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Codfish and Kings, Seals and Subsistence

NORSE MARINE RESOURCE USE IN THE NORTH ATLANTIC

Sophia Perdikaris and Thomas H. McGovern

IN THE PAST TWO DECADES, the archaeology and paleoecology of the North Atlantic have been transformed by a series of major international, interdisciplinary projects (Barrett et al. 2000; Church et al. 2005; Dockrill et al. 2005; Edwards et al. 2004; McGovern 2001; McGovern et al. 2007; Parker-Pearson and Sharples 1999; Sharples 1998, 2005; Simpson et al 2001). Most have been inspired by the theoretical framework of historical ecology (Crumley 1994) in their investigation of the complex interactions of climate, landscape change, and human culture in the region, and all have made geoarchaeology, archaeobotany, zooarchaeology, and human osteology part of their fundamental research design. Since 1990, the North Atlantic Biocultural Organization (NABO) has aided these collective efforts by holding coordinating meetings and workshops (New York 1992, Glasgow 1994, St. John's 1997, Glasgow 2001, Akureyri 2002, Copenhagen 2003, Quebec 2006), providing identification manuals and data management tools to aid comparability (Krivogorskaya et al. 2005; McGovern 2004), and by publishing monographs, working group reports, and conference volumes (Bigelow 1991; Arneborg et al 2006; Housely and Coles 2004; Morris and Rackham 1994; Ogilvie and Jónsson 2001). NABO has sponsored long-running international field schools in Iceland and Shetland, which have drawn students from 26 nations since 1996 (McGovern 2004). Major regional research foci include culture contact, the impact of climatic fluctuations of the Medieval and early modern period, and the varied environmental impacts of imported European agricultural systems upon island ecosystems. The interaction between marine and terrestrial economies is a cross-cutting theme that unites virtually all investigations in the region. This chapter presents some of the results of this long-term international collaboration and makes use of newly available data sets and regional syntheses to provide a broad overview of Norse use of marine resources for subsistence and for exchange in the North Atlantic (Figure 9.1).

VIKING AGE EXPANSION

The dramatic expansion of Scandinavian culture and settlement during the Viking Age

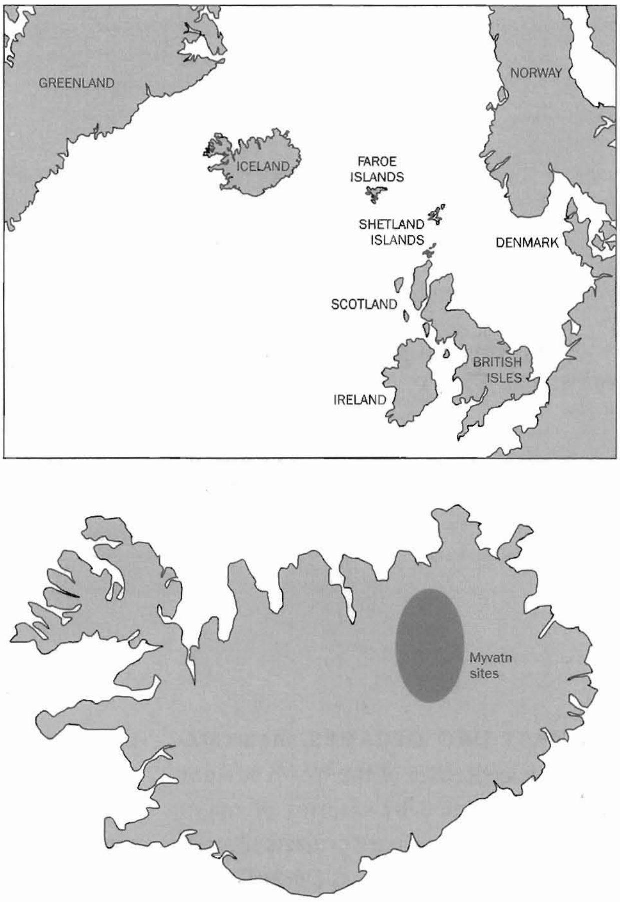

FIGURE 9.1. Map of the North Atlantic study area.

(ca. AD 750–1050) resulted from interconnected factors including climate change, external trade, and technological improvements in ships and navigation that allowed long open-water voyages out of sight of land by AD 750 (Brøgger and Shetelig 1951; Christensen 2000; Crumlin-Pedersen 1997; Nicolaysen 2003; Olsen et al. 1995). All these changes took place in the social context of intense competition among Nordic chiefly elites attempting to consolidate power, undermine social leveling mechanisms, and create an effective transition to state-level organization with themselves as founding monarchs (Hedeager 2000; Jones 1987; Thurston 1999; Thurston and Fisher 2006). The new wealth and expanding opportunities overseas also created tension between established elites and ambitious commoners seeking to become chieftains through successful Viking raids or by establishing new settlements in the islands of the west (Jørgensen et al. 2002). Both routes to power required ships and seafaring skills and the capacity to provision men kept long away from their farms. As raiding and overseas settlement intensified, social conflict also increased among lesser and greater chieftains who made use of both prestige goods and staple goods in their contests for power and followers (Perdikaris and McGovern 2007; Randsborg 1980).

The early Viking period of ca. AD 750–900 saw escalating Nordic piracy and sea-borne raiding along the coasts of northwest Europe and an expansion of settlement into the Faroe Islands (ca. 800–850), Iceland (ca. 875), the Northern Isles (Shetland and Orkney), and the Western Isles (Hebrides) (ca. AD 800–850) (Arge 2005; Vésteinsson 1998, 2000a, 2000b).

The later Viking period of ca. AD 900–1050 encompassed the settlement of Greenland (ca. AD 985) and briefly of Newfoundland (around AD 1000). This was also a period of escalating warfare in Britain, culminating in the establishment of an Anglo-Scandinavian dynasty under Knut the Great (AD 1014–1035) that controlled England, Denmark, and Norway for two decades (Lawson 2004). The end of the Viking period thus saw the transformation of pagan Nordic warlords into Christianized kings using clerics and Latin literacy to administer increasingly unified kingdoms with widespread political and economic contacts in northwest Europe (Adams and Holman 2004). Between ca. AD 1050–1100 and ca. AD 1500 many scholars working in northern Scotland recognize a Medieval "Late Norse" period characterized by increasing political integration within the Earldom of Orkney and the Medieval Norwegian monarchy along with widespread indications of intensified marine fishing (Bigelow 1984; Morris et al. 1995). Iceland and Greenland retained political independence until their integration with the Norwegian crown in 1264. The Greenlandic settlements became extinct by the mid-fifteenth century under what are still somewhat mysterious circumstances (Arneborg 2000, Barlow et al. 1997; Buckland et al. 1996; Diamond 2005; Gulløv 2000; McGovern 2000). The interaction of marine and terrestrial portions of subsistence economy with the changing demands of regional and international trade and changing climate in the later Middle Ages were to have very different impacts on these Scandinavian island communities (Buckland 2000).

CLIMATE CHANGE

The North Atlantic is fortunate in having a steadily developing set of high-resolution, multiproxy climatic indicators with resolution on the scale of decades, years, and occasionally individual seasons (ice, sea, and lake cores; dendroclimatology; historical climatology; see Barlow et al. 1997; Buckland et al. 1996; Jennings and Weiner 1996; Meeker and Mayewski 2002; Ogilvie and Jónsson 2001; Ogilvie and McGovern 2000). These proxy data sets are increasingly being combined with well-validated agroclimatological models, which have transformed our ability to convert these high-resolution temporal series into spatially mapped applications capable of flagging areas of probable maximum climate impact within culturally constrained landscapes (Dugmore et al. 2007; Simpson et al. 2004). In well-studied areas, it is now possible to closely model vegetation responses to both grazing pressure and growing season change on the scale of individual farm holdings and individual seasons (Simpson et al. 2003; Thomson and Simpson 2006, 2007). These steadily improving paleoclimatic data indicate that the old concepts of a uniformly warm "medieval optimum" (ca. AD 700–1300/1400) followed by a uniformly cold "little ice age" (ca. AD 1300/1400–1850) are considerable oversimplifications of actual variability, though the labels are still widely used as shorthand by climatologists (Ogilvie and Jónsson 2001).

For island societies and maritime economies, perhaps the most important climatic variables are the frequency and intensity of storms and the degree of interannual predictability of weather patterns. Storminess and unpredictable weather directly affect the hazards of both local and offshore voyages and raise the human costs of intensified marine resource exploitation. In the western North Atlantic, sea ice also plays a major factor in both marine and terrestrial ecosystems, and variation in sea ice extent in summer and winter has been traced by a combination of ice chemistry in the GISP-2 Greenland ice core (Meeker and Mayewski 2002; Rohling et al. 2003), sea cores in Danmark Strait between Iceland and Greenland (Jennings and Weiner 1996), and documentary evidence (Ogilvie 1997). The amount of sea salt sodium in ice cores has been used to reconstruct winter storm frequency and intensity, and the impact of both changing storm frequency and of catastrophic

storms is a major topic of regional research (Bigelow 1991; Dugmore et al. 2007; Meeker and Mayewski 2002). The early Viking Age (ca. AD 700–950) appears in the multiproxy record as a period of relatively low storminess and low sea ice incidence, with a spike in storm frequency AD 975–1025 and a dramatic increase in the frequency and intensity of North Atlantic storms after AD 1425 that continued into the eighteenth century. Based on the sea salt sodium record and the sea core evidence, summer sea ice appears to have increased between Greenland and Iceland around the mid-thirteenth century and definitely saw a major increase after AD 1450. The mid-thirteenth-century Norwegian text *King's Mirror* reports on some of the hazards imposed by the newly arrived summer drift ice:

> It has frequently happened that men have sought to make the land too soon and, as a result, have been caught in the ice floes. Some of those who have been caught have perished; but others have got out again . . . . All those who have been caught in these ice drifts have adopted the same plan: they have taken their small boats and have dragged them up on the ice with them, and in this way have sought to reach land; but the ship and everything else of value had to be abandoned and was lost. Some have had to spend four days or five upon the ice before reaching land, and some even longer.
>
> (Larsen 1917: section XVI)

Sea ice in summer was thus not a regular problem for Viking Age navigators in the western North Atlantic but became a significant hazard in the later Middle Ages, especially between Iceland and Greenland. Interannual variability in storminess seems to have increased markedly after 1425, and there seems to have been a general increase in interannual climate variability after the late tenth century. Taken together, the changes in sea ice distribution, increased frequency of major storms, and decreasing interannual predictability of climate probably produced a significantly more hostile North Atlantic maritime environment for the seafarers of the thirteenth through eighteenth centuries than that experienced by their Viking Age precursors.

CULTURE CONTACT AND MARITIME ADAPTATIONS

In Arctic Norway and Sweden, Norse farmers had long been in contact with northern hunter-fishers today called Saami. By the ninth century AD, these contacts had settled into a regular pattern of interactions between Norse and Saami, which apparently involved a mix of trade and tribute extraction that brought Arctic products (furs, seal oil, walrus ivory, and hide) south, and metal and woolen cloth north (Olsen 2003). A frequently cited account by a North Norwegian chieftain named Ottar was recorded in the court of King Alfred of Wessex in the late ninth century. Ottar describes income from "tribute" collected regularly from the Saami, including reindeer farming, whaling, and walrus hunting (Lund 1984). A wondering Anglo-Saxon scribe noted that this North Norwegian chieftain owned far fewer cattle than any respectable Thane of Wessex but was still "accounted wealthy in his own country." Archaeology confirms that while Ottar's kinsmen above the Arctic Circle in the Lofoten and Vesteralen Islands may have lacked the agrarian resources of southern England, they were far from poor, boasting huge chieftain's halls, rich troves of imported silver, gold, and glassware, and impressive *naust*—the boat houses that protected the seagoing ships that were the source of so much of this wealth and power (Munch et al. 2003). The chieftains of these Arctic islands demonstrated their military and naval power later in the Viking Age, repeatedly intervening in the power struggles associated with the development of the Norwegian state ca. AD 950–1050, with huge fleets filled with well armed supporters. In the eleventh century these northern earls of Hálogaland acquired additional power and moved south to settle near Nidaros (Trondheim),

assuming the title "Earls of Hlaði" and became Cnut of England's allies.

After AD 1300, the nature of Norse-Saami contact changed in the North Cape area, as Norway and Novgorod began to contest access to the walrus and fish of Finnmark and the Kola Peninsula. Warfare pitting Norwegian and Saami against the Karelians employed by the Russian cities led to construction of castles and fortified churches in the high Arctic, negotiated territorial divisions, and eventually the development in the late Middle Ages of an ethnically diverse society caught up in market production as well as subsistence (Urbańczyk 1992). Recent work in coastal Finnmark indicates the complexity of economic and social interactions around North Cape in the fourteenth to sixteenth centuries, and has documented settlements aimed at market production of cod as well as settlements mainly engaged in subsistence (Amundsen et al. 2003; Henriksen et al. 2006).

Nordic contacts with seafaring Celtic populations in the Northern and Western isles of Scotland accelerated after AD 800. Scandinavian colonization early in the Viking Age is attested by burials, farm sites, and widespread place name change (especially in the outer Hebrides and the Northern Isles; see Barrett 2003; Graham-Campbell and Batey 1998; Jennings and Kruse 2005; Owen 2004; Richards 2001). The nature of Norse contact with Late Iron Age Celtic populations (Picts, Dalriadic Scots, Britons) in what is now Scotland remains hotly debated but is usually seen as involving a mixture of conflict and assimilation on both sides, now illuminated by ongoing modern and ancient DNA investigations and stable isotope analyses (Barrett 2003; Barrett et al. 2000). The economic aspects of the Iron Age–Viking Age cultural transition in Shetland, Orkney, Hebrides, and Caithness have been investigated by several major projects, and it is now possible to compare pre-Norse, Viking Age, and Late Norse-Medieval marine resource use in some detail for this region (see Barrett 2003; Bond et al. 2005; Dockrill et al. 2005; Owen 2004; Parker-Pearson and Sharples 1999; Sharples 1998, 2005; Sharples et al. 2004; Smith and Mulville 2003).

In the Faroe Islands and Iceland, Norse settlers may have encountered small communities of Christian monks, but these appear to have been driven off or swamped by the later colonists, as historic settlement pattern, house forms, and place names are entirely Scandinavian. (Osteological and DNA evidence suggests that despite Nordic cultural and linguistic dominance, the ninth- to tenth-century settlers of the Faroes, Iceland, and Greenland did include a substantial British Isles component, especially visible in maternal mtDNA of modern Icelanders [Helgason et al. 2000]).

In Greenland, the Dorset Paleoeskimo who had once occupied most of the long coastline apparently survived only in the far northwest, and the Norse settled in the southwestern fjords in what had become an abandoned landscape (Gulløv 2004). Norse-Dorset contacts took place in the Norse northern walrus hunting grounds *(Norðursetur)* in northwest Greenland, and these contacts may have extended into Arctic Canada (McGovern 1985a, 1985b; Schledermann and McCullough 2003). Sometime in the late twelfth to early thirteenth centuries, the Norse Greenlanders came into contact with the Thule Inuit who had migrated across the Canadian Arctic, replacing the earlier Dorset hunters (Gulløv 2000). By the mid-fifteenth century, the Norse Greenlanders were also replaced by the Thule people, and different cultural marine resource exploitation strategies probably played a significant role in the Norse extinction in Greenland (Arneborg 2003; Diamond 2005; McGovern 2000). The North Atlantic thus provides a rich array of case studies of the interaction of cultures, changing economies, and different uses of marine resources. Since space is necessarily limited in this chapter, we will focus on a few themes that may illustrate different aspects of Norse marine resource use and that serve to highlight some recent advances in North Atlantic maritime research.

MARINE PRESTIGE GOODS: NORSE WALRUS HUNTING IN ICELAND AND GREENLAND

As Ottar's account illustrates, Norse marine resource use provided sources of wealth and power unfamiliar to the managers of the primarily agrarian economy of Anglo-Saxon Wessex, generating prestige goods whose low bulk and high value made them attractive items for the elite exchange networks of the early Viking Age. Walrus ivory and hide (used for high-quality ships' line) were clearly in this category, and Norse chieftains like Ottar controlled the main source of walrus products in Arctic Norway before the late ninth century. When Norse voyagers reached southern Iceland ca. AD 870, they encountered resident walrus populations in the area around modern Reykjavik, as bones of both adult and young juvenile walrus have been recovered from ninth-century midden deposits beneath the city streets at site Tjarnargata 4, and walrus place names are found along the nearby Reykjanes peninsula.

In 2001, an early dwelling hall dated by volcanic tephra to just after AD 871 was excavated at Adalstraeti in downtown Reykjavik, producing three adult walrus tusks apparently cached but not recovered from beneath the side benches of the hall (McGovern et al. 2001). Walrus tusks are deeply rooted and difficult to extract without breakage, but these ninth-century tusks showed evidence of careful and expert removal from the dense maxillary bone, suggesting familiarity with walrus hunting among these earliest Icelandic settlers. Bjarne Einarsson (1994) has argued on artifactual grounds for a substantial North Norwegian component among the first Icelanders, which may help to explain the Adalstraeti walrus tusks and the ready exploitation of the local Icelandic walrus colonies. Adolf Fridriksson (Fridriksson et al. 2004) and Christian Keller (personal communication 2006) have suggested a period of initial settlement of both Iceland and Greenland characterized by hunting of walrus and other marine species, which may have preceded the process of chiefly land-claiming and establishment of the farming economy documented in later texts. At present, a combined survey and excavation program directed by Orri Vésteinsson of the University of Iceland is underway to attempt to locate early walrus hunting stations in southwest Iceland. In Iceland, the resident walrus population apparently could not long sustain human predation, and most of our evidence for Norse walrus hunting comes from the Greenlandic colony established from Iceland after AD 985 in two parts of west Greenland (the Western Settlement in modern Nuuk district, and the larger Eastern Settlement to the south in the modern Qaqortoq and Narsaq districts).

Documentary sources for the lost Greenland colony are few and often hard to interpret, but it is clear that walrus ivory and walrus hide rope along with polar bear and seal skins were major exports from Greenland from first settlement down to the end of the colony in the mid-fifteenth century (Arneborg 2003; Larsen 1917; Roesdahl 2005). In 1127, the Greenlandic chieftains are said to have traded the king of Norway a live polar bear for their first bishop, illustrating the value of well-placed arctic prestige gifts (Jones 1987). In 1327, the Norse Greenlanders contributed over 300 kg of walrus ivory to help fund a papal crusade against heretics in southern France, but we cannot determine if this special tithe was the product of multiple hunting seasons or a single massive effort (Gad 1970). Archaeological traces of the Greenlandic Norðursetur walrus hunt have been found in the Disko Bay area (800 km north of the northernmost permanently settled farm), the center of the largest walrus populations in Greenland from at least the eighteenth century(McGovern 1985a, 1985b). These finds support textual references to weeks of rowing in six-oared boats from the farms to the south to the Norðursetur hunting area in the spring (McGovern 1985a, 1985b). The Norðursetur hunters seem to have transported only limited portions of the walrus back to the home farms, as walrus bone finds from both the Western and Eastern settlement areas are made up almost entirely of fragments of the

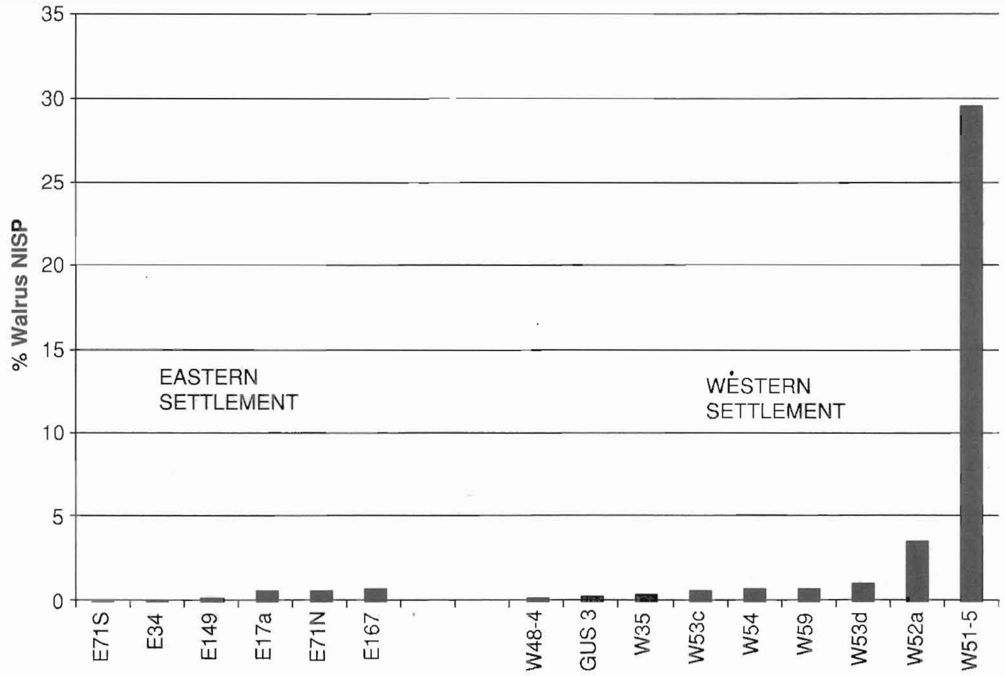

FIGURE 9.2. Relative percentage of walrus bone fragments in the larger Greenlandic archaeofauna (Enghoff 2003; McGovern 1985a, 1985b; McGovern et al. 1996). Note that these are almost all pieces of the dense maxilla around the tusk root. W prefix, Western Settlement; E prefix, Eastern Settlement; NISP, number of identified specimens.

maxilla from around the deep rooted tusks. As Figure 9.2 indicates, walrus bone fragments are found on many Norse sites in both the Western and Eastern Settlements, but their greatest concentration is at the chieftain's farm (W 51) Sandnes in the Western Settlement (McGovern et al. 1996). At Sandnes, the percentage of walrus maxilla rises steadily from the eleventh century to the abandonment of the Western Settlement ca. AD 1350, while the frequency of accidental chipping of the ivory appears to decline over the same period as tusk extraction expertise apparently improved with time (McGovern et al. 1996; Perdikaris and McGovern 2007).

There are also reports of substantial amounts of walrus bone recovered from early twentieth-century excavations at the bishop's manor at Gardar in the Eastern Settlement, perhaps reflecting the Episcopal interest in the walrus ivory trade. The processing of walrus maxillae seems to have been concentrated on coastal elite farms of the Western Settlement, but most Eastern Settlement archaeofauna contain at least a few maxillary fragments, and maxillary fragments are also found at inland farms in both settlement areas (sites E71N, E71S, E167, E34, W35, W53d, W53c, W54, and GUS3 are all more than two hours' walk from the nearest saltwater). There are very few artifacts made of walrus ivory among the many worked bone objects recovered from Norse Greenland. Where walrus tooth was used for buttons or amuletlike figurines (often representing walrus or polar bear, see Fitzhugh and Ward [2000:321]), this came from the apparently unmarketable peglike postcanine teeth. Apart from a few accidentally removed chips and flakes, nearly all the walrus ivory seems to have been efficiently gathered and exported, rather than circulated within Greenlandic society. The ivory was evidently not itself a marker of prestige within Greenland but was instead the means of acquiring status markers from Europe (beer, wine, construction timber, fine garments, church bells, and stained glass all

appear archaeologically or in documentary references; Arneborg 2000; Gad 1970). While it appears that boat-owning elites in the settlement area closest to the Norðursetur hunting grounds probably played a leading role in the organization of the hunt and ivory processing, the widespread distribution of walrus maxillary bone chips in virtually every excavated archaeofauna suggests that many, if not all, the Greenlandic households participated at some point in the long-range hunt for walrus.

The walrus bone fragment distribution may be evidence for something like a share system that worked to coordinate scarce labor from inland farms, but it is apparent that "noneconomic" forces were also at work in the form of magic, ritual, and perhaps individual rights of passage. Walrus bacula (the massive penis bone) are found on many Norse farms, including a set of four bacula apparently displayed on the wall of the inland farm W54 in the fourteenth century, and a row of whole walrus and narwhal skulls were found buried within the churchyard wall at the cathedral at Gardar. The dangerous long-distance hunt, probably socially embedded in a matrix of economic, political, and ritual activity, very likely became more dangerous as the frequency of storms increased in the later Middle Ages and as Thule Inuit began to occupy the core of the Norðursetur sometime after AD 1250 (Gulløv 2004). After 1200, taste in Europe began to switch away from ivory, and elite interest in Greenlandic ivory seems to have plummeted at the same time the expanded Norwegian and Russian exploitation of North Cape and Finnmark expanded access to Barents Sea walrus populations (Roesdahl 2005). The majority of the surviving clerical correspondence regarding the walrus ivory crusade tithe of AD 1327 centers on the problem of profitably marketing such a large cargo of unfashionable material without further depressing prices. The Norse Atlantic walrus hunt may well have played a major role in the initial colonization of Iceland and Greenland, and it certainly retained a major place in the moral and political economy of the Medieval Greenlanders. However in the long term, walrus products could not hold their value as an elite prestige item, and Greenland may have been increasingly cut off by summer drift ice from European market centers after 1300.

SEABIRD AND SEAL SUBSISTENCE HUNTING

Seabirds and seals are seasonally accessible nearshore and onshore resources, which have been exploited by a range of northwestern European cultures going back at least to Mesolithic times. As Viking Age colonists moved into the offshore islands of the Faroes and Iceland, they encountered huge populations of seabirds in nesting colonies probably little disturbed by prior human predation. Later Icelandic written sources noted that at the time of settlement, wild animals of all kinds were unwary and easy to catch (Vésteinsson et al. 2002). Figure 9.3 presents percentages of seal and bird bones from a selection of sites from the North Atlantic dating to the Iron Age, Viking Age, and Late Norse-Medieval period.

In most of the collections from all periods, birds form a fairly minor element in the overall archaeofauna (<10 percent), clearly providing a supplement rather than a staple resource. The notable exceptions are in the stratified archaeofauna from Junkarinsfløtti on Sandoy in the Faroes, and two early settlement period sites from southern Iceland (Tjarnargata 4 and Herjolfsdalur). Both the Faroese and early southern Icelandic collections are made up mainly of colonially nesting seabirds (mainly Alcidae, auk family), and the Icelandic Tjarnargata 4 collection includes a few bones of the now extinct great auk *(Pinguinis impennis)*. The two early Icelandic sites appear to reflect the drawdown of the massive natural capital represented by the previously unharvested bird colonies of the south coast at a time when the small herds and flocks of imported domesticates could not yet fully provision the first colonists. After the early settlement period, Icelandic archaeofaunas generally have less than 5 percent bird bone, the

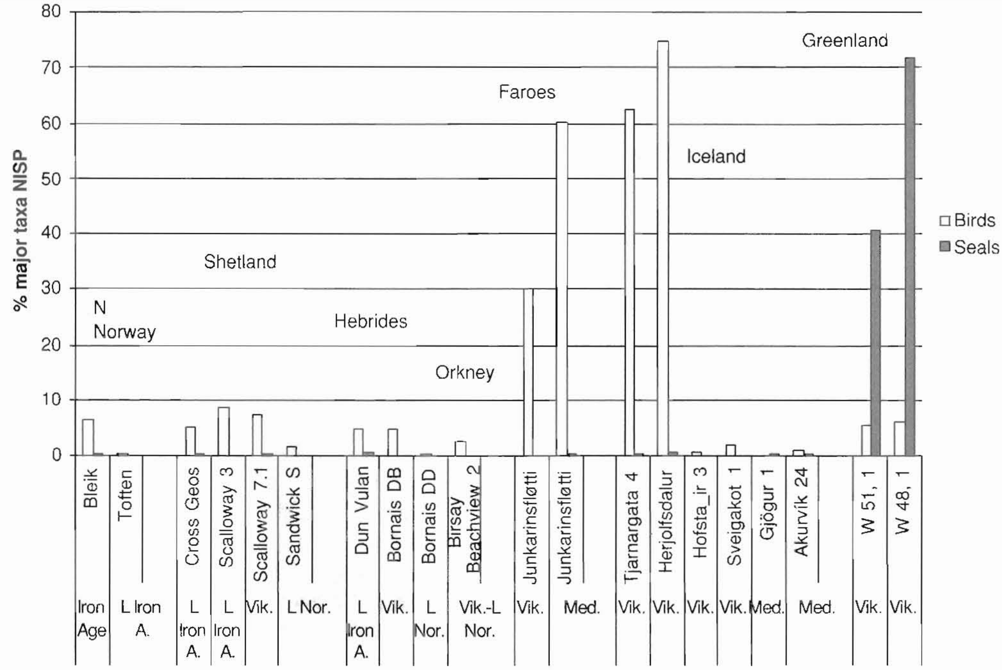

FIGURE 9.3. The relative percent of major taxa made up by birds and seals from a selection of systematically sampled sites across the North Atlantic. NISP, number of identified specimens. For references and data sources see Table 9.1.

only exception being the site of Miðbaer on the small island Flatey in the midst of major seabird colonies in Breiðafjord (Amundsen 2004). In the Faroes, recent excavations led by Símun Arge at the deeply stratified site of Junkarinsfløtti on Sandoy have produced a very large archaeofauna extending from the Viking period to the early thirteenth century (Church et al. 2005). These collections have produced massive numbers of bird bones (mainly puffins, *Fratercula arctica*), whose frequency actually increases relative to domestic mammals and fish in the sample, reaching 60 percent of identified fragments in the Medieval upper layers. Older unsieved collections from the Faroes also show high percentages of puffins extending into the later Middle Ages, indicating that the Junkarinsfløtti archaeofauna is not unique (Gotfredsen 2007). Excavations on Sandoy are ongoing, but results so far suggest a successful long-term management of the Faroese bird colonies for sustainable yield rather than an immediate and rapid drawdown paralleling the south Icelandic pattern. Norse seabird exploitation in the North Atlantic has clearly followed more than one trajectory.

As Figure 9.3 also indicates, seals have been hunted throughout the region, but only in Greenland do seal bones make up a major portion of the bone collections from first settlement onward. Viking Age colonists in the eastern North Atlantic encountered gray seals (*Halichoerus gryphus*) and common or harbor seals (*Phoca vitulina*), both mainly vulnerable during spring pupping seasons and usually taken by clubbing on shore or netting (Fenton 1978). In Greenland, the Norse encountered a different range of seal species, some seasonally accessible in vast numbers. Colonies of the familiar common seal existed where summer drift ice was not prevalent, but far more numerous were the millions of harp seals (*Pagophilus groenlandicus*) and hooded seals (*Cystophora cristata*) that ride the drift ice from Labrador along the coast of Greenland each spring. These migratory ice-riding Arctic seals were vulnerable

TABLE 9.1

Data Sources for Chapter 9 Figures

PERIOD	REGION	SITE AND PHASE	REFERENCE
Iron Age	N Norway	Bleik	Perdikaris 1999
	N Norway	Toften	Perdikaris 1999
	Orkney	Brough Rd. 3	Rackham 1989
	Orkney	Howe 3	Dockrill et al. 1994; Smith 1995
	Orkney	Pool 6	Nicholson 1998
	Orkney	Saevar Howe 1	Colley 1983; Rowley-Conwy et al. 2004
	S Uist	DunVulan 5	Sharples 2005
	Shetland	Scalloway E 3	Ceron-Carrasco et al. 2005; Sharples 1998
	Shetland	Cross Geos	Bruns and McGovern 1985
Viking Age	Faroes	Junkarinsfløtti 1	Church et al. 2005
	Caithness	Smoo 5	Barrett 1995
	Orkney	Brough Rd. 1 and 2	Rackham 1989
	Orkney	Birsay Beachview	Morris 1996
	Orkney	Pool 7	Nicholson 1998; Bond 2007
	Orkney	Saev. H	Colley 1983
	S Uist	Bornais DB	Sharples 2005
	Shetland	Scalloway L 3	Sharples 1998, 2005
	N Iceland	Sveigakot 1–3	McGovern et al. 2006
	N Iceland	Hofstaðir 1–3	McGovern et al. 2006
	N Iceland	Hrísheimar 2	McGovern et al. 2006
	N Iceland	Granastaðir	Einarsson 1994
	S Iceland	Tjarnargata 4	Amorosi et al. 1996
	S Iceland	Herjolfsdalur	Amorosi et al. 1996
	S Iceland	Adalstraedi	McGovern et al. 2001
	Greenland	W 51-1 Sandnes	McGovern et al. 1996
	Greenland	W 48-1	McGovern 1985a, 1985b
	Greenland	E 17a Narsaq	McGovern 1994
Late Norse–Medieval	N Norway	Storvågan 11th	Perdikaris 1998
	N Norway	Storvågan 13th	Perdikaris 1998
	N Norway	Helgoy 14th	Perdikaris 1998
	Faroes	Junkarinsflotti 3	Church et al. 2005
	S Uist	Bornais DD	Sharples 2005
	Shetland	Sandwick North 3-4	Bigelow 1984
	Caithness	Roberts Haven	Barrett 1997
	Caithness	Freswick	Morris et al. 1995
	NW Iceland	Gjögur 1-2	Amundsen et al. 2005; Krivogorskaya et al. 2005
	NW Iceland	Akurvík 22, 24	Amundsen et al. 2005; Krivogorskaya et al. 2005
	NW Iceland	Finnbogastaðir	Edvardsson et al. 2004
	Greenland	W54	McGovern 1985b
	Greenland	W52a	McGovern 1985b
	Greenland	W35	McGovern 1985b
	Greenland	W53d	McGovern 1985b
	Greenland	W53c	McGovern 1985b
	Greenland	E149	McGovern 1985b
	Greenland	E167	McGovern 1985b
	Greenland	E 71N	McGovern 1985b
	Greenland	E71 S	McGovern 1985b
	Greenland	GUS	Enghoff 2003
	Greenland	E 34	Nyegaard pers. com. 2004

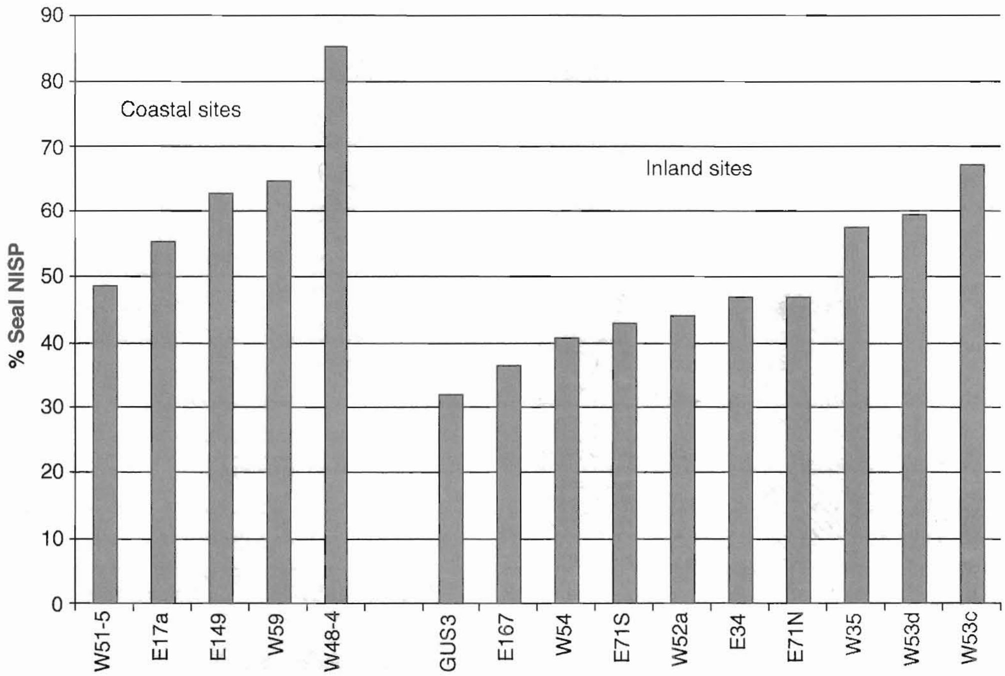

FIGURE 9.4. Seal bones are found in all Norse archaeofauna in large numbers (Enghoff 2003; McGovern 1985, 1985b; McGovern et al. 1996; Nyegaard G., personal communication 2004). These later-phase large collections illustrate a widespread pattern of transport of seal carcasses inland. Bone element distribution study indicates that nearly complete carcasses (gutted, as the baculum is generally missing) were transported up to 30 km from any possible landing point. W prefix, Western Settlement; E prefix, Eastern Settlement; NISP, number of identified specimens.

to clubbing and to entrapment in nets and could be taken effectively with existing Norse technology. Two resident nonmigratory seals also lived in the Greenlandic fjords, the very common ringed seal *(Phoca hispida)* and the rarer but larger bearded seal *(Erignatus barbatus)* Both of these arctic seals are most reliably taken with toggling harpoons and other ice edge and breathing hole hunting gear, which was part of Inuit and Paleoeskimo, but not Norse, subsistence technology.

Despite their lack of harpoons, Norse hunters in Greenland became expert in taking substantial numbers of the resident and migratory species most vulnerable to netting and clubbing, and seals rapidly became a key subsistence resource in Greenland rather than the occasional supplement sealing represented in the other North Atlantic islands. Figure 9.4 presents the relative percentage of seal bones from the later (fourteenth- to mid-fifteenth-century) archaeofauna from the two settlement areas, divided by coastal or inland location. The effort involved in transporting seal carcasses over rough terrain to upland farmsteads up to 30 km from the sea indicates the importance seals had for the Norse economy. Seasonality studies based on tooth cementum analysis indicates that the harp and common seal were all early spring kills, thus occurring at the low point of the agricultural year when the stored dairy produce and meat from the previous summer would be running low and domestic stock were no longer producing milk. The arrival of the migratory ice-riding harp and hooded seals and the spring pupping concentrations of the common seals would thus have been critical points in the Norse seasonal round in Greenland. The distribution of seal bones so far from any beach also underlines the communal scale

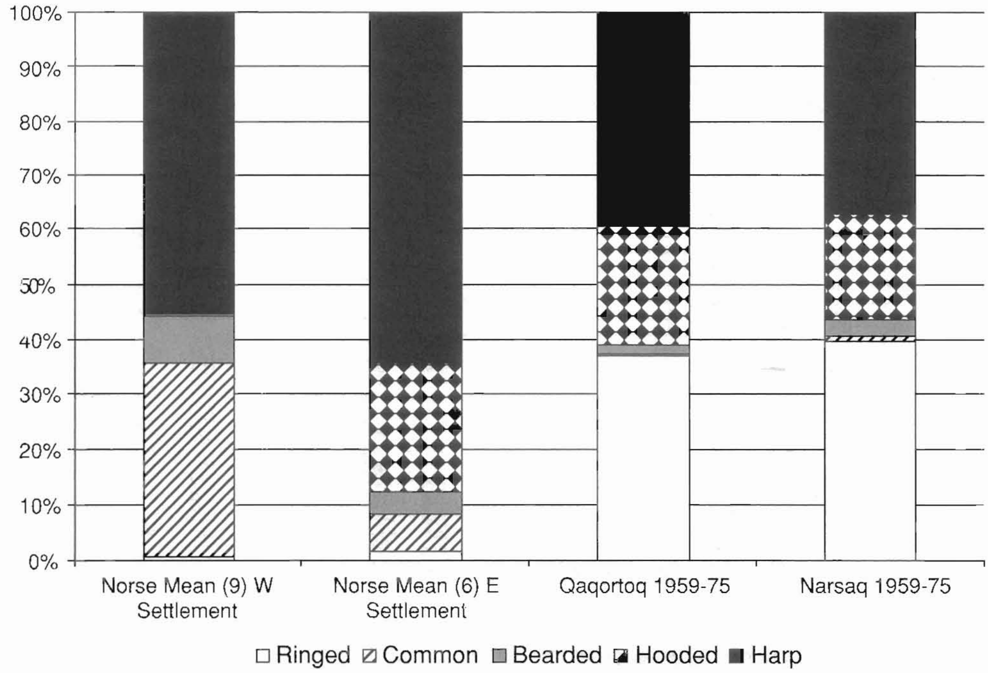

FIGURE 9.5. Comparison of the mean relative percentages of identified seal bones (number of identified specimens) for the 15 substantial archaeofauna available for the later phases of Norse Greenland, with catch statistics gathered for the two modern communities in the former Eastern Settlement (relative percentages of count of seals landed).

of Norse subsistence in Greenland—the individual farm was not the basic unit of survival, and a great many households would be dependent upon a limited number of boats maintained at the larger farms with access to the fjord or coast. Seabird bones (mainly auk family) are also found on inland farms in both settlement areas.

Figure 9.5 presents a comparison of the mean of the relative percentage of seal bones identified to species level in the major Norse archaeofauna, with modern seal catch statistics from Inuit Greenlandic communities in the area of the former Eastern Settlement. The differences between seal species regularly taken by Norse hunters in the Western Settlement and the Eastern Settlement are explained by biogeography: hooded seals seldom reach the Western Settlement area, and common seal colonies are much larger in the Western Settlement area. However, the differences between the seal bones present in the Eastern Settlement Norse archaeofauna and the modern catch statistics for the very same hunting area point to cultural and technological differences. Ringed seals make up the majority of seals taken by traditional Inuit subsistence hunters in winter in most of the eastern Arctic, heavily supplemented by migratory harp seals where available (as in southwest Greenland). The ability of Inuit hunters to take ringed seals in winter at their breathing holes and at the ice edge has meant that these seal hunting communities do not rely so completely upon the timing of the arrival of the migratory seals in spring, and that they have the capacity to reprovision themselves throughout the winter months. The failure of the Norse to acquire Inuit ice-hunting technology despite centuries of contact is remarkable and has been cited repeatedly as a potential root cause for the subsistence failure that ultimately doomed Norse Greenland during a period of climatic change and increased interannual variability (Diamond 2005; McGovern 1985a, 1985b, 1994).

However, it is important to see Norse sealing in Greenland in its economic and social context bound up in a socially embedded seasonal round that involved a nested sequence of activities requiring communal coordination: hay harvest and seabird hunting in late summer followed by caribou drives in autumn and sealing and the Norðursetur hunt in summer. All or most of these activities drew upon the labor of multiple farms and produced the inland distribution of the seal and seabird bones and walrus maxillae that we can observe archaeologically. Inland farmers were dependent upon coastal boat-keepers, who were in turn in need of boat crews and laborers during the short, intensively scheduled Greenlandic summer. Seal hunting by drives into nets and clubbing on shore or on sea ice was a coordinated communal activity, and the sharing of the mass kill was an occasion for carefully calibrated redistribution that reinforced cooperation. Modern Faroese cooperative pilot whaling by mass stranding is carried out today, as much for asserting community solidarity as for the whale meat that is meticulously shared out according to Medieval regulations still enforced. Seal hunting with harpoons at breathing hole or ice edge is an individual or small-group activity, with seals killed singly rather than en masse and thus less suitable for comparable distribution. We do not yet understand the full dimensions of sealing in Norse Greenland, but it seems clear that it represented a powerful social and economic pattern that drew on ancient Nordic seal-hunting techniques, but which developed far more intensively than in any other part of the Norse North Atlantic and played a vital role in subsistence for coastal and inland farmers alike.

BETWEEN LOCAL SUBSISTENCE AND WORLD SYSTEM: FISHING IN THE VIKING AGE

While seals and seabirds contributed to local subsistence, and walrus hunting for a time provided valuable elite prestige goods for trade, none of these marine resources was to have more than local economic importance within the communities of the North Atlantic. By contrast, a series of changes in marine fishing and in the preservation of fish for later consumption that spread throughout the North Atlantic by the close of the Viking Age were to transform the economies of northwest Europe and to contribute to the colonization of North America five hundred years later. Some of the most significant advances in the archaeology and paleoecology of the North Atlantic in recent years have resulted from coordinated work by a number of field projects and analysts aimed at recovering, identifying, and comparing fish bones and other evidence for early fishing (Amundsen et al. 2005; Barrett 2003; Bigelow 1984; Bond et al. 2004; Cerron-Carrasco et al. 2005; Church et al. 2005; Krivogorskaya et al. 2005; McGovern et al. 2007; Morris 1996; Morris et al. 1995; Mulville and Thoms 2005; Nicholson 2004; Parker-Pearson and Sharples 1999; Perdikaris 1996, 1999; Sharples 1998, 2005; Smith and Mulville 2003). Thanks to the work of these collaborating teams we are now able to compare multiple large, fish-rich archaeofauna from well-dated, systematically sampled and sieved contexts that span the period from later Iron Age (sixth to ninth centuries AD) through Viking Age to Late Norse-Medieval period. A key question uniting these investigations has been the causes and origin of the expansion of marine fishing from subsistence production for local consumption into the vast commercial bulk-goods marketing program that brought dried and salted cod to distant inland consumers across Europe after AD 1100.

Historical documents have long indicated the role of preserved cod and herring in the expansion of trade and towns and the strengthening of royal power in Scandinavia by the early twelfth century (Perdikaris 1999). When properly air-dried, low-fat white-fleshed cod family (Gadidae) fish can keep without salting for over five years, providing a light and storable source of high-quality protein that could sustain sailors, armies, and inland populations far from

the shore. The two air-dried products of the early Medieval period were *stockfish* (beheaded and dried in the round, hung from racks) and *rotscher* (beheaded and flat dried, sometimes simply spread on cobble beaches). Stockfish production requires winter temperatures within a few degrees of freezing and was best carried out with fish 60 to 110 cm long. Rotscher could be produced under a wider range of temperatures and made use of fish optimally 40 to 70 cm long. Cod became the preferred fish for curing, and methods of fish cutting and preparation became standardized as the older artisanal fisheries were rapidly converted into full-scale commercialization, producing a commodity that could be stored for long periods, widely transported in bulk, and bought and sold in counting houses far from the fishing grounds. By the thirteenth century the Hanseatic League had been formed, with the control and regulation of the codfish trade as a primary collective concern. By the mid-fifteenth century, over 100 cities in Europe had Hansa connections, run from major offices in Novgorod, Bergen, Brugge, and London. Demand continued to expand, and the codfish became a commodity used for futures trading, as collateral for loans, and as a dietary standard in late Medieval cook books (most of which suggest pounding the dried fish with a large hammer for an hour to tenderize it; Fagan 2006). By 1500, the discovery of the Grand Banks fishery off Newfoundland attracted hundreds of vessels from Europe to the New World annually, and the cod fisheries remained an economic engine driving the European colonization of what became New England and the maritime provinces of Canada for the next three centuries (Kurlansky 1997).

"FISH MIDDENS" IN THE NORTH ATLANTIC

The role of preserved cod in the later history of the North Atlantic is thus both dramatic and well documented, but the origins of this phenomenon prior to the beginning of historical records around AD 1100 remains an archaeological problem. The existence of "fish middens" apparently dominated by dense masses of fish bones has been observed in many parts of the North Atlantic for many years, but prior to the late 1970s excavations of these deposits that employed systematic sieving programs were rare, and the analysis and identification of marine fish bones was still in its infancy (Morris et al. 1995). This situation has since changed dramatically, with advances in both excavation and zooarchaeological analysis of fish bone. Systematic sieving and flotation of bone-bearing deposits has become standard, generating substantial, comparably excavated fish bone collections from a wide area, and at the same time significant advances have been made in standards of analysis and data comparability ("number of identified specimens" becoming a standard comparative measure, and species-level identification based on most of the bones of the fish skeleton replacing selected-element approaches). Figure 9.6 presents some of these new data for the relative abundance of fish bones on a sample of comparably excavated major sites in different parts of the North Atlantic (see Amundsen et al. 2005, Barrett et al. 1998, 2000; Bigelow 1991; Krivogorskaya et al. 2005; Perdikaris 1999; McGovern 1985a, 1985b, 1990; McGovern et al. 1996, 2001; Morris et al. 1995; Nicholson 1998, 2004; Parker-Pearson and Sharples 1999; Sharples 1998, 2005).

Relative abundance of marine fish bone in an archaeofauna is a relatively crude indicator of fishing intensity, but it may provide a starting point for comparative discussions (Krivogorskaya et al 2007; Perdikaris 1999; Perdikaris and McGovern 2007). Figure 9.6 underlines the degree of variation between sites, regions, and periods in the North Atlantic from pre-Viking Iron Age to the Late Norse-Medieval period. The major role of fish in the two Arctic Iron Age Norwegian sites of Bleik (a high-status chieftain's farm on Andoya) and Toften (a middle-ranking Andoya site) is clear. Classic fish middens definitely extend back to

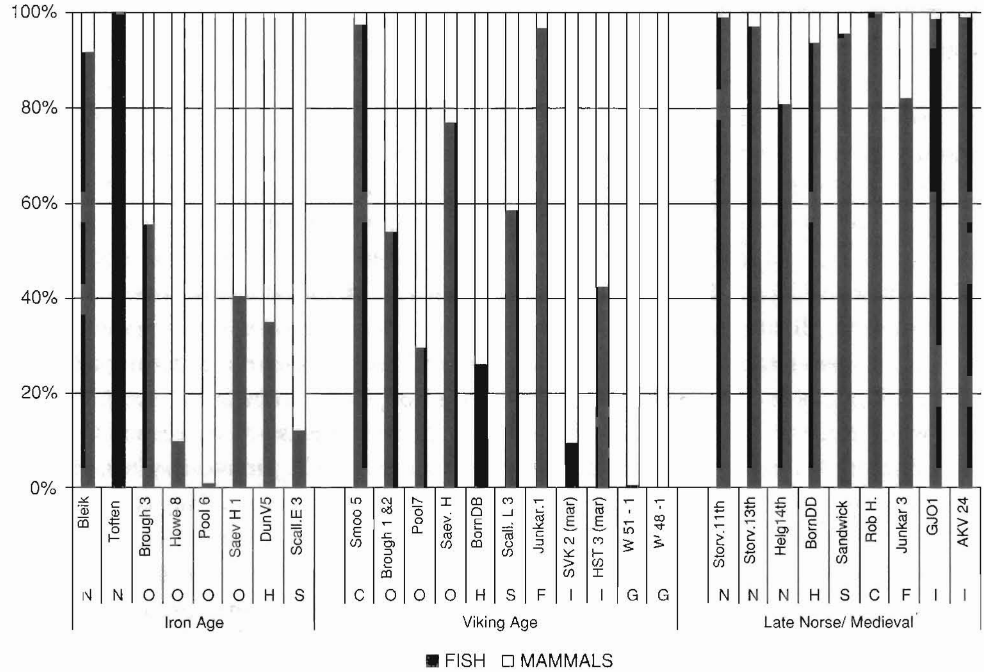

FIGURE 9.6. Relative percentages of marine fish bones and mammal bones from sites dating to the Iron Age, Viking Age, and Late Norse–Medieval period grouped by region. Only sites with systematic sieving are included. N, arctic Norway; O, Orkney; H, Hebrides; S, Shetland; C, Caithness; I, Iceland; G, Greenland. See Table 9.1 for data sources.

the second and third centuries AD in the Lofoten and Vesterålen region of arctic Norway, predating the Viking Age Scandinavian expansion by centuries (Perdikaris 1999). Equally striking is the nearly complete absence of fish from the Viking Age and Medieval Greenland (W51-1 and W 48-1, both in the Western Settlement; McGovern et al. 1996). Despite generally excellent conditions of preservation that regularly allow the recovery of hair, cloth, feathers, and large amounts of mammal bone, and the intensive sieving and whole-soil sampling efforts of multiple projects since 1975, marine and freshwater fish bones have remained exceptionally rare in all Greenlandic archaeofauna (Enghoff 2003; McGovern 1985a, 1985b, 1990; McGovern et al. 1996). Explanations for this shortage of fish remains have ranged from issues of seasonal scheduling and labor shortage (Perdikaris and McGovern 2007) to religious sanction (Diamond 2005). Whatever the cause, it is clear that the Norse Greenlanders made sealing rather than fishing the mainstay of their subsistence economy, and that they never generated the fish middens that create archaeofauna predominately composed of fish bone.

THE PICTISH-NORSE TRANSITION IN NORTHERN SCOTLAND

Between the extremes of apparently intensive marine fishing in Iron Age Arctic Norway and apparently insignificant fishing in Viking and Medieval Greenland are the more complex zooarchaeological patterns of the Northern and Western isles, Faroes, and Iceland. In an important regional synthesis combining the evidence of zooarchaeology, radiocarbon chronology, and stable carbon isotopes in human bone from pre-Norse, Viking Age, and Late Norse contexts, Barrett et al. (2000) presented a strong argument for profound differences between Late Iron Age Pictish and Viking Age diet and

economy in the Northern Isles. Pictish fishing was argued to be mainly inshore, aimed at small saithe (1- to 2-year-old "sillocks and piltocks"), which can be caught close inshore, sometimes from rocky cliff-side craig seats (Fenton 1978) rather than from boats. These young saithe are too small to effectively air dry, but they can be smoked for later consumption, and their liver yields oil (in later centuries extensively used for lighting as well as for food). Other marine species taken on Iron Age sites include anadromous species such as eels and salmon, which can be taken in streams or close inshore. Fishing, sealing, and seabird hunting were seen as supplementary to well-developed cereal agriculture (mainly based on barley but including oats in the Late Iron Age; Bond et al. 2005). Available carbon isotopic ratios from Pictish skeletons indicated a largely terrestrial diet (human bone $\delta^{13}C$ values around −20 ‰), and produced a strong contrast with more maritime samples from Viking Age and Late Norse skeletons indicating a stronger participation in the marine food web ($\delta^{13}C$ values around −17 ‰; Barrett et al. 2000:149). Since the 2001 synthesis, important new analyses have been carried out on collections from the sites of Dun Vulan (Late Iron Age; Parker-Pearson and Sharples 1999) and Bornais (Viking to Late Norse; Sharples 2005), approximately 3 km apart on South Uist in the outer Hebrides, and from Viking and Late Iron Age phases at the elite Iron Age site of Scatness in Shetland (Bond et al. 2005; Nicholson 2004). As Figure 9.6 indicates, the Iron Age–Viking Age transition between nearby Dun Vulan and Bornais did not result in an increase in the proportion of fish bones deposited, though there was a shift toward cod and toward larger individuals, as seen in most other transitional contexts. The later pre-Norse Iron Age phases at Scatness in Shetland are producing evidence for intensified fishing and probably storage of dried fish and fish liver oil for elite redistribution prior to the Scandinavian settlement, and the analyst now argues for some significant continuities between Pictish and Viking Age fishing patterns (Nicholson 2004:161). Barley, smoked saithe, and fish liver oil all may have played a role in Late Iron Age Pictish chiefly economies based on resource concentration and redistribution by local elites (Dockrill and Batt 2004). While the Viking Age saw the intensification of flax production (probably in part providing fishing line and sails) and continued soil fertilization and amendment, these patterns are now often seen to represent intensifications of economic patterns begun in the late Iron Age (Bond et al. 2005). Although the clarity of the Pictish-Norse economic transition has blurred slightly in recent years, most workers still model the Pre-Viking Iron Age inhabitants of the Northern and Western isles as primarily farmers who made use of a range of largely inshore marine resources to supplement their terrestrial subsistence economy, in strong contrast to their Pre-Viking Scandinavian contemporaries in the islands of Arctic Norway, whose economies were based primarily upon deep-sea fishing. If the Iron Age peoples of northern Scotland could be characterized as farmers who fished, the contemporary Iron Age North Norwegians were fishermen who also farmed.

While the Norse arrival in northern Scotland ca. AD 800 is very visible in terms of elite burials, change in house forms, and modern place names, it remains far less clear cut in the zooarchaeological and archaeobotanical record. At some sites a strong zooarchaeological case can be built for radical change in degree and type of maritime adaptation after the arrival of the Norse, but in other areas the case for significant continuity can also be made. Some of these differences among archaeofauna may be due to sampling issues (midden vs. house floors, column samples vs. open-area excavations) or issues of chronology (the resolution required to securely date an occupation as before or after the Norse arrival pushes the limits of radiocarbon chronology), but it increasingly appears that this local variability in marine resource use at the Pictish-Viking transition may be signal rather than noise. Different

economic patterns in marine resource use may well have existed in the same area, even on the same islands. This economic complexity has contributed to continued debate about the extent of population replacement versus assimilation during the Viking Age contact period (Jennings and Kruse 2005; Owen 2004). Major linguistic and ritual changes can be associated with conquest and replacement of elites, but even scattered continuities in basic subsistence practices may point to a variable blending of local and imported subsistence strategies and technology at the very local (perhaps intra-household) level, and the very discontinuity in the different forms of evidence may carry its own message. The economic and environmental story of Norse-Pictish contact in Scotland is by no means a settled issue and remains a very active research focus for many teams.

As Figure 9.6 indicates, the major jump in fish bone relative percentages in northern Scotland comes not with first contact in the ninth century, but with the Viking Age to Late Norse–Medieval transition around AD 1050–1100 throughout the region. While cod and cod-family gadid fish make up most of the majority of these new fish middens, herring bones provide the jump in fish abundance between Viking and Late Norse contexts at Bornais (Sharples 2005). Continued excavation coupled to a major radiocarbon dating program at the site of Quoygrew in Orkney has clearly demonstrated a break between mammal-dominated Viking Age middens and a classic Late Norse fish-dominated midden that can be closely dated to a generation or so on either side of the year 1000 AD (Barrett 2003; Simpson et al. 2004). As Barrett et al. (2000) have argued, the apparent arrival of a coherent Viking Age economic package involving simultaneous intensification of fishing, grain production, and long-distance dried fish trading breaks down when additional dates on stratified sequences can be applied. These processes may begin with the Norse arrival in northern Scotland around AD 800 but do not take off synergistically until two centuries later. The Late Norse transition has been identified by Bigelow (1984, 1991) as the origin point of the crofter farmer-fisher life ways so evident in the historic and ethnographic record of the Northern and Western isles:

> In fundamental terms, the model proposes that particularly during the twelfth century the majority of Shetland household economies shifted from a predominately subsistence orientation to the mixed subsistence/surplus-for-exchange pattern that in various forms was characteristic of the islands until the twentieth century.
>
> (Bigelow 1991:20)

THE FISH EVENT HORIZON IN BRITAIN

The dating of the fish middens in the Northern and Western isles has become more significant with the documentation of what Barrett et al. (2004) have called the "fish event horizon" (FEH) in Britain (see also Bailey et al., this volume). Derived from a comprehensive data survey of the very large number of archaeofauna reported for Britain from early Iron Age to Medieval periods, the FEH marks a striking transition point in the pattern of marine fish distribution in inland sites in Britain; prior to the temporal horizon of AD 950–1050 there are virtually no marine fish bones in any archaeofauna more than 10 km from the coast. After the FEH, bones of Gadidae and herring become increasingly common on inland sites, as would be expected from the well-documented dried-fish trade after AD 1100. Marine fishing and the intensive marketing of preserved marine fish thus do not date to the Anglo-Saxon period (it is not clear that Anglo-Saxon speakers had a word specifically meaning "cod"; Barrett et al. 2000) nor does it begin with the first Scandinavian settlements in what became the Danelaw in northern England in the late ninth and early tenth centuries. This finding has stimulated a major reevaluation of the evidence for pre-FEH fishing and inland fish distribution in the North Atlantic. We can now be confident that the combination of intensive fishing (producing specialized fish

middens in producing areas) and large-scale bulk marketing of preserved marine fish (producing inland fish bone distributions in consuming areas) was not the result of Celtic or Anglo-Saxon cultural traditions, and that (in the British Isles at least) it was also not a product of the early Viking Age arrival of Scandinavian raiders and settlers. We need to look outside the British Isles for the ultimate origins of the FEH and the highly visible Late Norse transition.

EARLY FISHING IN FAROES AND ICELAND

As Figure 9.6 indicates, marine fish appear to have played a very important role in northern Norway, Faroes, and Iceland from Iron Age times into the early Viking Age and Medieval period, both before and after the British FEH. A Scandinavian origin for the FEH seems a clear possibility on these grounds alone, but it is fish preservation technology and fish distribution expertise (through exchange, tribute, or market) that underlies the economic and social changes of the FEH, not simply seafaring skills and level of fishing effort. Since fisher folk everywhere tend to consume fish themselves as well as sell them (often eating the less salable species or size ranges), most coastal site middens tend to reflect a confusing mix of local subsistence and production for market even in later Medieval and early modern situations long after the FEH. This mixture can make unraveling the commercial signature in fish archaeofauna challenging, and clear-cut patterns of species abundance and element representation are not always easy to see in coastal midden deposits (Morris et al. 1995). As has been argued elsewhere, the way forward involves a multiindicator, multiarchaeofauna approach combining species proportions, skeletal element distribution, size and age reconstruction, and the use of later sites of known function as reference points for the understanding of earlier archaeofauna (Amundsen et al. 2005, Krivogorskaya et al. 2005; Perdikaris 1999; Perdikaris and McGovern 2007). A simple comparison of the recovered proportions of different skeletal elements can provide some indications of specialized fish processing.

Figure 9.7 presents a comparison of the relative proportions of two fish skeletal elements (cleithrum around the gill slit, and premaxilla in the upper jaw) for a range of sites of different period and location. In the production of all types of dried gadid fish, the head and jaws (including the premaxilla) are removed in the first stages of fish cutting, and thus premaxillae and other head and jaw bones tend to accumulate where fish are processed. The cleithrum and associated bones in the pectoral arch are normally left in the headless body, as these bones help to keep the fish together and aid drying of the carcass when spread apart. Thus cleithra tend to travel with the prepared body, while premaxillae tend to remain at processing sites. Where subsistence fishers consume their catch on site, middens tend to accumulate cleithra and premaxillae in more or less equal proportions (both elements are robust and easily identified to species level). Where export of preserved stockfish or rotscher takes place, cleithra and premaxilla of the same fish may be deposited thousands of kilometers apart. As Figure 9.7 illustrates, Iron Age sites in Norway (Bleik and Toften in Perdikaris 1999) and at Dun Vulan on South Uist in the Hebrides (Sharples 2005) show some minor fluctuations around the 50:50 natural proportion, with the closest match to the high-status site of Bleik being the eighteenth-century contexts at Finnbogastaðir in northwest Iceland, which is known to derive from a mixed subsistence/market production pattern (Edvardsson et al. 2004). The Beachview (Bv) Birsay Area 3 collection has also been interpreted as primarily domestic consumption refuse probably mixing initial processing and local consumption (Morris et al. 1995). The Viking–Late Norse contexts from Freswick Links Caithness (Phases T, U, V, Area 4; Morris et al. 1995:185–190) by contrast come from a more specialized classic fish midden deposit and show a marked surplus of cod premaxilla (or deficit of cleithra), suggesting processing for distant consumption.

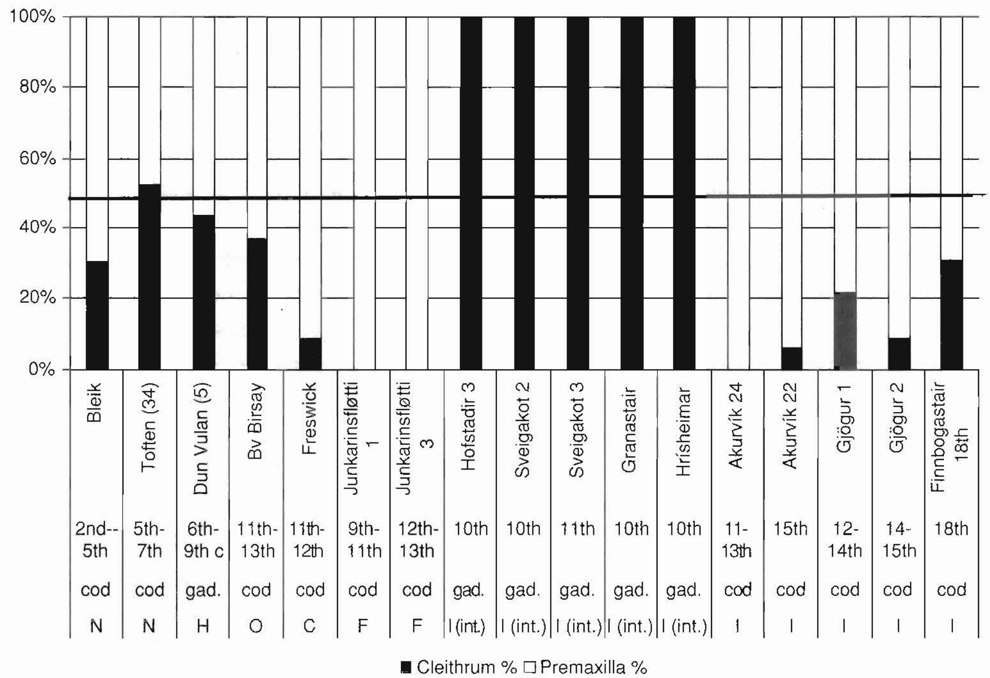

FIGURE 9.7. Relative proportions of cleithrum and premaxilla (number of identified specimens) on selected large archaeofauna. Where possible cod (the major commercial species) has been used for this comparison, but in some cases all gadid fish have been pooled due to sample size issues. The horizontal line indicates the natural proportion of these paired elements in a whole fish. N, arctic Norway; H, Hebrides; O, Orkney; C, Caithness; F, Faroes; I, Iceland. See Table 9.1 for data sources.

The Viking Age and Late Norse-Medieval contexts at Junkarinsfløtti in Sandoy on the Faroes show closely similar patterns of concentration of premaxillae and near absence of cleithra (Church et al. 2005). The site area sampled thus far includes many bird and domestic mammal bones and is thus not simply a fish processing area, but the strong patterning does raise some questions about the role of the site in producing preserved cod for either local or distant markets. Excavation is ongoing at this site, and a multiseason effort now underway should generate very large stratified collections as well as a better understanding of the site as whole.

In Iceland, the current Viking Age coastal archaeofauna available are all from incompletely sieved excavations, from contexts with poor bone preservation, or not yet large enough to effectively quantify. However, large well-preserved modern collections are available from inland sites dating to the Viking Age and from coastal sites in northwest Iceland dating to the twelfth through fifteenth centuries (Amundsen et al. 2005; Krivogorskaya et al. 2005; McGovern et al. 2007). The set of large sieved inland archaeofauna from northern Iceland dating to the late ninth to tenth centuries comes from both inland Eyjafjord (Granastaðir; Einarsson 1994) and from the Lake Mývatn region to the east (Hofstaðir, Sveigakot, Hrisheimar; McGovern et al. 2007). These sites are from 50 to 80 km from the sea and are securely dated through a combination of AMS radiocarbon dates and volcanic tephra. Despite their distance inland, all have produced substantial numbers of marine fish bones datable to before, after, and during the British FEH, indicating the presence of a Viking Age fish distribution system in ninth- to tenth-century Iceland perhaps comparable to the later communal system that transported so many seal carcasses to inland farms

in Greenland. The pattern of element distribution signaled by the complete absence of any premaxilla and the abundance of cleithra extends to cod, haddock, saithe, ling, and other Gadidae imported inland; all were brought in as headless preserved fish. Scattered finds of postcranial gadid elements on other early inland sites in both southwestern and eastern Iceland indicate that the Mývatn and Eyjafjord pattern of distribution was widespread, and that inland households throughout Iceland had no problem in provisioning themselves with preserved marine fish early in the Viking Age (McGovern et al. 2007). These Viking Age inland sites not only provide a clear consumer's profile of fish element distribution, but also indicate the existence of a regional-scale network that was capable of producing and distributing substantial amounts of preserved fish over a wide area.

One source for this Viking Age regional fish trade may have been the West Fjords of northwest Iceland. This district has very limited pasture but excellent access to fishing grounds and seems to have supported wealthy elite manors from the Viking Age whose income came from fishing rather than farming (Edvardsson et al. 2004). The sites of Akurvík and Gjögur, which appear in Figure 9.7, are less than 3 km apart on the shores of Nordurfjord in northwest Iceland (Amundsen et al. 2005; Krivogorskaya et al. 2005). Akurvík is a seasonal fishing station composed of briefly occupied sod booths with associated fish middens, while Gjögur is a deeply stratified farm mound. Both produce fish-dominated archaeofauna, and both show strong "producer" signatures in their early and later Medieval contexts. The early phases of both sites predate the historically known mid-fourteenth-century date for the arrival of commercial fishing via England and the Hanseatics and suggest the presence of a still poorly understood precommercial chiefly fish production and exchange network that operated in Iceland (and perhaps in the Faroes and Arctic Norway) before the FEH and the full-scale commercialization of the high Middle Ages.

Another major tool for North Atlantic marine zooarchaeology is the reconstruction of live fish length from measurement of bone fragments (Wheeler and Jones 1989). As Figure 9.8 indicates, dentary and premaxillary measurements tend to produce similar distributions, and these can be used to investigate the nature of the fish product being prepared at fishing stations. While both the Gjögur fishing farm and the Akurvík seasonal fishing station were producing and exporting cod in the Middle Ages, only the Akurvík station seems to have been systematically processing cod fish within the "stockfish window" of ca. 700 to 1,100 mm. Were the stockfish bound for the new overseas markets and the smaller rotscher circulating in local Icelandic exchange systems dating back to the early Viking Age?

Additional measures that cannot be presented here (vertebral element distribution, age-size correlations) provide more tools for the investigation of these early fisheries, but even this limited discussion of the rich data sets now available may serve to illustrate the main results of the investigation (see Amundsen et al [2005] and Krivogorskaya et al. [2005] for discussion of other indicators).

During the early Viking Age, prior to the FEH in Britain, parts of the Scandinavian world already practiced a combination of fishing, fish preservation, and fish distribution that lay somewhere between the patterns of local subsistence that seems to characterize most fishing in Iron Age Atlantic Scotland and the full-scale proto-world-system commoditization and commercialization of the Hanseatic League. This earlier Nordic fish distribution system connected distant districts in what was probably a social and economic web of obligation and exchange mediated by chiefly managers who, like Ottar, were quite capable of drawing wealth and power as well as food from the sea. It may be significant that the clearest current evidence for such a precommercial production and distribution system comes from those parts of the North Atlantic where Nordic colonists found few or no preexisting Celtic or Anglian populations

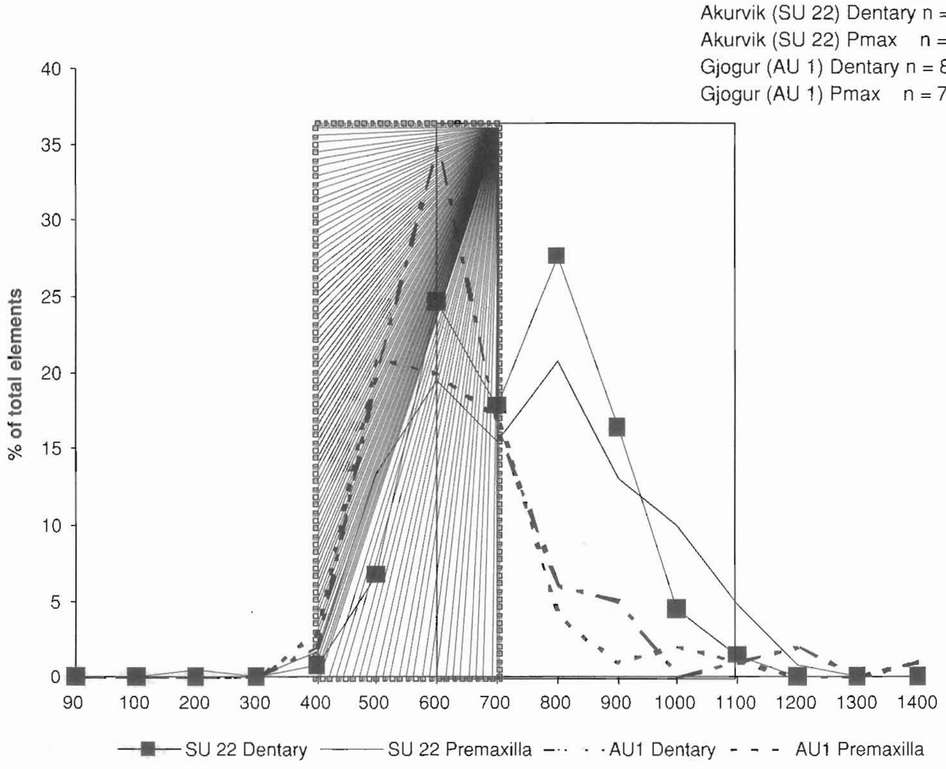

FIGURE 9.8. The distribution of cod live length reconstructions in millimeters for the later Medieval (fourteenth- to fifteenth-century) deposits at the seasonal fishing station Akurvíkand the nearby permanently occupied farm mound Gjögur. The solid line encloses the optimal size range for the production of stockfish, while the dotted line encloses the optimal size range for rotscher production. Akurvík appears to have been actively engaged in both stockfish and klipfish production, while Gjögur seems to have concentrated upon rotscher, perhaps serving different markets.

and were compelled to construct basic economic patterns without reference to preexisting local experience.

ENVIRONMENTAL IMPACT ASSESSMENT

Nordic settlers in the North Atlantic region had varied impacts upon marine and terrestrial ecosystems during the past millennium (Dugmore et al. 2007). In the Northern and Western isles of Britain, Norse settlers entered island ecosystems long exploited by farming cultures who had supplemented barley and stock with varied amounts of fish and sea mammals. Economic changes during the initial ninth- to tenth-century settlement seem to have involved expanded offshore fishing, but substantial fish middens signaling major intensification of fishing and skeletal evidence of substantial numbers of fish being prepared for export seem to date to the eleventh century or later. Human impact on seals, seabirds, and local fish stocks thus probably changed only slightly across the Pictish-Norse transition, and there is little evidence for a significant new impact on these resources. In the Faroes, Iceland, and Greenland, first settlement by ninth- to tenth-century Norse created the potential for significant impact due to the drawdown effect upon accumulated natural capital represented by previously untouched seabird and marine mammal colonies as farmers attempted to provision households while nurturing initially small stocks of imported domesticates. The Faroese evidence is still limited, but ongoing study suggests a heavy but sustainable use of

the great nesting cliffs, with no indication of massive seabird depletion after settlement. In Iceland, south coastal sites do show a dramatic "spike and crash" pattern in seabird use, but no species seem to have been driven to local extinction (even the great auk survived to the nineteenth century). Walrus in Iceland did not fare so well, and resident populations seem to have been depleted fairly rapidly, perhaps contributing to the settlement of the Greenland colony in the late tenth century. Nonmigratory seal populations (harbor and gray seals) were also vulnerable to overexploitation but were apparently successfully managed to provide a minor supplementary resource in most areas. Norse walrus hunting in Greenland may well have caused some initial population shifts, but the Norse Norðursetur hunting area of the later Middle Ages was in the same region that retained major walrus populations through the period of intense nineteenth-century exploitation down to the present. In Greenland, seals played a central economic role, with the huge migratory harp seal populations providing a vital seasonal staple resource to subsistence economy throughout the history of the Norse settlements without any credible evidence for depletion. Overall, while the Icelandic walrus colonies may have fallen victim to human impact, there is little evidence for overexploitation of marine resources in the rest of the record, and several indications of successful local level sustainable management of seals and seabird hunting on the millennial scale. While the Atlantic islands' environmental legacy of the Viking Age introduction of farming includes severe erosion and widespread degradation of soils and vegetation, it appears that these chiefly agricultural societies were often effective long-term managers of marine resources. However, in the broader historical view it has recently become clear that the Norse in the North Atlantic bear the mixed responsibility for the origins of western European commercial fisheries that have so drastically altered marine ecosystems worldwide over the past two centuries.

KINGS AND COD: ECONOMIC HERITAGE OF THE LATE VIKING AGE

Although a great deal of work remains to be done in all areas, thanks to the collective efforts of a great many scholars it is now possible to identify the origins of the commercial cod fishery of the North Atlantic with some certainty. The historic fishery seems to have been ultimately a product of prehistoric Scandinavian fishing and fish preservation skills that probably first centered in northern Norway and spread unevenly into the North Atlantic islands colonized after AD 800. In Iceland and possibly in the Faroe Islands, this chiefly fish preservation and distribution experience rapidly translated into economic webs of fish production, curing, and distribution perhaps somewhat similar to those of Iron Age northern Norway. In the Danelaw in northern England and Atlantic Scotland, these networks may have been less easily imposed on local tastes and existing economic structures in the Early Viking Age, and other sources of wealth and power may have been more immediately available through raiding, slave trading, and tribute collection. In the Later Viking Age, the advent of the FEH in Britain seems to have gone unrecorded by the chroniclers, who were far more absorbed in the dramatic story of escalating warfare between an England increasingly unified by Wessex and a succession of ever more powerful Nordic "sea kings" capable of fielding substantial armies of now-professional soldiers. As Randsborg (1980) has argued, the prolonged escalation of military conflict between western Scandinavia and England had social consequences on both sides of the North Sea, promoting centralization, Latinization, and state building on each side. By the time Cnut the Great was briefly able to unite both shores under his rule (AD 1014–1039) he had become a Christian monarch married to a high-ranking Anglo Saxon queen, was a pious patron of monasteries and churches, and was a prolific founder of towns and trading centers in Scandinavia (Lawson 2004). While his dynasty did not long survive his death (and his burial in

Winchester Cathedral near King Alfred), Cnut's rule brought Scandinavian administrators into many inland burghs throughout England and left indications of Anglo-Scandinavian cultural fusion in contemporary sculpture and court poetry. While no mention of un-saga-worthy codfish appear in King Cnut's panegyric poems, it may be significant that his military campaigns have been described as triumphs of logistics rather than of battlefield tactics. While temporal correlation does not in itself prove a connection to the archaeologically visible FEH, it is difficult not to suspect that the strong demand for army rations during the prolonged warfare of AD 950–1012, and the urgent need for funds to sustain postwar economic expansion may have together created an opportunity that only a Scandinavian king could have seized so effectively by introducing a longstanding Nordic resource from the sea to the peoples of Europe.

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