IN: HISTORICAL ECOLOGY: CULTURAL
KNOWLEDGE AND CHANGING LANDSCAPES
EDITED BY CAROLE CRUMLEY pp. 127-154
SAR PRESS, SANTA FE. 1994

Chapter 6

Management for Extinction in Norse Greenland

THOMAS H. MCGOVERN

Five hundred years before Columbus arrived in the Caribbean, Scandinavian communities sharing a common language and a common culture stretched from western Norway to eastern North America. Between ca. AD 800 and 1000, Nordic warriors, traders, and settlers colonized the Faroes, Shetlands, Orkneys, northern Scotland, the Isle of Man, parts of Ireland, England, and Frankland, as well as the western Atlantic in Iceland, Greenland, and Vinland (see Bigelow 1991; Jones 1985; McGovern 1990). By the early Middle Ages, thriving European communities existed in arctic Greenland and subarctic Iceland, and the great saga-men of the western North Atlantic were producing medieval Scandinavia's first histories and finest historical novels.

Because the medieval Scandinavian North Atlantic route to North America was ultimately fruitless, Columbus surely deserves credit for the effective connection of the Old World with the New. By the time Columbus sailed, the Norse North Atlantic had long been an economic and social backwater, and its island communities were undergoing contraction and a desperate struggle for survival. In 1492, it is just possible that the very last of the Norse colonists of Greenland were losing that struggle, slipping into social and biological extinction. This westernmost European colony of the Middle Ages probably fell vacant within a few decades of the first Iberian voyages to the Caribbean (ca. 1475–1500).

What caused the failure of the early, northern route to the New World? Why were the early centuries of Scandinavian exploration and relative prosperity followed by isolation, impoverishment, and extinction? Were the Scandinavian colonists of Greenland simply overwhelmed by the challenges of global climate change and contact with Thule Inuit? Did critical source management doom the settlements? Does the grim case of Norse Greenland hold any lessons relevant to a modern world faced by climate change, universal culture contact, and the consequences of human management choices on a global scale?

In this paper I briefly explore the 500-year-long interaction of culture and nature in Norse Greenland, explicitly attempting to draw lessons of wider potential relevance. The data employed are archaeological, documentary, and paleoecological. (Recent archaeology is discussed in greater detail in Berglund 1991; Keller 1991; McGovern 1985a, 1985b, 1992; McGovern et al. 1988. For a more complete discussion of the documentary sources, see Arneborg 1991; Gad 1970; Jansen 1972; Keller in press.)

Documentary sources for Norse Greenland are few (and historically reliable documentary sources even fewer), and they do not provide much nformation about basic subsistence, settlement pattern, land-use changes, or culture contact (Gad 1970). They do, however, provide a great deal of information about medieval Norse world view and cultural evaluation of "correct" social and environmental relations. Sagas, law codes, myths, and popular stories all provide a rich data set only now undergoing systematic analysis from an anthropological perspective (Durrenburger 1991; Durrenburger and Palsson 1989; Hastrup 1985; Miller 1986).

Thanks to the work of Scandinavian and English-speaking scholars of Greenland over the past three hundred years we now have a rich archaeological data base for many of the aspects of life not deemed "saga worthy" by he Norse themselves. In Atlantic Scandinavia it is thus possible to combine he long, diachronic perspective of history and archaeology with the emic, inside view" usually restricted to ethnographic cases. Historical archaeology is only beginning to exploit this sort of interface, but a rich potential surely exists for a combination of standard environmental analyses of esource exploitation and land-use patterns with cognitive approaches incorporating concepts of limited knowledge, management hierarchy and eterarchy, and a world view significantly different from our own.

SETTLEMENT PROCESS

s described in Landnamabok, The Book of the Greenlanders, and Eirik he Red's Saga (Jones 1985), the settlement of Greenland began with competition between chieftains in Iceland. The loser in this power struggle was Eirik the Red, who *departed hastily to investigate reports of new land* to the west. This voyage replicated earlier Norse voyages of exploration and settlement, since chiefly competition in the previously settled island colonies encouraged further emigration under the sponsorship of the defeated elites. Many such desperate or hopeful voyagers simply disappeared in the gray waters of the North Atlantic or were forced to accept subordinate positions in already settled colonies. But for a lucky few like Eirik, the special status of Landnamsmann (first settler) rewarded the exploration of a new settlement area.

A first settler was not necessarily the first to discover a new land; he was the one who pioneered a successful settlement, discovering firsthand both the potentials and the hazards of an unknown region. Not all would-be first settlers were successful. Iceland's legendary history describes two failed settlement attempts before the eventual success of Ingolfur Arnarson around 870 (Jones 1985). The Vinland settlements did not survive the first few years when they were most vulnerable (McGovern 1980–81; Wallace 1991). The risks of pioneering were exceptional since the normal buffering effects of a larger Norse community were absent, the timing and length of the growing season (and its variability) could only be estimated, and the potential hostility of unpacified native humans, elemental in-dwelling land spirits, and nonhuman magical beings (trolls and elves) would be a real threat to a small and restricted settlement. Success could come only to a strong chieftain with both the economic resources (ships, animals, seed, and laborers) and the personal, semimagical "luck" that could overcome great natural and supernatural obstacles.

Successful first settlers were able to claim lasting privileges in return for their luck and their early economic investment. The primary first settlers (like Eirik) could lord it over later-arriving chieftains and could count on playing a leading role in the new colony for the rest of their lives. Many primary and secondary chiefly pioneers set up pagan temples and, later, Christian churches on their home farm, ritually reinforcing their early authority and forcing other settlers to come to them for religious observances (see discussion in Keller, in press). The first settlers often arranged the location of the local *thing* (assembly, attended annually by free farmers who meet minimum property requirements) and had a great deal to say about its operation.

The first settlers named broad tracts (often naming whole fjord systems after themselves) and local landscape features, giving meaning and form to a culturally blank wilderness. Names had lasting power, both division of landscape on the chief-tains' terms. Eirik the Red named the longest fjord of the eastern settlement Eiriksfjord and then claimed the best land in Greenland at its head, naming his manor Brattahlid.

First settlers usually centered their main farms on the best agricultural land, then parceled out less-desirable tracts to followers (see Keller, in press). The Icelandic first settler Skalla-grim was well known for skill in integrating coastal, valley floor, and upland resources. He sent slaves and subordinates to harvest seasonally available seals, birds, and fish. He also assigned workers to *saeters* (shielings, summer pastures with shepherd's huts) in higher elevations, while overseeing the working of the main farm n the prime agricultural zone himself (Durrenburger 1991). Skalla-grim's manor thus was said to "stand on many feet": in modern terms, enjoying a wide niche breath as well as a large foraging territory.

This early "Skalla-grim effect" may have initially dispersed chiefly cen- ers over the whole habitable landscape rather than encouraging villagelike clusters. Certainly in Greenland the archaeological data (backed by a small but growing series of radiocarbon dates) suggests that all of the pockets of potential pasture vegetation in the fjords of West Greenland were occupied by Norse settlers within a generation of first settlement (Berglund 991; Keller, in press; McGovern 1981). The Norse in Greenland seem to have settled two major regions: the eastern settlement around the modern Qaqortoq and Narssaq districts in the southwest and the smaller western settlement in the more northern Nuuk district.

Initial settlement may have been broad but thin, but as immigration nd reproduction continued, the landscape seems to have filled in with mall, less-extensive holdings. Many small holdings may initially have been pecial-purpose seasonal stations later upgraded to year-round farms, or hey may have been created by subdividing early chieftain farms among blings. As the filling in process continued, the niche breadth of individual rms may have narrowed, and access to localized wild resources may have quired the cooperation of a local community rather than the coordination of a single chieftain's household labor. As the Viking period ended and cal populations increased, slavery was replaced by the use of tenant labor Durrenburger and Palsson 1989; Hastrup 1985). By ca. 1100, the initial mpact of first settlers and the Skalla-grim effect may have been history, but was to prove a pervasively influential history for the rest of the settlement.

West Greenland's plant communities are similar to those of Iceland and the eastern North Atlantic (Buckland 1988) but are restricted to the lower elevations of the warmer inner fjords of the south and southwest—precisely the location of the Norse eastern and western settlements. Virtually every meadow is marked by a Norse ruin, with close correlation between pasture productivity and settlement density in most regions (Christensen 1991; Keller 1991, in press). Summer pasture and hay for winter fodder were critical determinants of the number and productivity of domestic animals, and North Atlantic farmers were keen observers of pasture potential (see McGovern et al. 1988 for examples and discussion).

The distribution of these critical resources was certainly a key variable politically and economically, as well as environmentally. By the height of the settlement, productive pasture was far from evenly distributed. Figure 6.1 presents the pasture area available to a series of well-surveyed western settlement sites we have reason to believe were contemporary (McGovern 1985a) and illustrates the correlation of pasture area with the size of the farm. The site of W51 (Sandnes) was a chieftain's (probably first settler's) farm with one of the three churches in the western settlement (and the only church farm in this sample).

Table 6.1 summarizes available floor areas of halls (a proxy for human space), byres (cattle sheds), barns (hay storage), storage features, and churches for both settlement regions. The larger farms had a distinctive architectural pattern, with byres and storage buildings having far larger floor areas relative to human dwelling spaces than is found on smaller holdings (see McGovern 1992 for discussion). The site with the largest total floor area, and also the site showing the greatest surplus of storage capacity and cattle production, is the bishop's manor at Gardar (site E47; modern Igaliko).

The later Norse Greenlanders were indeed Christianized and eventually acquired a small monastery and nunnery as well as a bishop. The first bishop, Arnald, was provided by the king of Norway around AD 1127 in exchange for a live polar bear. According to Einar Sokkason's saga, the bishop became an active player in Greenlandic elite politics, eventually causing the deaths of most of the important men in the eastern settlement (Jones 1985).

The architectural and settlement data certainly indicate that Arnald and his successors were effective land managers as well as serious competitors with the other, nonclerical chieftains. By the later phases of occupation the episcopal manor at Gardar far outstripped the old first-settler's

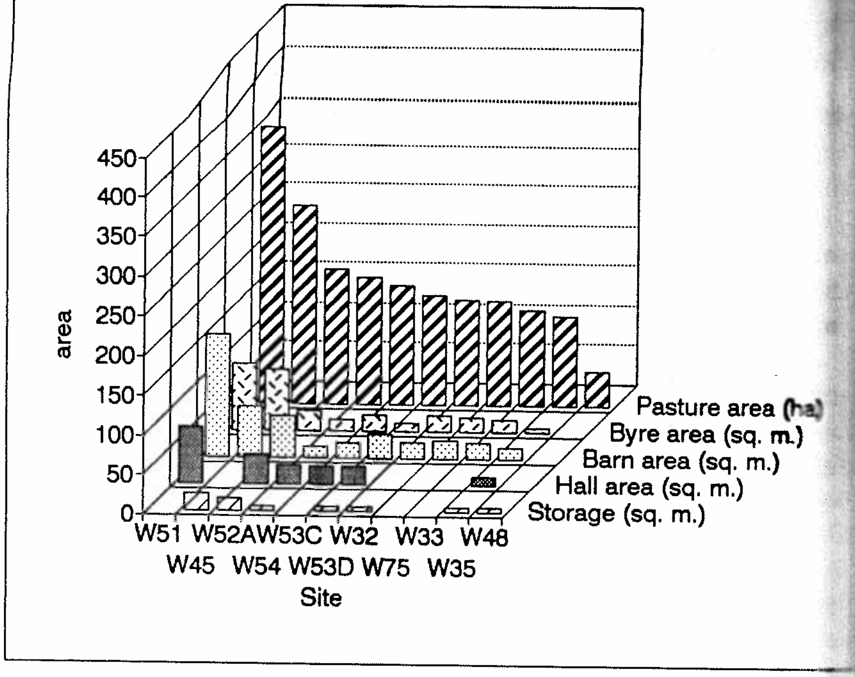

Figure 6.1. Comparison between pasture area and floor space for various uses at eleven sites in the western settlement.

farm at Brattahlid in all our architectural measures. Gardar's massive byres may have held more than 125 cattle (an average farm might have had between three and ten cattle), and an elaborate system of irrigation channels watered the bishop's pastures (Krogh 1982).

It also appears that Gardar was better able to suppress nearby settlement than Brattahlid had been. An excellent locational study by Keller (1991, in press) comparing ruin density and modern pasture productivity in the eastern settlement area reveals that the Gardar area maintained a surplus of pasture relative to site density, while the Brattahlid area did not. In other parts of medieval Europe, churches were often able to maintain and extend landholdings while the secular aristocracy was eventually forced to divide manors among siblings and retainers. A single (rather unreliable) document dating to the mid-fourteenth century and listing church property indicates that the church then owned outright or controlled access

TABLE 6.1.
Comparison of floor space at sites in the eastern and western settlements of Norse Greenland

Site	Site Rank (Name)	Floor Area (sq. m.)				
		Hall	Byre	Barn	Storage	Church
Eastern settlement						
E47	1 Gardar	131	389	353	361	154
E83	2 Hvalsey	82	53	107		68
E29N	2 Brattahlid	66	127	105	118	59
E111	2 Herjolfsnes	66	48	43	59	86
E105	3		20	20		53
E29R	3	35	77	56	51	
E20	3	32				
E66	3		44	36		
E64C	4	19	18	25	7	
E64A	4	14	10	18	8	
E78A	4				5	
Mean		56	87	85	87	84
Western settlement						
W51	2 Sandnes	72	84	155		40
W7	2 Anavik		50	54	38	58
W45	2		77	64	21	
W52A	3	38	25	52	15	
W54	3	24	15	15	6	
W53C	3	23	20	19		
W53D	3	23	11	30	6	
W8	3	21	12	14		
W16	4	14	14	11	12	
W35	4	11	6	14	6	
W32	4		20	20	6	
W33	4		16	20		
W75	4		18	23		
W44	4		14	13		
W48	4				6	
Mean		28	27	36	13	49

to most of the most productive resource spaces in the eastern settlement (Gad 1970; cf. Keller in press).

Whether sponsored by chiefly patrons or ambitious clerics (not mutually exclusive categories in the early Middle Ages), the churches of Greenland clearly played a role in the expression of both status and piety. As has long been noted (Bruun 1918), the stone churches of Greenland are very large by the standards of Atlantic Scandinavia. The episcopal cathedral at Gardar was nearly as large as its counterparts in Iceland (contemporary population estimated at ca. 60–80,000), and it was only one of several large stone churches built during the thirteenth century in Greenland (maximum population ca. 6000). These stone churches were modeled on the latest European fashions and included imported stained glass and English bells as well as costly timber and appropriate vestments. Even if we assume that most of the heavy work of dragging and raising stone was done in the winter, the amount of labor and resources allocated to such ceremonial structures remains impressive for a community whose domestic architecture consisted of a series of low sod huts.

SUBSISTENCE ECONOMY

Our evidence for subsistence economy in Norse Greenland is largely zooarchaeological and locational. Faunal data are available for a large number of Norse sites in Greenland (see McGovern 1985a for summary), as is a rich body of modern biogeographical information (Vibe 1967) and a growing number of paleoecological studies (Buckland 1988; Fredskild 198[illegible]; Sadler 1991).

From both documentary and climatic studies, we know that cereal agriculture was never possible on an economic scale in Norse Greenland. Herding and hunting supplied the surpluses that fueled clerical and chiefly building projects. Although the location of the Norse farms in the pasture-rich inner fjords suggests the importance of domesticated cattle, sheep, goats, horses, and pigs, the zooarchaeological evidence indicates a major reliance on wild species of the coast and mountains (see McGovern 1981, 1985b for discussion). Seal and caribou bone often make up the majority of the site archaeofauna, followed by caprines (both sheep and goats) and cattle (fig. 6.2).

The majority of the seals in the assemblage were migratory harp (*Pagophilus groenlandicus*) or hooded (*Cystophora cristata*) seals, while harbor or common seals (*Phoca vitulina*) were locally important in the eastern settlement. Ringed seals (*Phoca hispida*) are rare or absent. The migratory seals were probably caught in the outer fjord zone during their spring migration. Two small seasonal hunting stations have been documented in the outer fjord islands of the western settlement (Gulløv 1983), and it appears that nets and communal boat drives were used to catch groups of seals at the same time (probably like modern Faroese pilot whale drives). Harpoons, absent from Norse artifact collections, are post-medieval introductions in most of the Scandinavian North Atlantic.

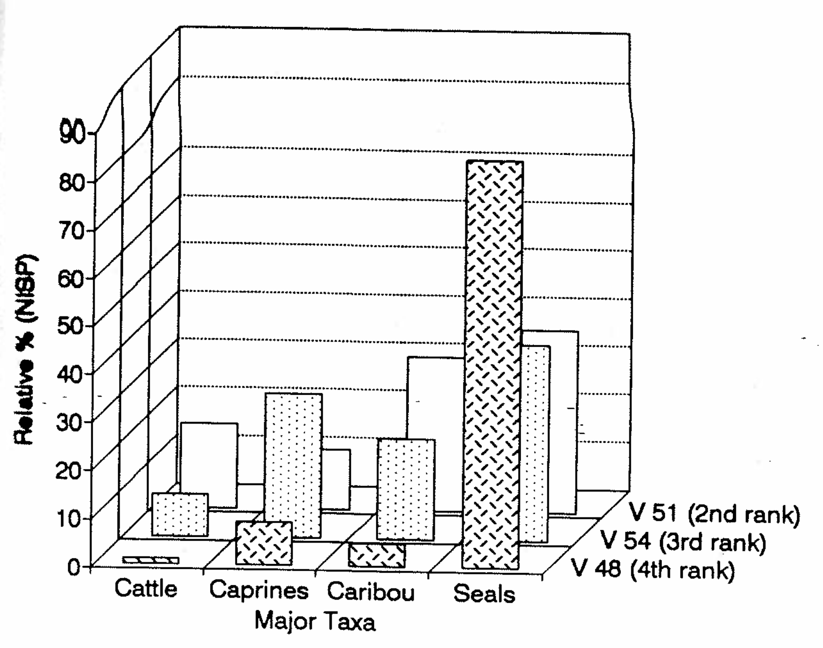

Figure 6.2. Major taxa in the faunal assemblages from three sites of different ranks.

The seasonal round of the Norse Greenlanders (partly based on unpublished tooth sectioning studies carried out by Bryan Hood) may serve to underline the key role of seals (especially the spring harp seal migration) in the Norse subsistence round (fig. 6.3). By late winter, domestic stock would have long since ceased milk production, and stored food would have run short on many farms. Cattle and some sheep and goats were kept in the warm dark byres most of their lives, standing nearly immobile in a rising tide of their own dung. Many of the small Norse cattle had to be carried out to pasture in the spring because their muscles were too weak after a winter of severe inactivity, and it is clear that Greenland was always near the limit for even the most skillful Scandinavian stock-raising techniques.

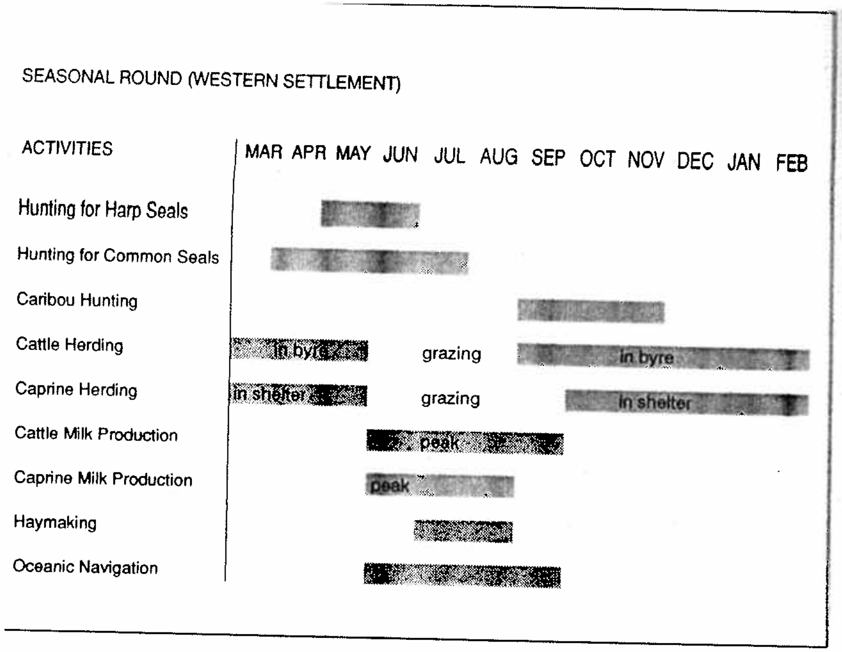

Figure 6.3. Hypothetical Norse seasonal round (western settlement).

These difficult conditions, combined with the very small size of most le herds (probably between three and eight animals), suggest the im- tance of the few large herds (and especially the 100+ herd at Gardar) uffering the whole community against catastrophic losses and in main- ing the biological viability of the domestic animal population. If they e organized as in Iceland, local communities (*hreppur*) of 15 to 25 farms tered on a single church operated as minimal subsistence units, pooling or for critical seasonal tasks (like hay harvests and seal hunts), sharing and common grazing, and providing fodder, food, and replacement k to members whose holdings were damaged by fire or other disaster. eral authors have independently employed a range of locational tech- ues centered on known church locations in an attempt to reconstruct enlandic regional divisions in both settlement areas; all of them have deled basic units in the same size range of 15 to 25 farms (Berglund 2; Keller 1991, in press; McGovern 1980).

The distribution of animal bones in Norse sites further suggests the mmunal nature of Norse hunting and resource redistribution. The sites h the highest percentage of harp seal bones are those at the highest elevations, often several hours' walk from the nearest salt water. Seabirds most commonly found in Norse middens (alcids, mainly murres and gullemots) are those best taken by groups of hunters exploiting seasonal concentrations, and these bones too are found many kilometers inland.

At the same time dead seals and sea birds were being moved uphill, dead caribou appear to have been moved downhill. Norse caribou hunters appear to have used crossbows (Roussell 1936) and drive systems (Christensen 1991; McGovern and Jordan 1982) to intercept migrating caribou in the higher elevations. Strangely, the highest percentages of caribou bones are found not on the small holdings nearest the drive systems, but on the larger manors closer to the sea (McGovern 1985b). Patterning so contradictory to the normal assumptions of site territory points to the social dimension of resource exploitation in Norse Greenland.

Social hierarchy is apparent in the bone collections as well as in pasture distribution and site architecture (zooarchaeology, architecture, and locational data show high levels of correlation; see McGovern 1985b). Figure 6.2 compares three archaeofauna typical of western settlement sites of second, third, and fourth rank. The role on the larger farm (W51) of domestic mammals, especially cattle, is clear, as is the inverse role of caribou and seal. While elite farms were able to emphasize cattle production and enjoy a diet of dairy produce and deer meat, lowest-ranking farmers must have been strongly dependent upon seal meat taken in the communal drives.

The Norse subsistence economy in Greenland was thus a balanced exploitation of the inner fjord pastures required by the imported domestic animals and of the outer fjords frequented by the migratory seals. Both communal organization and economic hierarchy seem well marked, with the larger holdings playing a critical role in buffering short-term resource crises. Norse Greenland's productive subsistence economy depended upon careful management of socially structured land and resources in a marginal environment relative to traditional forms of European agriculture. Coordination of labor with seasonally variable resources (especially the migratory seals) was critical for the survival and prosperity of the community as a whole. The skills of Norse community managers at different levels are visible today both in the impressive stone churches built so far from the centers of Christendom and in the piles of seal bones in inland middens so far from the sea. Both communal cooperation and social hierarchy shaped the Norse economy more than simple proximity to resources, either material or social.

TRANSATLANTIC TRADE AND LONG-RANGE HUNTING

Communal cooperation, hierarchical control, and willingness to exploit distant resource spaces are all evident in the remarkable trips to the Nordrsetur, or northern hunting grounds. Documentary sources describe ong and dangerous journeys far north of the settlement areas by groups of hunters seeking a range of arctic products but concentrating on walrus ivory and hide (which was used to produce exceptionally strong ships' cable). This hunting ground appears to lie in the modern Disko Bay–Holsteinsborg area, still home to one of the largest concentrations of walrus in the Eastern Arctic. The trips north were apparently an annual event, with a few men probably overwintering regularly (see McGovern 1985a for more complete references and discussion of the Nordrsetur hunt).

Despite the documentary and archaeological evidence for the northern hunt, walrus ivory itself is extremely rare on Norse sites in Greenland. Most of the "ivory" artifacts produced for home consumption are in fact fabricated from the peglike post-canines of the walrus. Rich in walrus, Norse Greenland was singularly poor in walrus ivory; most of this valuable arctic treasure was evidently reserved for overseas trade.

Unlike their contemporaries in Norse Shetland, the Orkneys, and Caithness (Batey 1987; Bigelow 1989; Morris 1985), the Norse Greenlanders did not enter into the expanding exchange of fish for grain that enabled survival and some prosperity to the eastern North Atlantic islands in the later Middle Ages. Instead, the Norse Greenlanders seem to have been locked into an early medieval–Viking period pattern of exchange of durable high-value goods suitable for elite consumption (Keller, in press). In exchange for walrus products and skins, we know that the Norse imported stained glass, church bells, elite clothing and church vestments, building timber, wine, and iron. A careful analysis of the documentary sources (Gad 1970) indicates that no great volume of material could have been imported at any time, and that most Greenlanders probably had only occasional access to imported goods. The rarity of imported artifacts in Greenlandic excavations, even in comparison with Iceland and Shetland, and the finds of bone or antler substitutes for items normally made of metal (including a spectacular whalebone battle axe) serve to confirm Gad's analysis.

While overseas trade may have brought only limited benefit to most Norse Greenlanders, the Nordrsetur hunt may have been costly to many. The northern hunt was described as dangerous, and the wild northern heaths were apparently dangerous places for the medieval Norse hunter. Pierced amulets carved from walrus post-canines to represent walrus and polar bear have been found on several sites. Whole walrus and narwhal skulls (which normally would have been broken up at the kill site) were deliberately buried in the consecrated soil of the episcopal churchyard at Gardar (Norlund and Stenberger 1934).

Despite such sacred and magical protection, it seems likely that many hunters failed to return from the north. The vessels used were not the ocean-going ships of the Viking period, but small open "six-oared boats" vulnerable to the ice, rocks, and bad weather of the Greenland coast. Even these small boats must have been extremely valuable to a community lacking most shipbuilding timber, and the loss of such vital tools of production must have been felt almost as keenly as the loss of lives when one of the boats went down. These losses were not the only price of the northern hunt and the transatlantic trade it fueled, since the absent hunters could play little role in the labor-intensive summer activities back on the home farms. The northern hunt was expensive in lost lives and resources, but also in deferred or blocked alternate uses for scarce labor and summer days.

CULTURE CONTACT

When the Norse arrived in West Greenland, they found only archaeological traces of the earlier Paleoeskimo inhabitants (Jones 1985). Their first contact with the ancestors of the modern Inuit came ca. 1100–1150, as the Thule folk pushed across from Ellesmere Island and moved down the coast of West Greenland (Schledermann 1990). The *Historia Norvegiae* of ca. 1170 noted that Norse hunters in the Nordrsetur had encountered strange skin-clad *skraelings* (the same term was applied to Native Americans in Vinland one hundred years earlier; see McGhee 1984, Fitzhugh 1985), who did not know metal and used stone and ivory tools. The most remarkable feature of these skraelings was that when merely wounded, they did not bleed, but when finally killed, their blood rushed out dramatically (Gad 1970).

This strange and bloody encounter did not prevent further Inuit migration southwards, and by ca. 1300 large Inuit settlements had been established in the Disko Bay region, and some winter houses had been constructed in the outer fjord zone of the western Norse settlement (Gulløv 1983). The two cultures must have been in increasing contact from ca. 1100–1500, or approximately as long as Native Americans and Europeans have been in contact in the eastern United States following the Jamestown settlement in 1607. Despite ongoing research, we still know frustratingly little about the details of this earlier contact situation (McGhee 1984; McGovern 1979, 1985a). Inuit legends, and scattered references to the skraelings in Scandinavian documents, indicate both peaceful and hostile relationships.

The archaeological evidence for Norse-Inuit contact is strangely one-sided. A growing number of Norse artifacts have been identified in Inuit contexts, including metal objects and woolen cloth, as well as souvenirlike trinkets such as Norse draughtsmen converted into Inuit-style spinning tops. Although no major realignment of Inuit settlement, subsistence, or material culture seems to have occurred, there is abundant evidence on the Inuit side for contact with the Norse settlers.

On the other side, Inuit objects in secure Norse contexts are very rare. A handful of finds, mainly of the nonfunctional souvenir category, are known from the many late phase Norse structures that have been investigated. Notably absent are harpoons or any of the host of refined sea and ice hunting gadgetry so characteristic of Inuit sites. Also absent from Norse collections are the bones of the species of seal most commonly taken with this Inuit technology—the ringed seal (*Phoca hispida*). In the tens of thousands of seal bones from Norse middens examined by three generations of zooarchaeologists, fewer than a dozen have been identified as ringed seal. Although a mainstay of Thule through modern Inuit subsistence (especially in winter), this common animal was not regularly taken by Norse sealers.

Climate Change

As many scholars have observed, the weather turned rotten on the Norse expansion (Lamb 1977[2]). Between ca. 900 and 1200, a period known as the Medieval Climatic Optimum (MCO) produced mean temperatures around 1 to 2°C above the 1930–60 modern baseline. Beginning around 1250, temperatures cooled to around 2 to 3°C below this baseline (Lamb 1977[2]; Ogilvie 1985), producing what many have called the Little Ice Age (LIA). Increasing variation between years and between decades (extreme in the fourteenth century; Dansgaard in Lamb 1977[2]) may have further complicated human economic response. These global climate shifts were of a magnitude to cause significant impact all across the Scandinavian North Atlantic, but they were probably felt first and most strongly in Greenland.

The growing season for pasturage would decrease, probably irregularly, reducing fodder yields and complicating harvest labor scheduling. Longer winters would increase winter fodder demand, just as the capacity to produce fodder would be reduced. Increased drift ice made navigation more dangerous, requiring a new sailing route from Iceland and probably discouraging transatlantic contacts. All these effects would certainly have presented challenges to the Norse Greenlandic economy as we now understand it, and many writers have cited the case of Norse Greenland as a prime remaining example of simple climatic determinism in human affairs. Many climate impact theories have been proposed (see McGovern 1986 for discussion), but most may be reduced to the simple statement "it got cold and they died." The Norse are seen purely as passive victims, overcome by an unanticipated and unstoppable force of nature.

This view is attractively simple, but it ignores several relevant points:

1. The Inuit of West Greenland did not die out, but instead spread and prospered during the same period that saw the extinction of the Norse Greenlanders. Greenland clearly did not become uninhabitable for humans, even during the depths of the LIA, ca. 1650–1700.
2. The Norse Greenlanders also did not die out the moment the climate changed. Much of the impressive church construction occurred after the onset of LIA conditions, and the colony probably endured in some form until ca. 1475–1500. Medieval Scandinavians had developed a multilevel subsistence system, with extensive social buffering, that had survived many short-term climate shifts. Norse Greenland did not succumb to the first, or the hundredth, bad winter. If climate change did play a major role in Norse Greenland's extinction, it cannot have acted alone.
3. When Norse society in Greenland did perish, it did not die in a resource-depleted environment after using up all possible means of survival. In fact, the Norse Greenlanders had failed to make full use of resources locally available, while continuing to deform the subsistence economy to produce inedible prestige goods for export.

These points, particularly the last, require further discussion, for the Norse Greenlanders did indeed die out, and a resource crisis of some sort remains the most likely proximate cause. If simple climatic determinism fails to explain the collapse adequately, then why did they die when it got cold?

Combining modern pasture productivity data for southwest Greenland and Iceland with archaeological and biological survey data and zooarchaeological evidence in a simple spreadsheet model, we can get an idea of the relative productivity of pasture communities within the holdings of

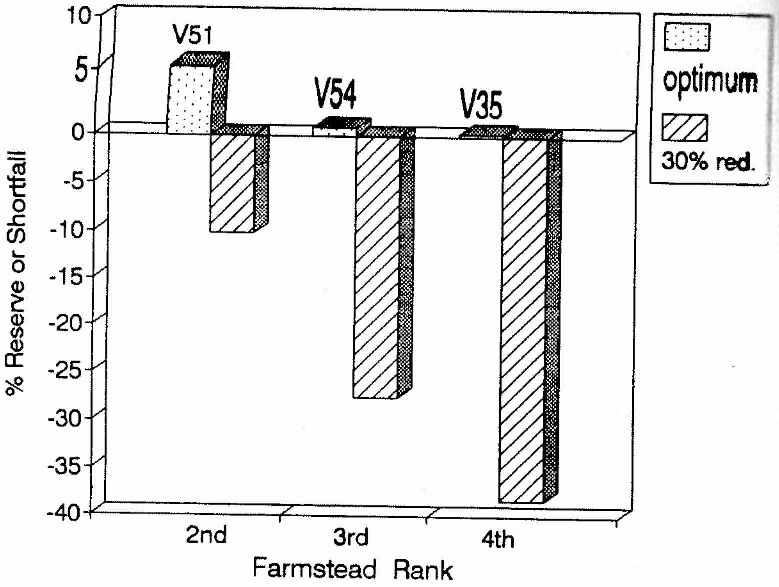

Figure 6.4. Effect of variation in fodder supply on farms of different ranks, modeled under situations of optimum productivity and 30 percent reduction therein.

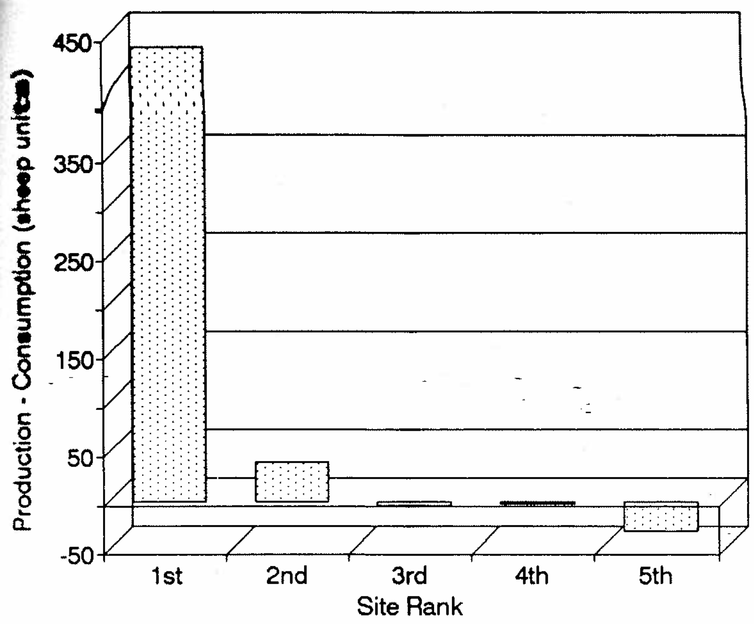

Figure 6.5. Ability of farms of different ranks to be self-sufficient (based on floor space as an indicator of population).

rms of different rank, and the adequacy of this pasture productivity to upply the fodder needs of the farm's domestic animal stock (see McGovern t al. 1988). Figure 6.4 illustrates the model output for optimum levels of asture productivity and for a 30 percent reduction in this level (a realtic worst-case scenario given the results of temperature decline impact odels and 1920s–80s weather data).

Note that colder periods will not affect all farms equally. The secondnk farm (Gardar is the only example of the first rank) typifies an old rst-settler's farm near sea level with relatively abundant pasture and a ajor investment in cattle. The modeled effects on third- and fourth-rank rms are based on data from less well sited farms with poorer pasturage, naller numbers of domestic animals, and a greater emphasis on sheep d goat herding. Although all three types experience fodder shortfalls that ould require stock reduction, note the disproportion between good year/bad year outcomes for the three types. In the western settlement, between 60 and 70 percent of sites fall into the fourth rank. Any adverse climate impact would affect these smallholders first and worst. The pattern of extensive use of wild species (particularly seals) by smallholders observed in the zooarchaeological data makes sense in light of this model prediction.

Using floor space as a proxy indicator, we can also model the balance between probable human population and domestic animal production (meat and milk) on a given site. Again using excavated sites as examples of a given site class, figure 6.5 compares the production-consumption balance for all four site ranks. The unique position of the episcopal farm at Gardar is evident. Even if model assumptions are only broadly correct, it is clear that Gardar could potentially produce a surplus above its own consumption needs far in excess of any other holding in Greenland.

These models and our locational and zooarchaeological data indicate that by the later phases of occupation, elite farms had a set of characteristics in common:

1. They were least and last affected by adverse climatic impacts on pasture productivity. Bad seasons will first impoverish lower- and middle-ranking farmers, while having comparatively minor effects on upper-ranking farmers. The immediate impact of LIA conditions would have been to steepen the economic and political gradient in the favor of the heirs of the first settlers.
2. They were most involved in domestic mammal (especially cattle) production. Although wild resources were clearly important to elite farms, they probably did not serve the same critical staple role as they did on smaller farms. The commitment of the elite farmers to cattle and to the best pastures would tend to increase as they became increasingly scarce and valued commodities.
3. They played a buffering role as sources of replacement stock and dairy produce for middle- and lower-ranking farms suffering periodic shortages. The more frequently the buffering role was played, the greater probability of loss of real or effective independence on the part of the recipients. The economic functioning of the local community would increasingly depend upon a few major households, even if the majority of farmers did not become actual tenants as they did in contemporary Iceland (McGovern et al. 1988).

The episcopal manor at Gardar played a critical buffering role for the settlement as a whole during large-scale resource crises. Whether managed by Greenlandic elites or foreign-born bishops, Gardar must have exerted unrivaled economic and political influence by later phases.

Social Stratification and Economic Management

Our current data and the results of our various land-use models suggest that later Norse Greenland was neither a haven for independent-minded individualists nor a home for any form of primitive democracy. Although Norse Greenland lacked all the trappings of high medieval feudal society (Keller 1991), it was clearly no longer the flexible, pioneering society of the first settlement era. Getting through the average year required community cooperation, and that community was increasingly likely to be dominated by a few great landowners. Bad years activated a nested series of community buffering strategies, none of which were cost-free to the recipient.

Studies by Arneborg (1991) and Keller (1991) have raised the possibility of significant doctrinal conflict between Greenlanders and the papacy, as well as probable internal elite competition, rather than unquestioned compliance with royal and papal demands (contra McGovern 1981). As in Iceland, the partly ecclesiastical elite may have had more than changing weather to worry about, and they may have been as concerned over the latest papal edicts as over this year's seal harvest. The disproportionately large and elegant churches of Norse Greenland may reflect growing internal competition and local display as well as orders from the continental core. Certainly the remarkable northern hunt could not have been carried out without the active sponsorship and direction of the local elite, who must have played a leading role in ensuring the remarkably efficient collection of processed walrus tusk for export.

In any case, the Greenlandic elite did not hesitate to employ a full range of positive and negative sanctions to enforce their leading role in this tightly managed society. Our last written record of Norse Greenland (from 1408; see Gad 1970) documents both the proper reading of wedding banns and the burning alive of the unfortunate Kolbein for witchcraft the same year.

Management Failure and Population Extinction

In retrospect, we can see that many of the management decisions made by the Greenlandic elite were disastrous (McGovern 1981). Although the scale and timing of the climate changes that affected Greenlandic managers were beyond human control, the vulnerability of their society to particular impacts and the response to perceived challenges and opportunities were certainly subject to culturally mediated political choice. As argued elsewhere (McGovern 1981), it would appear that Norse managers simply managed badly, and their society died as a result.

As Vibe (1967) demonstrates, ocean current dynamics make the west coast of Greenland unstable on the scale of centuries, with any given point on the coast passing through repeated cycles of resource scarcity and plenty as marine resource concentrations move up and down the coast and terrestrial resources undergo boom and bust cycles. The Inuit of West Greenland have survived and prospered by maintaining locational flexibility, moving up and down the long coastline as climate changed and seasonal resource zones shifted.

The Norse were far less mobile. The domestic animal component of their subsistence economy (especially cattle) was closely tied to a few restricted pockets of low-arctic vegetation in the fjords of the southwest. The with the richest pastures and heaviest investment in cattle :re least likely to consider any adaptive strategy that would devalue these sources. While Norse sealing parties might extend their hunting ranges, e inhabitants would still be tethered to the home farms (and the stone urches) deep in the southern fjords. The politically dominant (but cli- atically threatened) herding component of the Norse subsistence econ- iy thus limited the possibilities for effective development of the marine nting component.

The elite connections to the markets and political centers of conti- ntal Europe must have proved increasingly difficult to maintain. Docu- entary sources describe increased East Greenland drift ice as a growing zard to transatlantic navigation by the mid-fourteenth century. About e same time, changing fashions in Europe were replacing walrus and ele- ant ivory with Limoges enamels in luxury goods and religious artifacts. mand for the main product of the costly Nordrsetur hunt was dropping st as the climate-related dangers of both the hunt and the trip across the antic were increasing. We have no evidence for an attempted restruc- ing of trade goods production, and a late court case describes Green- iders forcing unwanted trade goods on chance visitors looking only for ovisions (Gad 1970). While other North Atlantic communities success- ly shifted to commercial fishing, the Greenlanders apparently continued offer increasingly devalued, old-fashioned goods to the few traders will- ; to risk the drift ice.

Since the lower-ranking Norse farmers were effectively dependent on sea mammal hunting anyway, and seventeenth- to nineteenth- itury West Greenland was to become an international center for whale, l, and walrus exploitation, we might imagine that the prospects for ianced Norse maritime adaptation would be considerable. Even if the rse farms remained nailed down to the inner fjords, expansion of marine nting efforts in the local area should have proved productive.

This strategy would almost certainly require acquisition of more Inuit hnology and expertise than the Norse Greenlanders apparently were ling to absorb. As we have seen, the Norse lacked both harpoons and ringed seals normally taken with them, despite nearly three centuries contact with the Inuit. The complex of whaling gear (large harpoons, it valves, etc.) so successfully employed by the Thule Inuit in West enland for five hundred years is also absent. There is also no evidence the acquisition of Inuit skin boats, despite the shortage of timber suit- e for the keels of traditional Scandinavian clinker-built ships.

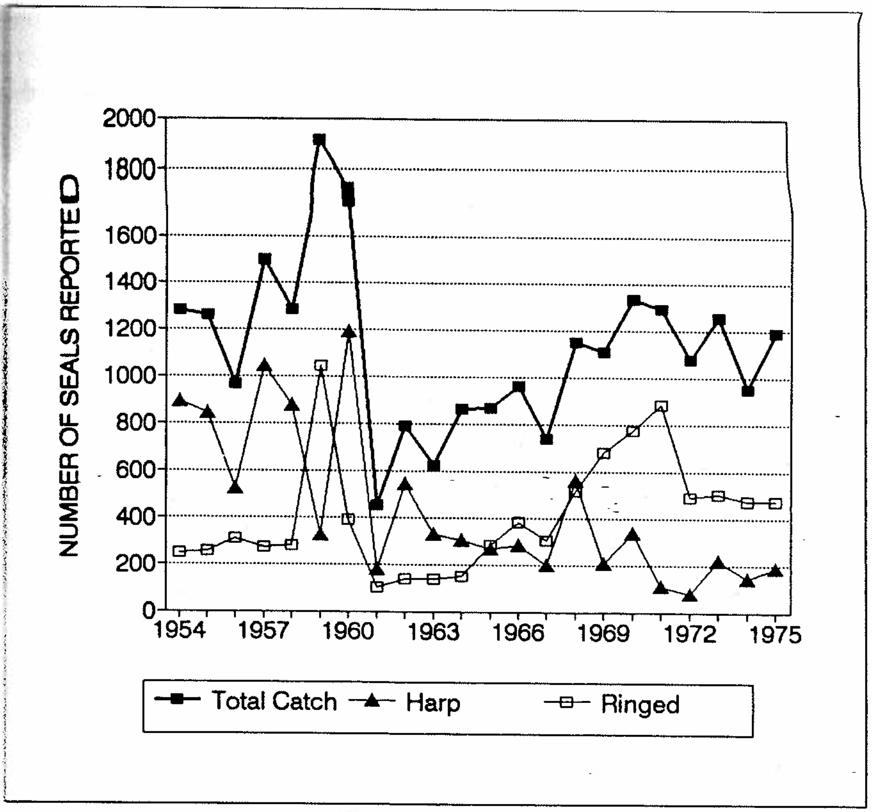

Figure 6.6. Reported seal catch, 1954–1975, Qaqortoq, Greenland.

Modern catch data from southwestern Greenland indicate that the failure of the Norse to exploit ringed seals effectively may have been increasingly costly during climatic fluctuations. Figure 6.6 presents a 21-year record of major seal species taken in one part of the former Norse eastern settlement (for a discussion of these data, see Vibe 1967; McGovern 1986). In the first third of the chart (approximately 1954–60) the total seal catch is dominated by migratory harp seals. The well-documented cooling of the early 1960s (just under 1°C) altered harp seal migrations, causing a crash in catches all along the southwest coast. Harp seal catches did not begin to recover until the 1980s. Note, however, that after a few hard years, the total seal catch reported at Qaqortoq recovered to nearly pre-crash levels—propelled by a steady increase in ringed seal hunting in the period 1960–75. Similar patterns of crash and rapid recovery through shift in target species are evident in catch records for the Narssaq and Nuuk districts in the eastern and western settlements. Because we have no reason to suspect a radical change in seal distribution since Norse times, it would appear that the Norse Greenlanders would have been able to manage a similar shift in critical resources, if they had acquired the necessary technology and skills.

More speculatively, we might also wonder what might have developed from an integration of Norse and Inuit populations and adaptive strategies. The Norse could have provided milk, wool, metal, and access to European markets in exchange for sea mammals, boats, and arctic products. Had the skraelings been properly Christianized and suitably socialized they could even have provided a welcome source of additional profit to their Norse patrons, much as the Sami of arctic Scandinavia provided income to elites in northern Norway. A variation of this pattern was actually developed by the Danish colonial administration in the eighteenth century and provided the basis for a culturally and technologically diverse society that persists to the present day in Greenland.

Speculative scenarios could be further elaborated, but it is clear that Norse Greenland did not perish in a barren wasteland devastated by the Little Ice Age. Instead, they starved in the midst of unexploited resources, with a working model for maritime-adapted northern survival camped on their doorsteps. The death of Norse Greenland was not caused by nature, but by culture.

WORLD VIEW AND MENTAL TEMPLATES

If the leadership of this tight little society did indeed manage so badly that the whole population failed to react appropriately to climate change, cultural competition, and market peripheralization, we might well ask why. After all, there is no lasting advantage to managing your own society so you have the privilege of starving last. We may assume that the managers of Norse Greenland did not intend the outcome that resulted from their self-serving, short-term choices. Why did they choose so badly, dooming themselves and their culture?

As many have observed, humans make decisions based upon culturally mediated perception and interpretation of reality and may or may not consistently observe environmental variables that other humans would find important. Some managers may be more interested in closely tracking church politics and the latest building styles than in accurately recording variability in seal catches. A variety of *cognitive maladies* common to all managers may have afflicted the Norse elite (discussed in McGovern et al. 1988):

1. False Analogy. The managers' cognitive model of ecosystem characteristics (potential productivity, resilience, stress signals) may be based on the characteristics of another ecosystem (Norway, Iceland) whose surface similarities mask critical threshold differences from the actual local ecosystem.
2. Insufficient Detail. The managers' cognitive model is overgeneralized and fails to allow for the actual range of spatial variability in an ecosystem whose patchiness is better measured in resilience than initial abundance (Moran 1984).
3. Short Observational Series. The managers lack a sufficiently long memory of events to track or predict variation in key environmental factors over a multigenerational period and are subject to chronic inability to separate short-term and long-term processes.
4. Managerial Detachment. The managers are socially and spatially distant from agricultural producers who carry out managerial decisions at the lowest level and who are normally in closest contact with local-scale environmental feedbacks.
5. Reactions out of Phase. Partly as a result of the last two factors, the managers' attempts to avert unfavorable impacts are too little and too late, or apply the wrong remedy.
6. SEP (Someone Else's Problem) (Buckland 1988:7). Managers at many levels may perceive a potential environmental problem but do not feel obligated to take action because their own particular short-term interests are not immediately threatened. Some adverse impacts may actually enhance the managers' position by differentially impoverishing unruly subordinates and potential rivals.

The Norse Greenlanders were probably also subject to a series of obstacles to perception and management that were far more culture-specific. The world view of a particular culture at a particular moment may be a product of both current social and environmental conditions as well as traditional knowledge of variable time depth.

The world view of the medieval Scandinavians of the North Atlantic is set out in considerable detail in law codes and sagas, and it has been the subject of a series of scholarly analyses (Andersson and Miller 1989; Byock 1988; Durrenburger and Palsson 1989; Hastrup 1985; Miller 1986; Palsson

1991). In her extended analysis of the twelfth-century Grågås law code, Hastrup describes a world view that rigidly partitions land and society into a series of dual oppositions. Law, society, home, and order lay on one side, and dangerous, lawless chaos lay on the other (Hastrup 1985:136–51).

These categories had a strong locational aspect. The farmyard and home field of the family farm were bounded by a low earthen dike (still visible archaeologically), which provided legal and symbolic security. An assault within a man's home field was legally more serious than one farther from home, and a variety of malign nonhuman beings were magically confined outside the dike. In Iceland, the center of human order and society lay at Thingvellir (the site of the major annual assembly), and the oppos-ng center of natural chaos and evil lay in the desolate "lava field of misdeeds" in the unpopulated arctic interior. Persons sentenced to permanent exile were both literally and figuratively set outside the bounds of human society. They could be killed on sight without the need to pay for spilling heir blood (blood money), and they had to live in the wilderness, where hey would be exposed to weather, hunger, and the inhuman creatures that haunted such places (several mountains in Iceland are still named "Trolls-Church"). A heroic outlaw could win readmission to human society by killing other outlaws and struggling successfully against the evil creatures of the wilderness.

Clearly, this was not a nineteenth- or twentieth-century romantic world view that sees pristine nature in positive opposition to corrupting ulture, but a more traditional European dichotomy of good, safe (but fragile) human culture and dangerous, potentially evil nature. Both pagan and Christian cosmology saw the natural world as potentially hostile, and both gloomily predicted a steady decline of humanity and the human world, nding in Ragnarok/Armageddon/Götterdämmerung.

Hastrup (1989) has argued that the identification of wilderness with threat and evil was so extreme in late medieval Iceland that it inhibited ffective exploitation of distant saeters (shielings). Although changes in ertical zonation during the LIA probably also played a part in settlement ontraction, there seems little debate over the character of this medieval ature-culture division among scholars most familiar with the Norse documentary and literary evidence.

What effect did this cognitive division have on the fate of Norse Greenland? Figure 6.7 presents the world view probably shared by medieval Greenlanders and Icelanders (categories based upon Hastrup 1985, alsson 1991). Although some individuals (heroes, witches, and Chrisan clerics) could safely act as intermediaries, the passage between realms

NATURE	Intermediary	CULTURE
lawlessness	hero	law
disorder, randomness		order, predictability
physical danger		safety
moral danger	priest	spiritual sanctuary
anti-Christian	priest	Christian orthodoxy
homelessness		home, family
trolls, elves,	witch,	
unquiet dead, land spirits	priest	mortal men
wild animals		domestic stock
hunting grounds		home farm
sea	sea spirits	land

Figure 6.7. Summary of medieval Greenland/Icelandic world view.

was dangerous and uncertain. In this light, the elaborate magical buffering associated with the trips to the Nordrsetur hunting grounds becomes immediately comprehensible.

This world view also places the Inuit in an ambiguous position. Are they normal humans of a different culture (like the English, Franks, Irish, etc.) to fight, trade with, marry, and learn from? Are they instead nonhuman creatures of nature to be shunned? Like trolls, they did not bleed when wounded. Like many water-beings, they did not use iron weapons. Had any Norseman overcome the barriers of language he would have encountered an Inuit world view and ideology full of humanlike animals and powerful sorcery not based upon a nature-culture dichotomy like his own. It is all too easy to imagine Norsemen culturally preprogrammed to reject all innovations from the Inuit, fatally ignoring tainted technology and alien expertise and keeping closer and closer to home, hearth, and church (Hastrup 1989).

This structuralist analysis leaves many questions unanswered. As Palsson argues:

> Some scholars concentrate on the search for abstract semiotic systems, emphasizing cultural codes rather than social action—language rather than speaking. . . . The saga-people become trapped in the superorganic, as prisoners of medieval culture. . . . We cannot observe or participate in the praxis of the natives, but

> the "world out there" presented in our second-hand field notes is a world of active persons—not of rules and things. (Palsson 1991:17–18)

Both traditional structuralist and traditional ecosystemic cultural :ological analyses have been criticized as overly static and unreflective the active role of individual humans in reshaping meaning and realign- g system linkages. If the Norse Greenlanders did maintain the ultimately aladaptive world view documented in their laws and literature, main- ining cultural purity at the cost of biological extinction, we still must ask hy. It is as much of a dead end to blame their extinction on rigid cultural ogramming as to resort to simple climatic determinism.

In responding to social situations, as well as to environmental ianges, the individual Norse colonist in fact had a range of potential otions open. The relative rigidity of the Norse world view and its enforce- ent were variables that could be altered from one generation to the next. ıe early pioneer settlers like Skalla-grim possessed the same cultural bag- ige yet showed far greater adaptive flexibility than their fourteenth- and teenth-century descendants. The Norse world view was subject to con- ious manipulation, reinterpretation, and alteration (as the battles over hristian doctrine indicate). If it solidified into a rigid barrier to successful laptation, fatally limiting options in a changing world, then this rigidity as a *result* of such manipulation. The choice *not* to innovate is a real choice ade by particular people in a particular political and economic context.

During the long contact period between Inuit and Scandinavian in reenland, many on both sides must have discovered mutual humanity, ıd it is hard to imagine that Norse seal hunters never admired the sealing ills of the kayaker. Had the Norse been a simple band-level egalitar- n society, we might easily imagine that households adopting Inuit tech- ology would gradually replace households that did not, as selection took toll on the overly conservative. It is hardly an accident that these life- ving skills were so systematically rejected—it took a great deal of effort ı somebody's part.

We have seen that Norse Greenland was far from egalitarian, and lection did not operate entirely at the level of the individual household kin group. Instead, a multifarm community, ritually and economically ependent on a few large manors, was the minimal unit of survival. If teration of the seasonal round, labor allocation, or social contract was oposed, its adoption or rejection would be a community decision highly influenced by the opinions of the wealthier farmers. According to our data and models, short-term climatic stresses would tend to enhance the authority of the elites and increase the dependency of the majority. Propelled by short-term economic necessity, the Norse social units may have emphasized cohesion and communal solidarity at the expense of innovation and cross-cultural experimentation.

If increased Inuit technology transfer and a declining emphasis on inner-fjord pastures were optimal for the society as a whole, they were by no means optimal for the elites. Some Nordrsetur hunters or seal-dependent smallholders may have seen greater benefits in a more mobile existence and more merit in Inuit lifeways than did the partly clerical Norse elite, proud of their stained glass and church bells. In the contest for community support, however, there is no question who was better placed to manipulate both world view and social sanctions. Increasing the rigidity of the existing northwest European nature-culture split through sermons, thing meetings, and the occasional execution at the stake would be only one means of bolstering social control in a threatened society.

The economic hierarchy that fostered this deadly control was itself a product of pasture distribution and the initial division of land and resources. The Norse pathway to extinction was directed by the distribution of natural resources, by the pattern of climatic impact, by culture-specific cognitive patterns, as well as by divergent class interests. No single decision, but a cascade of decisions closing options and forestalling innovation made Norse Greenland one of the most conservative of the Scandinavian North Atlantic colonies. Culture, ecology, and history together provided the backdrop for the last fatal decision not to choose.

CONCLUSION

Whatever combination of unenlightened self-interest, class conflict, imperfect knowledge, and maladaptively rigid world view produced the disastrous management choices of the Greenlandic elite, the result was fatal to the whole society. Many important questions remain unresolved in Greenlandic archaeology, and more research is urgently needed to go beyond facile generalization. It seems clear, however, that like characters in a proper classical tragedy, the Norse Greenlanders contributed significantly to their own grim fate.

The case of Norse Greenland may have some disquieting parallels in

Like the Norse Greenlanders, many humans today are pursuing limited, but intensive strategies of exploitation requiring precarious balancing of distant resource zones and markets. Like the Norse, many economies have developed high levels of vulnerability to sudden change in a changing earth. Like the Norse cathedral in the arctic, there are today many monuments to peoples living beyond the means of local resources. Like the Norse elites, we are today very certain of the complete adequacy of a particular world view, and we are often willfully ignorant of alternate sources of expertise.

If modern managers of global resources respond to change and challenge no better than their predecessors in Norse Greenland, Ragnarok may yet prove more than myth. Like the Norse Greenlanders, however, we are not inevitably the prisoners of history and culture. Like them, we have many potential options. We can choose to broaden, rather than restrict, the management subculture and actively seek alternate courses. If the case of Norse Greenland can spur such efforts, then perhaps the Norse Greenlanders themselves will not have suffered and struggled and finally died in vain.

Note

I would like to thank all the people from many countries and disciplines whose hard work and kind cooperation have made field work in the North Atlantic so enjoyable over the past fifteen years. I am particularly grateful to our hosts in Greenland and Iceland, and to the field crews whose endurance and good humor were so often tested. Particular thanks are due to Claus Andreasen, Tom Amorosi, Jette Arneborg, Gerald F. Bigelow, Paul Buckland, Joel Berglund, and Christian Keller for providing practical help and constant intellectual stimulation. Thanks are also due to our hosts at the School of American Research in Santa Fe for making our stay so productive and relaxing. Funding for research reported here was generously provided by the National Science Foundation, the National Geographic Society, NATO's Scientific Grants Program, the Wenner-Gren Foundation for Anthropological Research, the American-Scandinavian Foundation, and the PSC-CUNY Research Grants Program. Anne, Daniel, and Eliza made it all worthwhile. All errors of fact or interpretation remain my responsibility.

Chapter 7

Population Ecology and Civilization in Ancient Egypt

Fekri A. Hassan

At a time when overpopulation and the prospects of accelerated climatic change are regarded as imminent threats to human survival and prosperity, archaeological and historical information that furthers our understanding of the long-term survival of human civilizations is indispensable. From it we can hope to gain insight into the magnitude of current problems, suggestions for ameliorative action, and clues to pitfalls in thinking and management. Egypt, with its long and eventful history, is a rich source of historical and archaeological data that may identify factors contributing to human survival under changing environmental conditions and the continuous flux of social, political, economic, and cultural forces.

The history of Egyptian civilization began seven thousand years ago when settled farming villages first appeared on the fertile banks of the Nile. Within two thousand years, the cultural landscape of Egypt was almost totally transformed. Villages and hamlets dotted the Nile floodplain from Nubia to the Delta. Towns and religious centers stood above the flat valley as vivid markers of the new era (Hassan 1988). Most of Egypt was under the rule of a single king. Within the span of three centuries thereafter, a prosperous state and a dynasty of divine kings erected the most ambitious architectural edifices of classical antiquity, the great pyramids of Giza, which remain today as striking reminders of the achievements of one of the earliest nation-states, 4600 years ago. For three millennia Egyptian civilization continued to flourish, until it was contained within the folds of the Greek, Roman, and eventually the Arab world.

Ancient Egyptian civilization may dazzle us with its monumental architecture, fascinating hieroglyphic writing, and exquisite art, but to