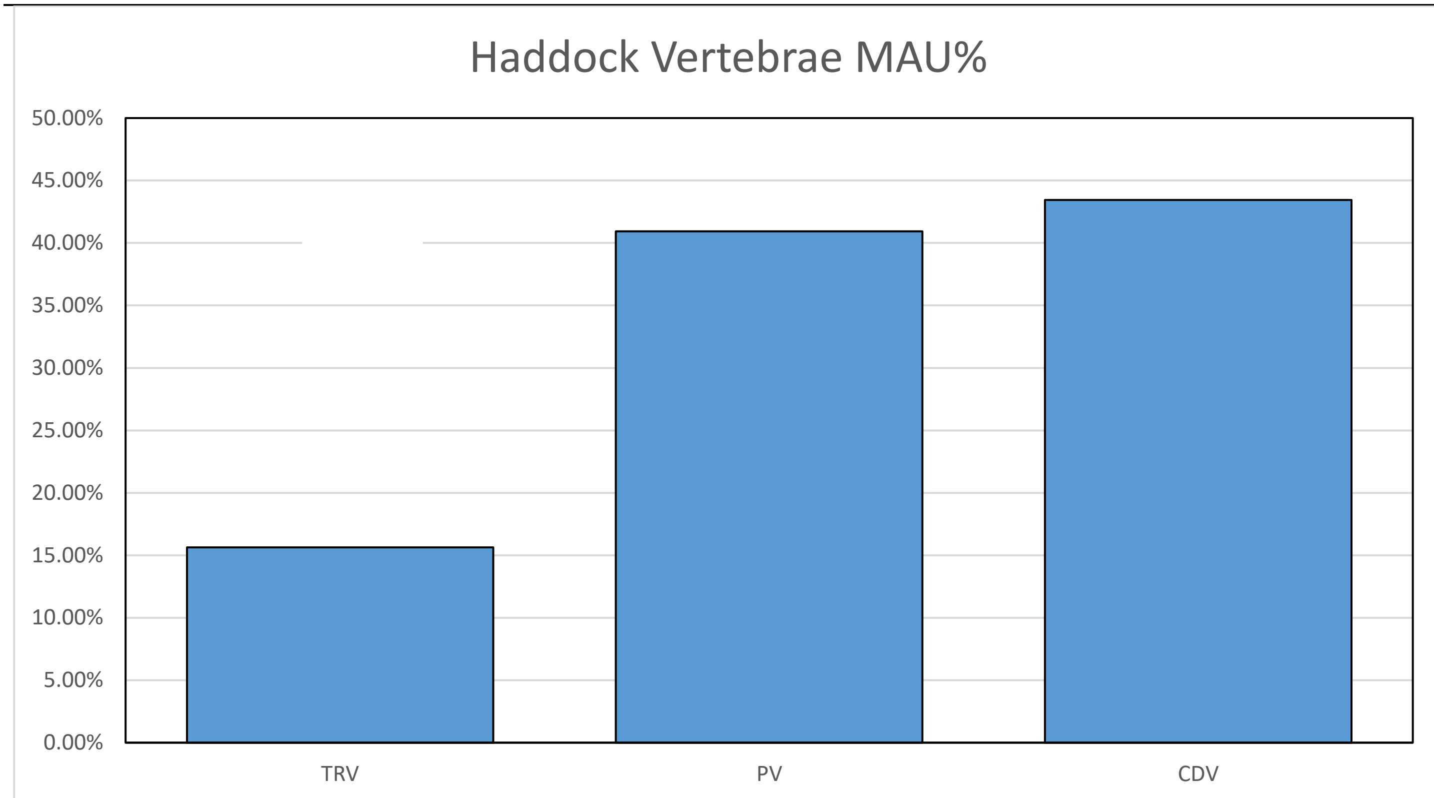

Figure 8 - Haddock vertebrae demonstrating that fish are being processed off-site and brought to Gufuskálar. The caudal vertebrae (CDV) make up the highest percentage. In a subsistence fishing site these bars would all be level. In a producer fishing site, we would find thoracic vertebrae (TRV) dominating the percentages.

Mammals: The mammal data from another context at Gufuskálar has previously been written about in Feeley 2011. The previous data indicated that the fishers were being provisioned with cuts of lamb with very few examples of other mammal species. Context 147 basically continues this trend with a few additions. This is very different than what's seen at the fishing station of Akurvík where only a few dozen domestic mammal bones were identified out of the extensive archaeofauna (Amundsen 2004).

Caprines - 6.82% of the mammal bones can be positively identified as coming from domestic sheep (*Ovis aries*), 18.18% are identifiable to the broader caprine group which includes sheep and goats, and 70.78% were identified as belonging to Medium Terrestrial mammals. The MTM category can also include dogs and pigs. Since most of the elements in the MTM category are probably from sheep and no goats have been identified, these categories are collapsed for the purposes of element distribution analysis. **Figure 9** contains the distributive data for these bones. As in the previous mammal bone analysis there are very few foot bones and very few cranial elements. This, again, suggests that the fishers at Gufuskálar are being provisioned with cuts of sheep meat. We have no evidence for Svið, a traditional Icelandic food consisting of a sheep's head cut in half. Two metapodials (one specifically identified as belonging to a sheep and the other identified as a caprine) have evidence for biperforation where marrow is extracted from the bone by drilling two small holes at either end of the bone to suck the marrow out.

Previous work indicated that the sheep were rather young and likely would be considered lambs. **Figure 10** contains the caprine bone fusion data. While there are certainly some percentage of lambs in this collection there are certainly quite a few older individuals from 2-3.5 years old.

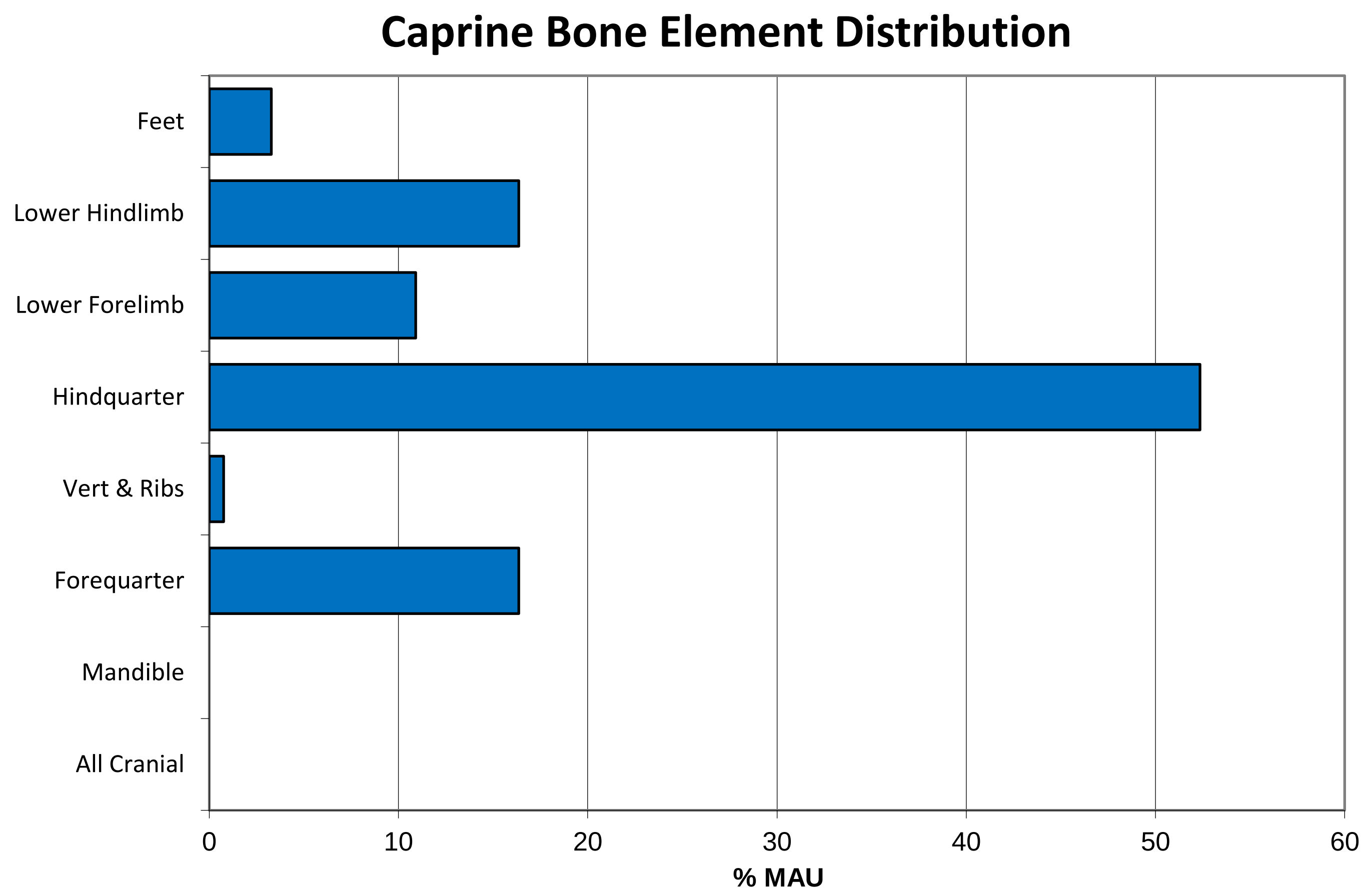

Figure 9 - Elemental distribution of sheep bones. Note the small number of cranial or foot bones. This indicates that cuts of meat are being delivered to the fishers.

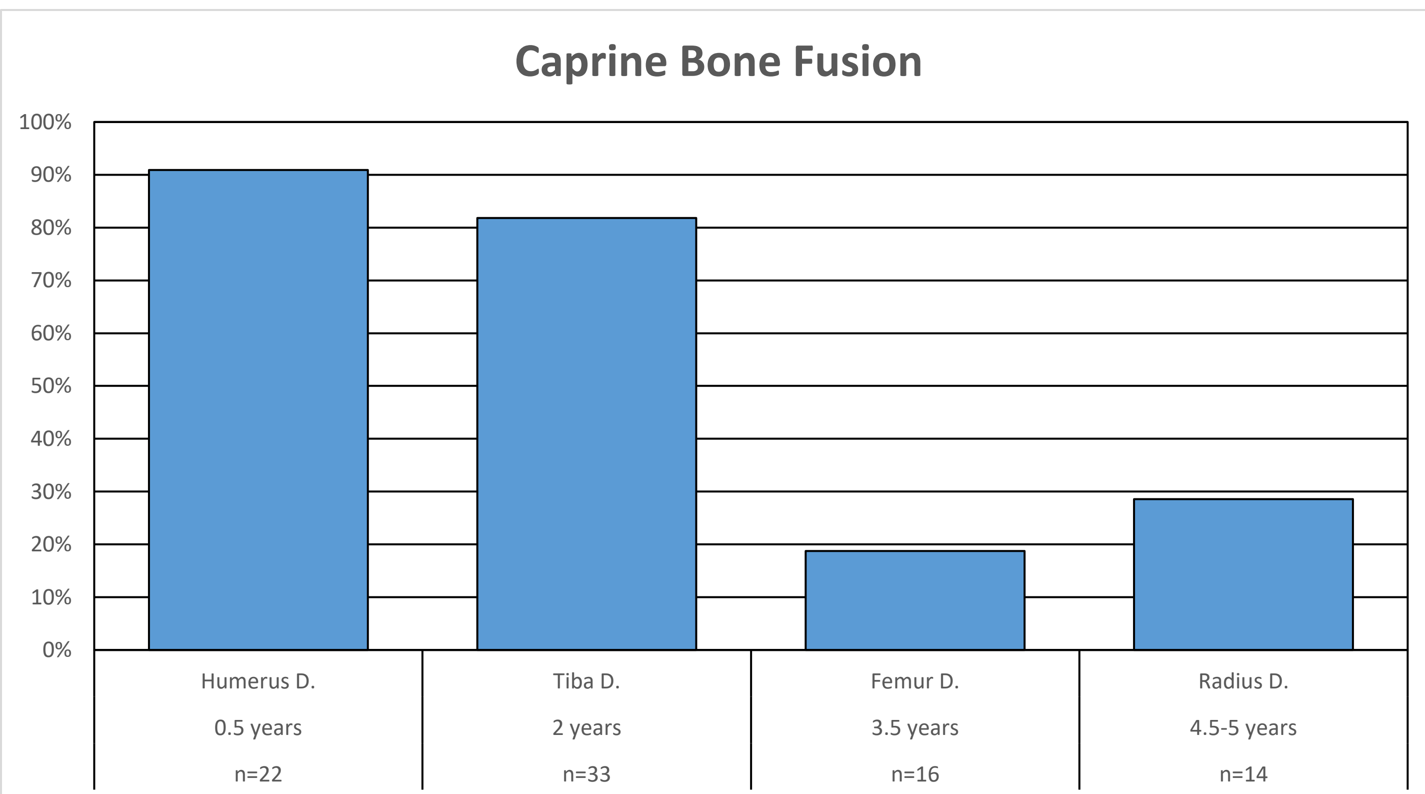

Figure 10 - The bars represent the percentage of fused elements from the sheep of context 147. The age of fusion follows McGovern 2013. This graph demonstrates that while some were certainly young lambs most were between 2 and 3.5 years old.

Cattle (*Bos taurus*) - Cattle bones number about 3.51% of the mammal bones from context 147. This includes the overarching Large Terrestrial Mammal category of which cattle and horse bones could reside. Again, the lack of horse bones leads one to believe that these bones are likely cattle. **Figure 11** charts the element distribution for these cattle bones. Again, no cranial elements and very few feet suggest that cuts of beef are being brought to the fishing station. The low number of cattle bones suggests that beef was a rare treat.

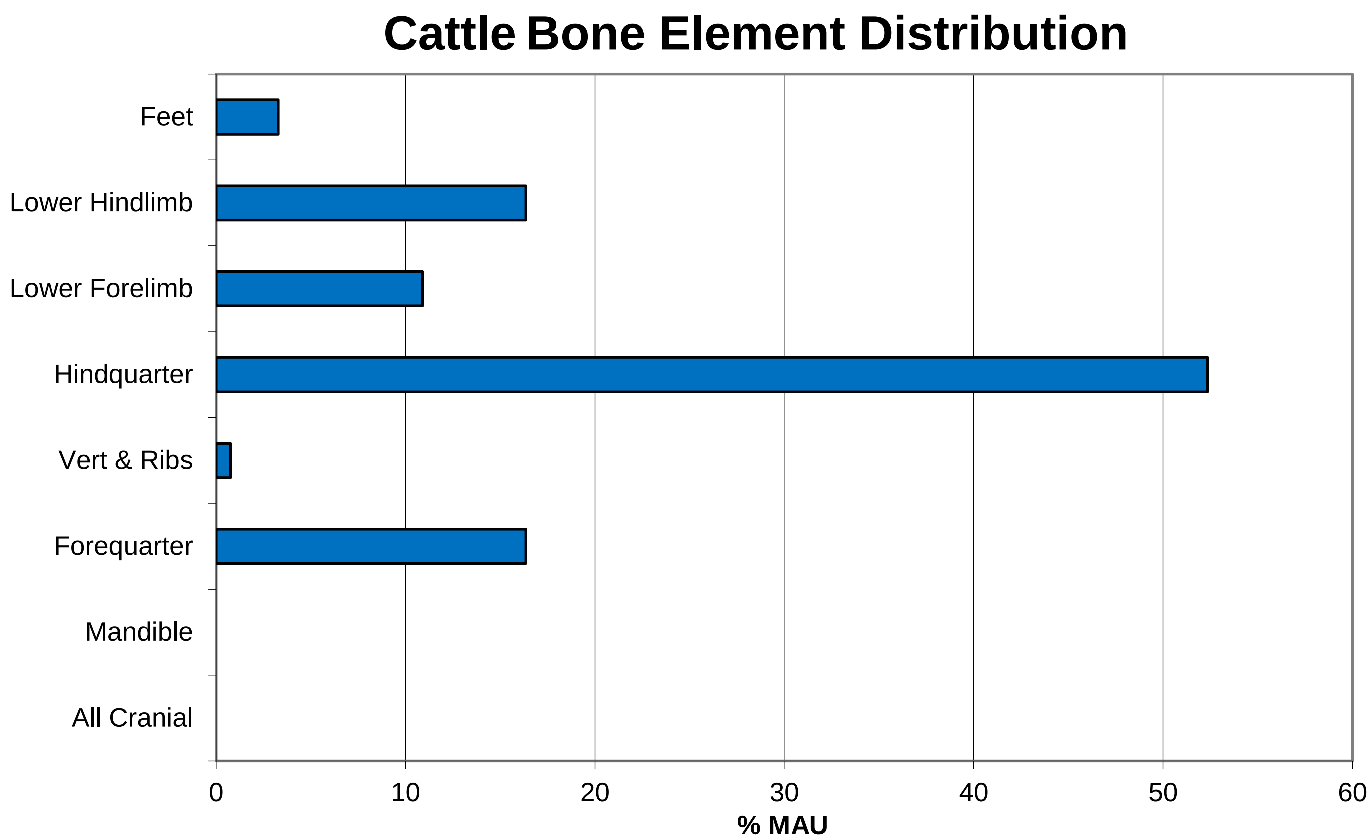

Figure 11 - Element distribution for cattle bones from context 147. The lack of cranial elements suggests that cuts of meat were coming into the fishing station rather than while animals. Cattle remains make up 3.51% of the total mammal remains suggesting that beef was a rare treat.

Pigs (*Sus scrofa*) - One unexpected find were the remains of a single, very young pig. The 12 bones articulated well and are of relative size to one another, so they almost certainly represent one animal. In the later medieval era pigs become rare in Iceland and aren't generally found in midden contexts. No cranial elements have been identified and forelimb and hindlimb elements are present. It's possible this pig came to the site as a preserved or pickled pork product.

Dogs (*Canis familiaris*), Horses (*Equus caballus*), and Whales (Cetacea) - The final mammal remains consist of a few teeth from a dog. The size is a bit smaller than the Icelandic sheep dog we have in our comparative collection, so it's likely from a medium-sized dog. There is a single horse tooth, and the whale chips are mentioned above. None of these species necessarily contributed to the diet of the residents.

Summary

The data presented above supports and adds to the previous interpretation of the Gufuskálar fishing station (Feeley 2011). The fishers here were primarily producing the highly valued stockfish dried fish product from the Atlantic cod (*Gadus morhua*). They were provisioned with haddock (*Melanogrammus aeglefinus*) which was being processed elsewhere and transported to the fishing station as well as with sheep (*Ovis aries*) and some cattle (*Bos taurus*). There is additionally a one-off cut of pork in the mix as well. The fishers also seem to have caught flatfish and consumed their bycatch to supplement their provisions.

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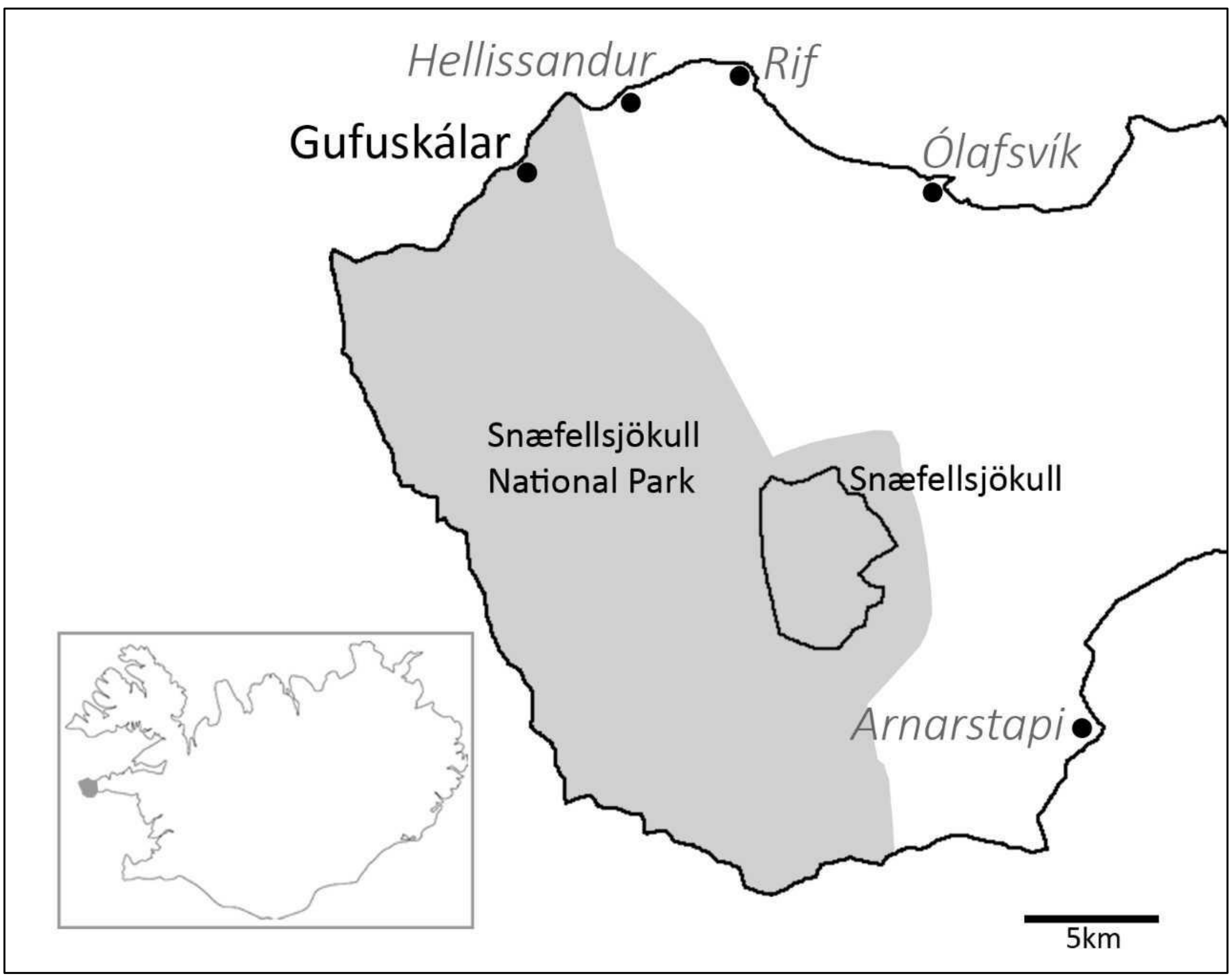
Location Map



Map of study area with modern village names in italics and the border of the national park outlined.

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