CHAPTER TWO

VIKING AGE ECONOMICS AND THE ORIGINS OF COMMERCIAL COD FISHERIES IN THE NORTH ATLANTIC

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The origins of commercial fishing: old problems and new insights

This paper presents the results of sustained investigations in Iceland over the past two decades, which have produced large archaeofauna from both coastal and inland sites dating from the ninth to the nineteenth centuries. It seeks to place these collections in the wider context provided by new inter-regional syntheses and to present a series of analytical approaches to understanding patterning within fish-dominated archaeofauna. A multi-indicator approach is applied to the complex issues of distinguishing fish consumer and fish producer sites, and the still more complex problems of distinguishing probable subsistence production from possible market production on coastal sites.

Nearly a decade of investigation of Viking-age inland sites around the highland lake Mývatn in northeastern Iceland has produced archaeofauna rich in domestic mammals and freshwater fish, but also containing significant amounts of apparently preserved salt water fish.[2] Work in the West Fjords of northwestern Iceland has produced fish-rich archaeofauna

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[2] McGovern, Perdikaris *et al.* (2001); McGovern *et al.* (2005).

from coastal sites (both classic deeply stratified farm mounds and shallow seasonal fishing stations) dating (from the twelfth to the nineteenth centuries).[3] These sites have all been comparably excavated (stratigraphic excavation with 100 percent sieving) and recorded into a common data management system,[4] and provide the basis for systematic comparison between archaeofauna. Thanks to the support of the Leverhulme Trust's *Landscapes Circum Landnám* project,[5] a series of radiocarbon dates and Carbon and Nitrogen isotopic assays are also now available for Viking-age human and animal burials in the inland Mývatn region, providing a check and supplement to the (zooarchaeological) evidence.

This Icelandic work is placed against a background of comparable archaeofauna from elsewhere in the North Atlantic, and this paper has been particularly inspired by synthetic work by James Barrett and his collaborators.[6] Barrett and his co-workers have recently made use of all available datable British archaeofauna to define a surprising but convincing 'fish event horizon' of c. AD 950–1050).[7] Prior to this temporal and spatial horizon, marine fish-bones are virtually absent on any inland site in Britain, and the dense 'fish middens' documented by many workers in Northern Scotland and the Northern Isles also seem to post-date the horizon. The 'fish event horizon' appears as an archeological event horizon (constrained at present by the limitations of radiocarbon dating) without evidence of a gradual local process of development. There is an emerging consensus among workers active in the Hebrides, Orkney, and Shetland that deep-sea marine fishing intensified with the arrival of the Scandinavians, and that the Celtic peoples of the Northern and Western isles were probably not engaged in large scale deep sea fishery during the later Iron Age.

This zooarchaeological pattern is also reflected in the far more terrestrial isotopic signatures of the bones of pre-Norse island human populations, which suggests a significant increase in seafood consumption following the Scandinavian settlement.[8] It thus appears that large-scale production and exchange of dried fish did not originate within the British Isles. Any evidence for extensive exchange between coastal

[3] Amundsen (2004); Amundsen *et al.* (2005); Edvardsson *et al.* (2004; 2005); Krivogorskaya *et al.* (2005).
[4] NABONE 8.0. Perdikaris *et al.* (2004).
[5] Edwards (2004).
[6] Barrett (1997; 2000; 2001; 2004; 2005; this volume).
[7] Barrett, Locker and Callum (2004; this volume).
[8] Barrett *et al.* (1997; 2001); Cerron-Carrasco (1998); Nicholson (1998).

and inland sites elsewhere in the North Atlantic/North Sea region prior (to c. 1000) becomes particularly significant. One potential source for the fish event horizon in Britain and the general expansion of marine fishing in the eleventh-early twelfth century are the Scandinavians.

The Scandinavian connection?

Fishing, hunting of sea mammals and sea birds, and the collecting of shellfish and sea-bird eggs were all features of Scandinavian subsistence economies far back into prehistory. Most Nordic farmers of the later Iron Age probably spent as much time aboard a boat as behind a plough, and the notion that Scandinavian coastal subsistence economies stood upon 'one green foot and one blue foot' is well established in Nordic archaeology.[9] The investigation of the interaction of marine and terrestrial economies remains an important regional research topic that is now attracting the sustained attention of several interdisciplinary, international research programs.[10] Even for inland settlements in Atlantic Scandinavia, the sea remained the lifeline of northern existence, with seals, seaweed, sea-bird eggs and marine fish travelling many kilometres from the shore.[11]

During the Viking age (traditionally c. 750–1100), Scandinavian peoples and their dual maritime/terrestrial economies expanded into northern Europe, and populated the offshore islands of the North Atlantic, briefly reaching North America by the year 1000. Viking age society was strongly competitive, and chieftains employed war, piracy, 'protection racket' threats (Danegeld), and the control of distribution of both staple and more prestigious goods to attract and hold followers both in the ancestral homelands and in the new lands of the Atlantic expansion.[12] A key element for these expansionist movements and the subsequent accumulation of wealth was intensive marine fishing and the production of air-dried cured fish.[13] This staple product could be stored for five to seven years without salt or refrigeration, and provided a source of light, portable, and highly nutritious protein to provision farm households, travellers, boats, crews, and marauding raiders.

9 Bertelsen (1991).
10 McGovern (2004); Edwards *et al.* (2004).
11 McGovern (1985); McGovern, Perdikaris *et al.* (2001), McGovern *et al.* (2005).
12 Vésteinsson *et al.* (2002); Perdikaris and McGovern (2005).
13 Perdikaris (1999).

While a range of preservation methods were used, the two most common products were 'stockfish' (air dried in the round, with most of the vertebral column left in the finished product) and *klipfisk* (air dried as a flattened product, with the upper thoracic and precaudal vertebrae largely removed along with the head). Stockfish production is possible only where temperatures fluctuate around the freezing point for months at a time, and strong winds aid the freeze-drying process. The Lofoten and Vesterålen islands in arctic Norway have ideal environmental conditions for winter stockfish production, and have produced some of the earliest archaeological evidence for intensive stockfish production, extending back to the early Iron Age.[14] *Klipfisk* can be produced under a wider range of temperatures, sometimes being dried simply by being spread over beach cobbles. Stockfish and *klipfisk* can be produced from a range of white- fleshed (non-oily) fish, but the cod family (gadid) fish have traditionally been the main species used. Stockfish are best made from individual fish between 60 and 110 cm in live length, while *klipfisk* are best made from fish around 40–70 cm in live length.[15]

From the twelfth century onward, there is abundant historical documentation for the large- scale production of stockfish from the Lofoten and Vesterålen islands, and the commercial-scale production of both stockfish and *klipfisk* from the Orkneys, Shetland, and (by c. 1250) from Iceland.[16] By the high Middle Ages, the preserved Atlantic fish trade underwrote much of the mercantile life around the North Sea and the Baltic, and fish production was standardized into strictly graded named categories. The naturally variable product of a prehistoric fishery along with the prehistoric local social networks of exchange that were embedded in the cultural context of multi-stranded interactions between individuals, lineages, and localities was transformed into a socially disembedded, standardized, uniformly graded commodity which could now play a wider economic role. Now dried fish had been transformed from a variable local product of local artisanal fishers into a commoditized economic abstraction to be bought, sold, and borrowed against by prosperous men in counting houses far from the windy beaches where fish were landed and butchered.[17]

[14] Perdikaris (1996; 1998).
[15] Perdikaris (1999).
[16] Nielssen (1994); Nielssen and Christensen (1996).
[17] Gade (1951).

This historical cod trade of the twelfth century and after is well known, but far less well understood are its origins. Where and when did a transition take place from an ancient artisanal fishery run by local chieftains to a new proto-capitalist international commercial fish trade? Contemporary documentary references to fishing before the twelfth century are rare. The colourful Icelandic sagas (written down 200–300 years after the close of the Viking age) cheerfully ignore most issues of daily subsistence in favour of dialogue and character development,[18] and the medieval Icelandic Grágás law code[19] barely mentions the fish whose bones had already become the single most common object dumped onto contemporary midden heaps. It is up to archaeology and environmental science to illuminate the early history of the cod trade, and the critical transition from a local to a global product.

Fortunately, the past three decades have seen a dramatic expansion in environmental archaeology in the North Atlantic area, with major projects ranging geographically from North Cape to Greenland and extending from the pre-Viking Iron Age down to the early modern period of known commercial fisheries.[20] Major analytical advances have also been made in the identification and quantification of fish-bone assemblages, and common standards of recovery, identification, and data management have been broadly achieved. Excavated fish-bone collections now routinely number in the hundreds of thousands of identified specimens, most from contexts well dated by radiocarbon and volcanic tephra as well as artefact association. These data sets are increasingly being integrated into regional syntheses which, for all their inevitable limitations, are producing some clear and unexpected patterns. International collaboration has been advanced by organizations like the *International Council for Archaeozoologists Fish Remains Working Group* (ICAZ FRWG) and the *North Atlantic Biocultural Organization* (NABO) cooperative.[21] These groups have taken the problem of the commercialization of fisheries as a major research topic, and it seems clear that the cooperative research resulting has now produced some significant breakthroughs.

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[18] Fridriksson and Vésteinsson (2003).

[19] Dennis *et al.* (1993).

[20] Amorosi *et al.* (1996); Amundsen *et al.* (2003); Barrett *et al.* (1997; 1999); Bigelow (1984; 1985); Cérron-Carrasco (1994); Church *et al.* (2005); Dockrill *et al.* (2001); Edvardsson *et al.* (2004); Enghoff (2003); Jones (1991); Nicholson (1998); Ogilvie (1996); Rackham (1996); Simpson *et al.* (2000).

[21] McGovern (2004).

The Icelandic sites and contexts

Marine fish and sea mammal bones have been found in ninth-eleventh century archaeofauna over ten km from the sea in southwestern Iceland (Reykholt, Háls),[22] in Aðalból and Hakonarstaðir in the eastern interior,[23] and in Granastaðir in northern Iceland.[24] Currently, the greatest concentration of inland sites with marine species present that are datable by tephra and radiocarbon to around the ninth and tenth centuries are in the lake Mývatn region of the north-eastern highlands (50–70 km from the sea, 200–300 m above sea level).

Figure 1 presents a summary of the marine species found in these inland archaeofauna, demonstrating the range of marine mammal, seabird bones and bird eggshells,[25] and fish remains found on these sites. The common mussel has been recovered from several inland sites, but the individuals are tiny (one cm and smaller) and are probably the result of seaweed collection transported inland, as mussels of this size are regularly contained within the root balls of the *Laminaria* sp. kelp washed on shore in many parts of Iceland.

At present, our earliest archaeofauna from coastal sites actively engaged in marine fishing come from the northwestern peninsula of Iceland (West Fjords), a region now the target of several ongoing research projects.[26] The earliest twelfth-thirtheenth century context is from the earliest contexts[27] at the site of Akurvík, a stratified series of seasonally occupied small 'booth' structures with associated midden spreads around them. The upper contexts at Akurvík are radiocarbon dated to the mid-fifteenth century, and eustatic uplift seems to have caused abandonment of this seasonal station before early modern times.[28] While this site is not directly contemporary to the earlier ninth-eleventh century collections from inland Iceland, it provides a useful case for comparison, as we can be reasonably certain that it was in fact a

[22] Olafsson *et al.* (2005).
[23] McGovern (1982); Amorosi (1996).
[24] Einarsson (1994).
[25] Identification by Dr. Jane Sidell, University College London.
[26] Edvardsson (2005); Edvardsson and McGovern (2005); Krivogorskaya *et al.* (2005a).
[27] All based on bone collagen from domestic mammals showing fully terrestrial delta 13C; for detailed discussion of the dating of the Mývatnssveit sites see McGovern *et al.* (2005).
[28] Amundsen *et al.* (2005); Krivogorskaya *et al.* (2005b).

specialized seasonally occupied fishing station rather than a year round farm mixing subsistence with market production.

The Lake Mývatn region (*Mývatnssveit*) straddles the Mid-Atlantic rift, and has been volcanically active for thousands of years. Lake Mývatn, a broad shallow lake, has a complex ecology that supports the vast population of chironomid and simuliid flies that provide its name ('midge lake') as well as sticklebacks and arctic charr (*Salvelinus alpinus*). The lake is fed by underground channels, and the major drainage is the river Laxá flowing northwards to the sea approximately 60 km away. The Laxá is a famous brown trout (*Salmo trutta*) stream and in its lower reaches also receives migratory Atlantic salmon (*Salmo salar*), which do not reach the lake area. The whole region has undergone profound environmental change since human settlement in the late ninth century, when the interior deserts were probably at least partially wooded, the wet meadows south of the lake were more extensive, and the low lying valleys probably supported dense stands of birch and willow, now almost entirely cleared. The Mývatnssveit archaeofauna come from five sites (Hofstaðir, Sveigakot, Hrísheimar, Selhagi, Steinbogi) located around the lake, and the Kráká and Laxá rivers that form part of its drainage. The sites are dated by a combination of artefact typology, AMS radiocarbon (currently a total of 39 dates on archaeological contexts), and volcanic tephra. Figure 3 presents the calibrated range distributions for the samples associated with the midden contexts discussed in this paper and for some of the pre-Christian burials.

Hofstaðir was a chieftain's farm in the tenth-early eleventh century and is archaeologically known for its huge long hall (the second largest in Europe after Borg in the Lofoten in Norway) and an associated complex of buildings. The Hofstaðir Viking age archaeofauna (NISP[29] = 8,681) is grouped into two phases (AU) by radiocarbon and tephra. The site has remained occupied down to the present. Sveigakot is a small farm that was founded in the late ninth century (basal midden deposits rest directly upon the 'Landnám' Veiðivötn tephra now dated 871 +/− 2 by the GISP2 ice core, Gronvold *et al.* 1995, Sveinbjornsdóttir *et al.* 2000). It underwent at least two phases of abandonment and reoccupation (on a steadily declining scale) before being finally abandoned in the late twelfth century, and its major archaeofauna (NISP = 14,513)

[29] NISP = Number of Identified Specimens, a count of identified animal bones from archaeological sites. See Grayson (1984).

Fig. 1. Marine species found on sites in Iceland more than ten km inland. Note that clam shells and pieces of great whale bone are excluded due to their use as artifacts and raw material. Atlantic salmon are included for the Mývatn area, as their migration does not extend upriver within ten km of the lake.

Table 1 Taxon		site Adalbol	Hakonarst.	Reykholt	Háls	Granast.	Hofstaðir	Sveigakot	Hrísheimar	Steinbogi	Steinbogi
Sea Mammals											
Phoca vituluna	Harbor seal						1				
Phocidae sp.	Seal sp.			3	1		7	2			
Small Cetacean	Small whale/porpoise							1	1		
Marine Birds											
Alca torda	Razorbill						1			1	
Fratercula arctica	Puffin		1				1				
Uria sp.	Murre or Guillemot						10			3	
Alle alle	Dovkie						2				
Larus sp.	Gull sp.						6	2			
Phalacrocoridae sp.	Shag or Cormorant						2				
Somateria mollissimus	Eider duck						2				
Uria sp. Egg Shell											

Marine Fish											
Gadus morhua	Atlantic Cod	1	1		1	80	372	193	4	51	11
Melanogr aegl.	Haddock					12	231	69	17	11	10
	Ling					1		15		1	
Pollachius virens	Saithe						26	64	9	8	
Brosme brosme	Cusk						3				
Gadidae	Gadid family fish			20		6	592	318	32	95	3
Hippoglossus sp.	Halibut sp.						3				
Selachii sp.	Shark sp.					1					
Anarcharias lupus	Wolf fish						3				
Heterosomata sp.	Flat fish sp.						1				
Salmo salar	Atlantic salmon						3	1	19		
Mussels											
Mytilus edulis	Mussel						32	6	13		
Bird Egg Shell											
Uria sp.	Murre or Guillemot						present				
Procillaridae sp.	Shearwater sp.									present	
total NISP		987	124	48	136	1,656	8,681	14,513	2,949	875	1,302
% Marine		0.10	1.61	47.92	1.47	6.04	14.95	4.62	3.22	19.43	1.84

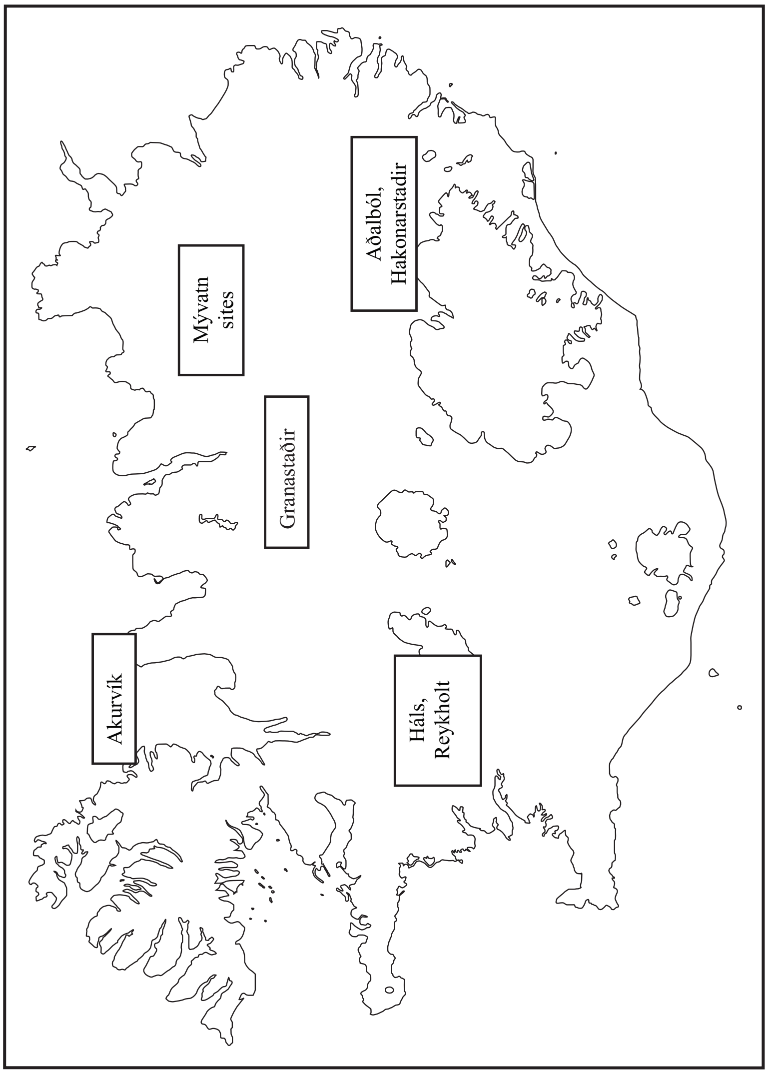
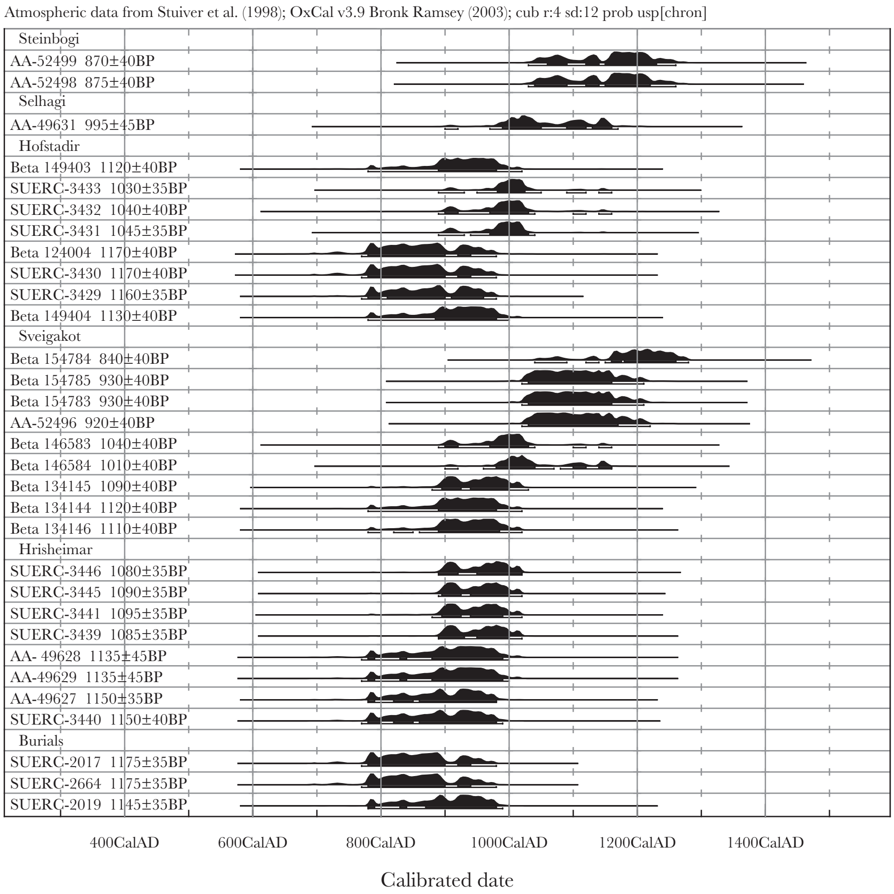


Fig. 2. Location map of inland sites dating to the ninth-eleventh century with marine species present and the location of the Akurvík fishing station used for comparative purposes.

Fig. 3. Mývatn area Calibrated Radiocarbon Dates on midden deposits and burials (fully terrestrial delta C13 only), arranged by site in stratigraphic order. Pre-christian burials make use of horse bones. All contexts dated from Hrísheimar, Sveigakot, Hofstaðir, Steinbogi and Selhagi contained marine fish bones: apparently pre- and post-dating the ca AD 1000 Fish Event Horizon in Britain. OxCal v 3.9 Bronk-Ramsey (2003).



can be grouped into three phases spanning the late ninth to eleventh centuries. Hrísheimur was a substantial site apparently specializing in iron smelting as well as extensive pig keeping.[30] Hrísheimar is still under excavation and its very large archaeofauna is thus presented here in a preliminary form (NISP = 2,949) but the site appears to have been settled shortly after the Landnám tephra and was abandoned prior to the fall of the Hekla AD 1104 tephra.

Radiocarbon dates from the contexts reported here consistently cluster in the tenth century (figure 3). Selhagi is a small site on the lakeshore, with a deep midden deposit extending from the ninth to thirtheenth c. This archaeofauna is the smallest reported here (NISP = 875) and has been omitted from some comparisons requiring larger sample size. Steinbogi is a small site founded in the tenth century and abandoned by 1300. Its archaeofauna comes from a single phase datable to the early thirtheenth c, representing the latest of the Mývatnssveit archaeofauna reported here (NISP = 1,302). The Mývatnssveit archaeofauna thus come from a variety of localities within the highland lake basin and come from sites of varied economic and social status.[31]

Multi-Indicator approach: commercialization signatures

The problems associated with identifying an undocumented pre-commercial, pre-historic, pre-'fish event horizon' pattern of fish distribution and exchange are considerable, given that fisher folk traditionally tend to eat their catch as well as market it, blurring the archaeological record. In the past, different indicators have been used to assess probable commercialization in the zooarchaeological record, ranging from simple abundance of fish-bones in an archaeofauna to more sophisticated arguments based on element representation and differential transport of body parts. A multi-indicator approach combining species diversity, skeletal element distribution, size reconstruction, and age assessment is suggested as a productive way forward, and will be employed in this paper.

[30] Edvardsson (2005).
[31] See Perdikaris (1998) for a detailed methodological discussion.

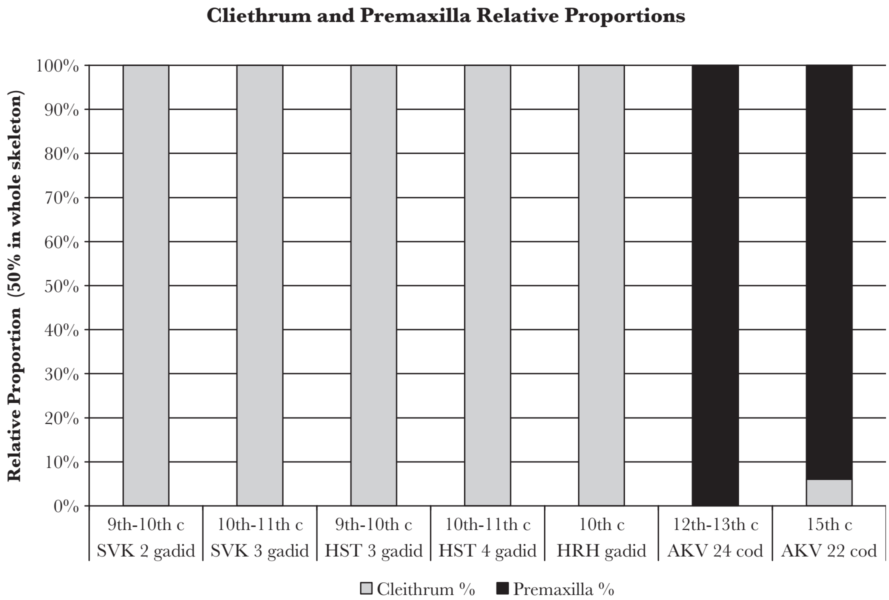
Producers and consumers: selected element distribution

Since fish spoil rapidly, prompt processing has been a key to maintaining seafood quality. Initial butchery tends to take place either at sea or directly upon landing the catch. Fish elements cut away and discarded in preparing fish for consumption or preservation thus tend to accumulate at or near the landing point. From a zooarchaeological standpoint this tends to create a 'producer signature' in the relative abundance of fish skeletal elements excavated. Typically, most of the skull and mouthparts are cut off and discarded at the same time the fish is gutted. Depending on the method of preservation employed, a variable portion of the fish vertebral column is also stripped out and discarded at the processing point. The remaining parts of the skeleton stay with the final product, and may be transported off site to distant consumers. For gadid fish, the crescent shaped cleithrum and associated bones of the pectoral girdle are usually left in the finished product, as these elements help to hold the body together and when spread can help speed drying of the body cavity. Thus a producer site will be disproportionately rich in cranial bones and upper vertebrae, while a consumer site should show a complementary concentration of lower vertebrae and cleithra.

Figure 4 presents the relative abundance of two indicator elements, cleithrum and premaxilla (part of the upper jaw structure), in our Icelandic sample of inland and coastal sites. If only whole fish were present at either coastal or inland sites, the proportions of these paired bone elements would be identical (as each fish has two cleithra and two premaxillae, the graph of a whole skeleton would show an even division of 50 percent each). Both bone elements are of comparable size and durability, both should be comparably subject to the same natural forces of decay and attrition and both can be reliably identified to species level. Thus the relative proportion of these two bone elements should mainly reflect past fish cutting decisions and the effects of differential deposition and transport. It is remarkable that no marine fish jaw parts whatsoever are present in any of the inland Mývatn archaeofauna, and that a clear surplus of mouthparts (or deficit of cleithra) is evident on the coastal producer sites.

Despite such clear patterning, it is somewhat dangerous to base arguments upon only two skeletal elements, and a broader-based approach grouping all the identified fish-bone elements into body areas may provide a stronger basis for comparison. Figure 5 presents a comparison of head and mouthparts, pectoral girdle (cleithrum and associated bones)

Fig. 4. Comparison of the relative proportions of cleithra (bones around the gill slits which tend to travel with preserved fish) and the premaxillae (jaw parts which tend to concentrate on coastal sites). The inland Mývatn area sites (SVK= Sveigakot, HST= Hofstaðir, HRH= Hrísheimar) contrast strongly with the patterning of the coastal seasonal fishing station at Akurvík (AVK). While this graph compares only the larger archaeofauna, it may be noted that no marine fish premaxilla has yet been recovered from *any* inland Icelandic site dating to the ninth-eleventh century. Deposit of whole fish on sites would tend to produce relative proportions close to 50% each.



and the three portions of the vertebral series (thoracic, precaudal, and caudal vertebrae), all normalized for their natural frequency in the gadid skeleton.[32] This figure compares both phases at Akurvík with both the inland Mývatnssveit sites (Hofstaðir, Hrísheimar, Sveigakot, Steinbogi) and the inland site of Granastaðir to the east of Mývatn. In this comparison, it is clear that a few bits of fish skull were reaching the inland consumers (all in the back portion of the skull, none from the front end), but the dominance of the pectoral girdle is clear. Also evident is the abundance of caudal (tail) vertebrae relative to upper body vertebrae in the inland site archaeofauna.

[32] MAU%. See Grayson (1984) for discussion.

Fig. 5. Relative proportions of major skeletal groups in the fish body, again comparing sites from inland (Sveigakot, Granastaðir, Hofstaðir, Hrísheimar, Steinbogi) with the coastal fishing station at Akurvík. By making use of all identifiable bones of the fish skeleton this analysis avoids some potential sampling problems associated with singe-element comparisons, but still provides the same clear-cut distinction between inland consumer and coastal producer sites.

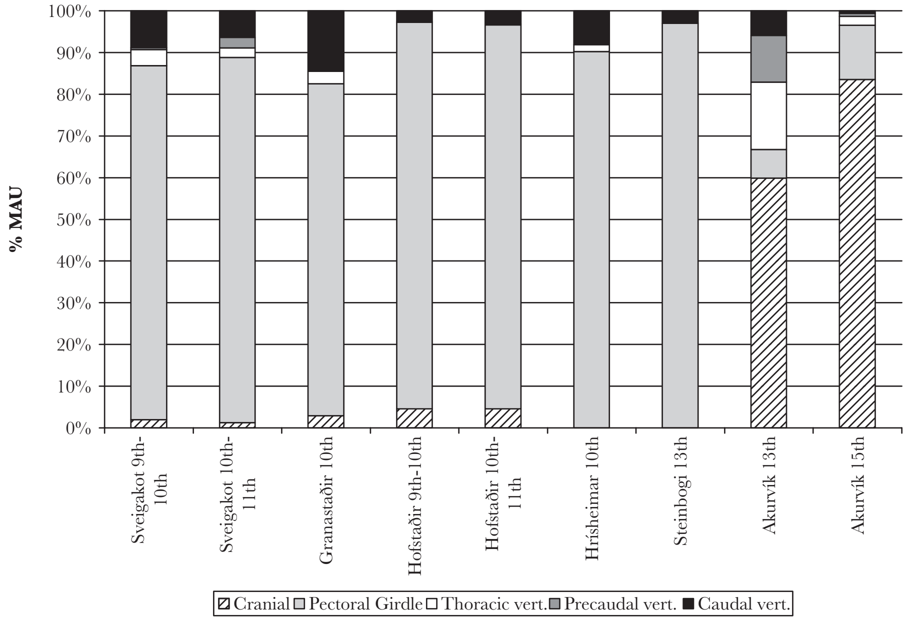
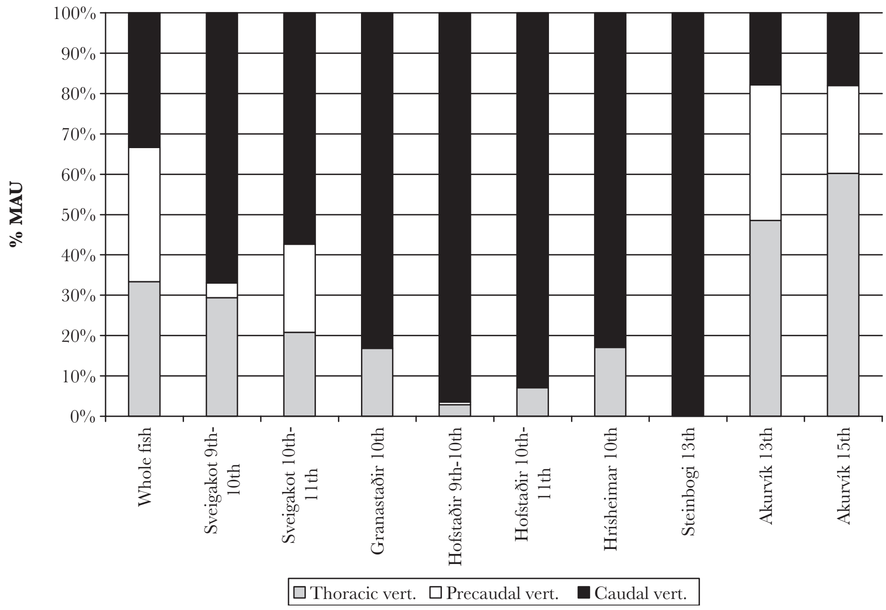


Figure 6 provides a more detailed view by comparing only these vertebral elements for the inland marine fish for the inland Mývatn sites and the two phases of the Akurvík fishing station (again normalized for relative frequency in the skeleton—a whole fish skeleton would have equal proportions of all three vertebral types). The coastal Akurvík vertebral distribution reveals that some fish (smaller individuals) were being deposited whole, with caudal vertebrae intact; these are probably the remains of the fishing crew's meals. However, the coastal fishing station produces a notable surplus of thoracic and precaudal vertebrae, suggesting that the station was producing a product like klipfisk as well as stockfish in both twelfth-thirtheenth centuries and mid fifteenth century.[33]

[33] See discussion in Amundsen *et al.* (2005).

Fig. 6. A comparison of the relative abundance of the three types of cod-family fish vertebrae. Thoracic and pre-caudal vertebrae are in the upper body, and caudal vertebrae are in the tail. The distribution in a complete cod fish is illustrated for reference.



It also seems clear that there was some variability in the type of dried fish reaching the different inland farms. While all phases at Hofstaðir, Hrísheimar, Steinbogi and Granastaðir are dominated by caudal vertebrae (typical of a consumption of *klipfisk*), both phases at Sveigakot include a higher relative percentage of thoracic and precaudal vertebrae. This suggests that two of the successive households at Sveigakot were being provisioned with at least some stockfish (which would carry a full set of precaudal and some thoracic vertebrae) as well as the klipfisk-like product being consumed on the other inland sites. On all the sites, haddock and cod (the two most common species consumed) seem to be treated identically—prepared mainly as *klipfisk* except at Sveigakot where both appear to have also sometimes been consumed as stockfish. Skeletal element analysis thus has potential not only for identifying producer and consumer site signatures, but also provides evidence for the type of product being distributed. From current evidence it seems that however they were processed, *not one* whole marine fish reaching the Mývatn consumers from the ninth century settlement down to the thirtheenth century—all marine fish arrived missing much of their