CHAPTER 4:

ARCHAEOLOGICAL, GEOGRAPHICAL AND CLIMATOLOGICAL BACKGROUND

TO THE NORTH ATLANTIC

‘...a people who, by their indomitable spirit, have made fair haven on the windy edge of nothing.’ (Linklater 1948, 16)

4.1 INTRODUCTION

The above quote by Eric Linklater refers to the Faroe Islands but may well be applied to any of the islands or archipelagos being studied here (see figure 4.1). The islands that form the basis of this research have variously been described as marginal and inhospitable, yet the Northern and Western Isles of Scotland have been successfully inhabited for thousands of years and the Faroe Islands and Iceland have been inhabited continuously since they were settled by the Norse over 1000 years ago. The only exception to these successes is the Norse settlement in Greenland, lasting only a few hundred years. The following chapter reviews the archaeological and environmental development of these islands with particular focus on factors likely to affect the growth of domestic mammals, as detailed in the previous chapter. At the end of this chapter a series of hypotheses are proposed relating to likely changes in the size and shape of domestic mammals based on the evidence presented. It is these hypotheses that will go on to be tested using the biometric data collected.
Figure 4.1 Map of the North Atlantic region with study areas marked and lines of latitude for reference. (Illustration by D. Bashford).

4.2 THE WESTERN ISLES

The Western Isles (figure 4.2) are an island chain on the edge of the Atlantic Ocean located approximately 50km west of the north west coast of Scotland (Hall 1996)
Figure 4.2 Map showing the location of the Western Isles and places mentioned in the text. (Illustration by D. Bashford).
and stretching approximately 200km from south to north (Serjeantson 1990; Hall 1996). Their most northerly point lies at 58°30’ N and the southern tip at 56°46’ N. From north to south the main islands are Lewis and Harris, North Uist, Benbecula, South Uist and Barra, additionally there are a hundred or so inhabited and uninhabited smaller islands (Serjeantson 1990).

4.2.1 Climate, geology and vegetation

Despite its northerly location, the climate of the Western Isles is somewhat ameliorated by the Gulf Stream. However, due to its maritime situation, the weather can be highly unpredictable and occasionally extremely severe, with high winds and rain being common features (Boyd & Boyd 1990; Armit 1996). There is only a small variation between seasons regarding temperature and precipitation, resulting in cool wet summers and not especially harsh winters (Armit 1996). The monthly average rainfall for Benbecula is 129mm for January and 76mm for June and the growing season (given as the period of time where the soil temperature is above 6°C) runs from early April to early December (Boyd & Boyd 1990).

During the period of human settlement the climate has not been constant. Anderson et al. (1998) identified climatic changes in the north of Scotland from a series of peat cores and found that these correlated well with other climatic data for northern Europe. The main change identified was a marked transition to wetter or cooler conditions from around 3900 cal. BP; this was not thought to be related to human activity but more likely due to oceanic, solar and volcanic effects (ibid.). Another
interesting time of climatic change was a large shift to drier conditions c. 1500 cal. BP followed by a shift back to wetter conditions after 1000 cal. BP (ibid.).

The principal geology of the islands is Lewisian Gneiss, which are grey quartz-feldspar gneisses, additionally there are some areas of acidic and basic igneous rocks (Hall 1996). The landscape of the islands is quite varied including areas of peat bog, hilly areas with summits around 700-800 m, inhospitable rocky terrain along the east coast and lush pastures on the sandy machair planes located along a large part of the west coast (ibid.).

Figure 4.3 Machair landscape on Vatersay, Western Isles. (Photo M. Cussans).
The machair landscape of the Western Isles (Fig 4.3) is one of the most distinctive and important landscape types present on the islands, forming a c. 1-2km wide strip up the west coast of the island chain from the islands of Pabbay and Sandray in the south up to Luskentyre in Harris (Owen et al. 1996), a distance of approximately 240 km. Ritchie (1976) gave a very strict definition of the machair plain, principally that it should have a shell rich, wind blown sand base, a morphologically mature surface with soils of pH >7.0, an oceanic climate, and that its development has been affected by a series of anthropogenic factors including grazing and cultivation. The machair plain is however only one of a series of habitats that make up the machair system as a whole (Curtis 1991, from Owen et al. 1996). These habitats include the strandline, sand dunes, the machair grasslands and the ‘blackland’ located between the machair grassland and the moorland (ibid.). The sand of the actual machair landform is thought to have originated from large quantities of sand made available following the deglaciation of Scotland (Ritchie 1979, from Owen et al. 1996), and it is thought that the effects of anthropogenic activity from the Mesolithic period onward have contributed to the development of the machair in its present form (Edwards et al. 2005b; Owen et al. 1996). As such, since the first appearance of humans in the Western Isles there has been some form of interdependence between the machair landscape and the human population. The machair has long been used for grazing and as cultivation land (Owen et al. 1996), with managed grazing helping in maintaining floristic diversity and the very fertile, potassium-rich machair soils providing good cultivable areas (ibid.; Smith & Mulville 2004); particularly the ‘blacklands’ (Owen et al. 1996; Smith & Mulville 2004).
Although the Western Isles present an almost entirely treeless landscape today with the majority of the land being covered by grassland (Owen et al. 1996) and moorland (Weaver et al. 1996), this has not always been the case. Brayshay and Edwards (1996) describe the changes that had taken place in the vegetation of the Western Isles since the end of the last glaciation. During the late glacial the islands were covered by open heath and grassland which at the beginning of the Holocene was replaced by a mosaic vegetation landscape of grassland, tall herbs, woodland and blanket bog (ibid.). The woodland areas consisted principally of birch and hazel which rapidly colonised, birch being present right at the beginning of the Holocene and hazel arriving c. 9000 BP. Other tree species were present in smaller numbers, elm and oak both arrived at c. 8000 BP with alder and ash arriving later (ibid.). In the later Holocene there was a decline in the birch and hazel populations and a corresponding increase in grasses and sedges. The timings for these vegetation changes vary between pollen sample sites and in many cases the arboreal pollen declines are gradual, which Brayshay and Edwards took to indicate that they were not caused by catastrophic destruction by humans but more likely through changes in climate or soil (ibid.). However agricultural activity must have played some part in these changes and there is evidence of possible anthropogenic disturbance from the Mesolithic period where in some cases reductions in birch and hazel pollen coincide with increased levels of microscopic charcoal (ibid.).

The modern day vegetation habitats are largely made up of those belonging to the machair system discussed above and those found in the moorland areas which form a ‘continuum of mires, wet and dry heaths, acid and more alkaline grasslands mixed
locally with maritime species’ (Weaver et al. 1996: 160). The distribution of the various habitats is principally related to soil conditions such as moisture content, organic matter content, depth and pH (Weaver et al. 1996). These conditions tend to vary in a zoned pattern depending on distance from the coastline; for example, as one moves inland there is an increase in organic matter and a decline in soil pH (Owen et al. 1996).

4.2.2 Settlement and economy

The archaeology of the Western Isles is ‘spectacular in its preservation’ (Mulville et al. 2005: 167). This is due to a number of factors, including a lack of modern development, the use of stone as the principal building material and the frequent burial of sites within calcareous windblown sand which provides outstanding preservation of architectural remains as well as artefacts and ecofacts (ibid.). The following section gives a brief overview of the settlement pattern in the Western Isles and more particularly the economic development over time to give a view of the resources available and the uses to which they were put.

Mesolithic

Although the Mesolithic period is essentially irrelevant to a study of domestic mammals it is thought necessary to include what little evidence there is here as a background to the later agricultural settlement pattern. As yet, no positive archaeological evidence has been recovered from the Western Isles of Mesolithic date (Edwards et al. 2005b). There are several reasons why potential sites may not yet have been located; one of the most likely of these is the increase in sea level
since the Mesolithic and the likelihood of many sites now being located under the sea (Edwards 1996; Armit 1996). Since the last glaciation the Western Isles have continued to sink relative to sea level as they have not experienced the isostatic uplift seen in mainland Scotland (Serjeantson 1990). Other sites may have been buried by blanket peat or deep under the landward moving machair (Edwards 1996). There is however some environmental evidence indicative of anthropogenic activity in the Western Isles during the Mesolithic period. Pollen records show periods of reduction in woodland taxa in association with increased microscopic charcoal content (Edwards 1996; Brayshay & Edwards 1996; Edwards et al. 2005b). This palynological evidence is very similar to that found in the Inner Hebrides (Edwards 1996) where sea level rises have not been so dramatic and there is archaeological evidence for a Mesolithic human presence (Armit 1996; Smith & Mulville 2004). Smith and Mulville (2004) used economic evidence from the Inner Hebrides to determine what the economy of Mesolithic people in the Western Isles may have been. This indicated a heavy reliance on marine resources, in particular shellfish, seals and fish; there was also some exploitation of wild pig, red deer and otter (ibid.). Evidence from plant remains show that nuts and tubers were probably also part of the diet (ibid.). Palynological evidence also suggests the possible management of heathland by humans at this time, in association with the potential introduction of red deer to the islands (Edwards 1996).

**Neolithic**

At some point after 4000 BC the introduction of agriculture marked the beginning of the Neolithic period, a time better known for its monuments than settlements (Armit
1996). However some settlement sites have been excavated and yielded economic evidence. In contrast to the Mesolithic period the faunal remains from the Neolithic period in the Western Isles are dominated by terrestrial mammals, the most numerous being sheep followed by cattle and then red deer; there was also a low presence of pig, dog, seal, fish and bird (Smith & Mulville 2004). This shows a very high reliance on domesticated mammals with wild animals playing a smaller role, in particular those from marine sources; however, compared to many other British sites the fact that any marine resources are exploited at all after the Mesolithic is remarkable (*ibid.*). It is also worthy of note here that all terrestrial mammals would have had to have been introduced by humans and transported to the islands by boat (Serjeantson 1990). The plant remains show a similar story, although perhaps the importance of cultivated crops is difficult to determine. The principal crop was naked barley with a small presence of hulled barley and wheat; some wild edible plants were also collected including hazel nuts, crab apples, strawberries and brassicas/oraches (Smith & Mulville 2004). Although the woodland would have been very much in decline at this time (Brayshay & Edwards 1996) wood resources were also still clearly available as there is evidence at some of the Neolithic sites for the use of hazel and birch as well as a variety of other tree species; heather was also exploited possibly as bedding or fuel (Smith & Mulville 2004). The land used for cultivation is indicated by the weed species present which point to the use of the landward part of the machair where the ground is heavier and less free draining than that nearer to the coast (*ibid.*). Owen et al. (1996) concur that this would have been the most suitable area for cultivation; the machair would also have made good grazing land for livestock (*ibid.*).
**Bronze Age**

At around 2000 BC significant social changes began taking place. The large ceremonial monuments of the Neolithic period ceased to be built and there was a shift to the burial of individuals (Armit 1996). At this time there was also the appearance of beaker pottery and increased evidence for long-distance trade and exchange networks partly necessitated by the need for copper and tin ore for bronze production (*ibid.*).

However, although this period appears to be a time of significant social change the economic evidence for the Beaker period is strikingly similar to that from the Neolithic. The faunal remains are dominated by cattle and sheep followed by red deer, and the cultivated plant remains are still dominated by naked barley with a small presence of wheat and hulled barley (Smith & Mulville 2004). Badger and horse have also been identified from Beaker period deposits, although the numbers are very low and the badger skull is thought likely to have been a trade item, probably attached to a skin (*ibid.*: 54). In the later Bronze Age sheep become the dominant domesticate, followed by cattle; red deer is still important, while pig, dog, seal, whale, fish and bird are present in low numbers at the majority of the excavated sites (Smith & Mulville 2004). A significant change is seen in the plant remains during the late Bronze Age when hulled barley becomes the dominant crop, although there is still a limited presence of naked barley. As in the Neolithic, the weed assemblage still indicates the cultivation of the heavier soils of the machair system (*ibid.*). One notable difference between the plant remains from the Neolithic and those from the
Bronze Age is the restriction in the wild species present in the later period, the only wild edible plants noted are bramble, strawberry and brassicas/oraches (*ibid.*); hazel nuts and crab apples having disappeared from the assemblage. Wood resources were also more restricted (*ibid.*).

With regards to the faunal remains from the Bronze Age one of the most interesting aspects is the high incidence of neonate cattle. At Cladh Hallan 72% of the ageable cattle mandibles came from animals less than one month old at death (Mulville *et al.* 2005). This is thought to be indicative of a dairying economy and is backed up by the identification of milk residues in pottery vessels from the same site (Craig *et al.* 2005). However as the intensity of dairying cannot be inferred from the presence of pottery residues (*ibid.*) arguments still persist about the reasons for high neonate mortality in cattle, particularly as early on as the Bronze Age (see Mulville *et al.* 2005 for a review). Halstead (1998) proposed that the early uptake of dairying in the Western Isles may have been a result of the marginality of the region and the consequent difficulty in growing crops and hence alternative food sources had to be sought. In these terms dairying is a sensible strategy, as dairy herds are more productive both per animal and per unit of land than a herd kept solely for meat (Smith & Mulville 2004: 59).

*Iron Age*

During the mid first millennium BC a new and dramatically different architectural style developed, the Atlantic round house; these massive dry stone circular structures took a variety of forms, the best know examples being the broch towers
(Armit 1996 & 2003). Later on in the Iron Age, in the last centuries BC, these structures were succeeded by the wheelhouses which were quite different in nature, most particularly as they were sunken into the earth (Armit 1996: 137). As well as new architectural styles developing during the Iron Age, several agricultural innovations occurred throughout Scotland including the advent of the rotary quern, the likely replacement of the stone ard with an iron alternative, and an increase in horse breeding and exploitation (Armit 1991: 191).

Economic evidence for the Iron Age is much more plentiful than for any of the preceding periods, due to a larger number of excavated sites. As for the other periods, the majority of this evidence is well summarised by Smith and Mulville (2004). In terms of animal remains sheep and cattle are the dominant species (Finlay 1991; Mulville 1999; Smith & Mulville 2004) although which in particular is dominant varies from site to site; pigs increase in importance relative to the preceding periods and other domesticates (horse, dog, cat) also become more common (Smith & Mulville 2004). Red deer appear to be found more often than in the Bronze Age but their numbers vary greatly between sites; roe deer represent a new wild species becoming available and pine martin and badger found at Dun Vulan (Mulville 1999) may represent trade items (Smith & Mulville 2004). Cetacean and seal bones are present at most sites (ibid.). There appears to be an increase in the exploitation of fish in the Iron Age (ibid.), the majority of fish were Gadidae (Finlay 1991; Cerón-Carrasco & Parker Pearson 1999), most likely caught on or close to the shore and representing small scale subsistence fishing (Cerón-Carrasco & Parker Pearson 1999). Birds also formed a small but significant part of the economy with small numbers of a
wide variety of species being present, the majority of which were seabirds (Finlay 1991; Cartledge & Grimbly 1999); domestic fowl and domestic goose were found in the very last Iron Age phases at Dun Vulan (Cartledge & Grimbly 1999).

The distribution of pigs remains is of particular interest in the Iron Age as it has been noted that pig remains occur in higher quantities at broch sites, such as Dun Vulan, than they do at wheelhouse sites, such as Cnip (Parker Pearson & Sharples 1999: 354). Additionally it was noted that there was a higher than expected frequency of front limb bones of pig suggesting that additional pork joints were being provided to the site from outside. Parker Pearson and Sharples (ibid.) attributed these patterns in pig distribution to the higher status of broch sites over wheelhouse sites in the Western Isles.

Cereal remains are found in much larger quantities in the Iron Age than in previous periods, although the distribution of species present is very similar to the late Bronze Age. The cereal assemblages are dominated by hulled six-row barley, there is also the possible presence of two-row barley and some emmer wheat is present (Smith & Mulville 2004; Smith 1999). Potential new introductions are oats (from this period no cultivated oats are positively identified) and rye (Smith & Mulville 2004; Smith 1999). The weed assemblages present are still indicative of the cultivation of the heavier, landward parts of the machair (Smith & Mulville 2004). Once again there is a narrowing in the range of wild edible plant species present; wild plant resources with other uses (e.g. fuel, thatching, bedding) include sedges, grasses, heather and
seaweed (Smith & Mulville 2004). The majority of the wood resources appear to come from driftwood, in particular larch (*ibid*.), indicative of the dwindling woodland.

Cattle neonate numbers appear to be slightly lower in the Iron Age than in the Bronze Age but it should be borne in mind that figures for this earlier period are based on a single site, whereas for the Iron Age data from a number of sites are available. This said, there is still an average of over 40% of cattle dying within the first month of life (Mulville *et al.* 2005), indicating that dairying was still an important part of the economy. At Dun Vulan sheep appear to have been kept for both meat and wool with peaks in slaughter at 6-12 months and 3-4 years; pigs were mostly killed before reaching skeletal maturity indicating their use for meat (Mulville 1999).

*Norse Period*

The 9th century AD marked the arrival of Scandinavian settlers, the Norse, in the Western Isles (Armit 1996); probably the most abrupt period of cultural change that has taken place in the settlement history of the islands with vast changes in material culture, architecture and economy. Many Norse period sites (settlements and burials) have been identified in the Western Isles, 23 in South Uist alone (Sharples *et al.* 2004); however, only a few settlement sites have been excavated to date. Many of the Norse settlements are located on top of or close by Iron Age settlements and Sharples *et al.* (2004: 42) took this to indicate some measure of continuity and integration between the native and incoming populations. The settlements also tend to yield high quantities of traded items particularly from other Scandinavian areas of the North Atlantic (*ibid*.).
No real change is seen in the proportions of the three main domestic animals present although sheep are almost always dominant over cattle; horse bones increase in frequency and goats are positively identified for the first time; cats and dogs also increase in numbers (Smith & Mulville 2004). Wild animals including red deer, seal, roe deer and whale are still present but mostly in low numbers (ibid.). Fishing activity picks up in intensity and fish appear to start to play a considerable role in the diet (ibid.). Although gadids are still exploited herring become an important aspect of the fishing economy (Smith & Mulville 2004; Cerón-Carrasco 2005), and this in association with the larger size of the gadid fish (particularly cod) that were being caught shows a distinct change in fishing technology from the inshore fishing of the Iron Age to boat based, offshore, deep sea fishing using nets to catch herring and lines for cod (Cerón-Carrasco 2005; Ingrem 2005). This type of fishing activity may also have been linked to the beginning of the production and trade of stockfish (Smith & Mulville 2004: 59). Additionally the selection of cetacean species present in the Norse period compared to earlier periods also indicates a greater exploitation of open sea resources (Smith & Mulville 2004).

In terms of cultivated crops, grain is again found in greater quantities than the preceding period but six-row hulled barley is still the dominant crop (Smith & Mulville 2004; Colledge & Smith 2005). There is a dramatic increase in the quantity of oats found and cultivated oats are positively identified for the first time; rye and flax are also found in considerable quantities (Smith & Mulville 2004; Colledge & Smith 2005). Furthermore at the site of Bornais there is the first occurrence of a structure directly
associated with crop processing (Sharples 2005a: 89ff). This apparent huge intensification in cereal and flax cultivation would have had a considerable effect on land use in the islands. Although oats and barley are likely to have continued growing on the blacklands or the area where the blacklands and machair meet, rye and flax prefer drier, free draining soils which points to the expansion of cultivation onto the machair proper (Smith & Mulville 2004; Colledge & Smith 2005). This expansion is likely to have had an impact on the available grazing land; however it is also likely that some of the cereal crop was being grown as fodder for livestock (Smith & Mulville 2004).

With this in mind it is likely that the moorland was used as a valuable grazing resource for at least some of the year, and it is thought possible that some form of sheiling activity was carried out during the Norse period (Mulville 2005). The moorland would have also provided resources such as heather, grasses and peat (Smith & Colledge 2005). Wood resources would have mainly come from drift wood on the shore (Gale 2005b) although it seems that some stands of hazel and birch may have still been growing in the valleys (Gale 2005a).

4.3 The Northern Isles

The Northern Isles of Scotland (figures 4.4 & 4.5) are composed of two distinct archipelagos of which only two islands are isolated from the two main groups: those of Foula and Fair Isle, the latter of which forms a mid-way stepping stone between the two island groups (O’Dell 1962). Shetland, the more northerly island group, is
approximately 165km NE of mainland Scotland and 340km west of Bergen (Mykura 1976), and lies between 59°50’N and 60°51’N latitude, with Fair Isle lying at about 59°31’N. Orkney lies just north of the Scottish mainland being separated from it by the Pentland Firth which at its narrowest is just 10km across (Mykura 1976). Orkney’s southern tip is at 58°43’N and its northern point at 59°23’N latitude. Shetland has a total land area of 1426km$^2$ and consists of over 100 islands of which thirteen are inhabited today; the land area of Orkney is a little smaller at 956km$^2$ and consists of approximately 90 islands of which 14 are currently inhabited (Mykura 1976).

4.3.1 Climate, geology and vegetation

As for the Western Isles the climate of the Northern Isles is largely controlled by the Gulf Stream providing the islands with higher temperatures than one would expect for their latitude; the mean winter temperatures for Lerwick are similar to those for London, the summers on the other hand are much cooler (O’Dell 1962). Berry and Johnston (1980) give the mean January temperatures for Lerwick, Kirkwall and Kew as 3.4°C, 3.8°C and 4.2°C respectively and those for June as 9.7°C, 10.8°C and 15.9°C based on averages of daily minimum and maximum temperatures. A key feature of the northerly location of Orkney and Shetland (and all of the island groups being examined here) is the long hours of daylight experienced in the summer months (and conversely the very short amount of daylight in winter). However, due to the low angle of the sun these extra daylight hours are not of particular advantage to the growing of crops as insolation is much lower than in more southerly climes (O’Dell 1962; Berry & Johnston 1980).
Figure 4.4 Map of Orkney (Northern Isles) showing location and places mentioned in the text. (Illustration by D. Bashford).
Figure 4.5 Map of Shetland (Northern Isles) showing location and places mentioned in the text. (Illustration by D. Bashford).
Snow is not a particular problem for the islands as it rarely lays on the ground for long. Much more of a problem are fog and cloud cover which dramatically reduce the impact of insolation and consequently have a negative effect on the ripening of crops (O’Dell 1962; Berry & Johnston 1980). The key feature of the weather for the Northern Isles is the wind, Lerwick being the third windiest place in Britain experiencing 236 hours of gales per year (O’Dell 1962). Kirkwall suffers significantly less, a mere 52 hours per year (ibid.) however winds are still capable of causing severe damage. In 1969 Kirkwall was the site of the highest gust of wind ever recorded at a lowland site at 136 miles per hour and some years previous to this, in 1952, a ferocious gale removed 7000 hen houses and 86000 hens from Orkney (Berry 1985). Overall then it can be said that Orkney’s climate is slightly milder and weather conditions less severe than its more northerly neighbour and the weather for parts of lowland Orkney has even been described as ‘fairly warm and rather dry’ (Berry 1985: 19).

As one would expect, the climate of the Northern Isles has varied over time since the end of the last glaciation. Many of these variations were recognised by Lamb (1988) and are summarised by Butler (1998). Following deglaciation by 9000 BP, climatic conditions are thought likely to have been similar to today and by 8000 BP temperatures were probably 1-3°C higher. In the later Holocene a period of climatic deterioration was experienced throughout north west Europe, and by the middle of the third millennium BP temperatures were approximately 2°C lower than they had been three millennia earlier and storminess and precipitation had increased (ibid.).
The climate ameliorated again in the early centuries AD, which was followed by a cold period with increased storminess and more severe winters between c. 550AD and c. 800AD. The period of warming that followed, known as the ‘Little Optimum’, began in the 9th - 10th centuries AD and lasted until the 13th to 14th centuries. This was followed by the onset of the ‘Little Ice Age’ with climatic deterioration beginning around in the early 16th century; poor climatic conditions reaching a peak in the 17th and 18th centuries (ibid.).

The two archipelagos of Orkney and Shetland also differ considerably in their geology. Shetland is described as having ‘some of the most complex geology seen anywhere in Britain’ (Mykura 1974: 1, from Birnie 1993). The geological formations fall into two main groups: ancient sedimentary rocks metamorphosed and intruded by igneous rocks during the Caledonian Orogeny and sedimentary and volcanic rocks of Old Red Sandstone (Devonian) age (Mykura 1976: 4). The geological resources available in Shetland include gneisses, quartzites, schists, limestones, sandstones, serpentines, granite and diorite (Mykura 1976). The geology of Orkney on the other hand is relatively simple and is made up almost entirely of sedimentary rocks and lavas and tuffs of Middle and Upper Old Red Sandstone Age (Mykura 1976: 8), with a small amount of Pre-Cambrian Basement Complex metamorphic schist and granitic gneiss (Brown 1996). The majority of available stone in Orkney is therefore flagstones and sandstones (Mykura 1976; Brown 1996).

In terms of vegetation change Orkney and Shetland have broadly similar histories and indeed the changes are not unlike those seen in the Western Isles (see above).
Following the climatic amelioration after the last Ice Age there was an expansion of temperate deciduous woodland throughout Europe and mainland Britain; Shetland (and Orkney) formed the north west margin of this forest on the exposed edge of the Atlantic (Butler 1998). Due to this exposed location and northerly latitude woodland development was much less marked than in other areas of Europe, however those visiting the Northern Isles today may be surprised that the region has ever supported woodland of any sort. Pollen data for Shetland show that maximum tree and shrub pollen values reach about 70% of total pollen (Butler 1998). In Orkney these values reach a maximum of around 80% with woodland cover being described as open but extensive (Bunting 1996). For both archipelagos the dominant tree taxa were *Betula* (birch) and *Corylus* (hazel); *Salix* (willow) was also common (Bennet *et al.* 1992; Bunting 1996; Butler 1998) and in Orkney *Pinus* (Scots pine) was also present (Bunting 1996). Other taxa present in smaller numbers included *Ulmus* (elm), *Quercus* (oak), *Alnus* (alder), *Sorbus aucuparia* (rowan) and *Juniperus communis* (juniper) (Bennet *et al.* 1992; Bunting 1996; Butler 1998). Ground cover was provided by ferns and tall herbs (Bennet *et al.* 1992).

Vegetation cover in Orkney and Shetland appears to suffer a period of disturbance from c. 7500 BP attributed to the likely presence of Mesolithic people. In Shetland this takes the form of changes in the ground and shrub flora with herb and fern communities being replaced by heaths and mires, attributed to the introduction of herbivores, most likely red deer, and an increase in charcoal accumulation (Bennett *et al.* 1992). In Orkney at around this time there was a decrease in tree cover and an increase in ferns and grasses and microscopic charcoal (Bunting 1996). After about
2000 years vegetation cover appears to return to its previous state (Bennett et al. 1992; Bunting 1996).

Much more dramatic vegetation change occurred in association with the introduction of Neolithic farming practices. In Orkney the decline in woodland occurred at c. 5000 BP (5600 cal. BP) (Bunting 1996), although timing varies from place to place and in Shetland woodland clearance appears to have begun c. 4000 BP and to have been almost complete by 3120 BP (Bennett et al. 1992). It appears in many cases that this permanent decline in woodland was at least partially influenced by human action. In some cases this may have been due to deliberate clearance to create more grazing land (Bennett et al. 1992; Butler 1998) or simply through increased grazing pressure from introduced livestock species (Bunting 1996). Non-human factors include climatic deterioration as well as specific events such as the catastrophic formation of the Bay of Skaill described by Keatinge and Dickson (1979, from Bunting 1996). Areas that were previously covered by woodland became pastureland, heath or cultivated plots (Butler 1998); there also appears to be evidence for the burning of heath to restrict the growth of heather and provide extra grazing (ibid.). During the Bronze Age species diversity further decreased and heather increased (Butler 1998), there is very little evidence for any remaining woodland and the climate became wetter (Dickson 2000). By this time the landscape would have been closer to that seen today, with large areas of heath and blanket peat and an environment which was much impoverished in comparison to that seen prior to human settlement (Butler 1998). In the Iron Age in Orkney charcoal evidence shows that some tree species (alder, birch, willow) still had a limited presence, however iron working appears to have exhausted
the last of these (Dickson 2000). Bennett et al. (1992) conclude that once the
woodland had been removed from Shetland, vegetation cover and land-use within
the islands had shown little variation over the past 3000 years.

4.3.2 Settlement and economy

As in the Western Isles the standing archaeological remains in Orkney and Shetland
are incredibly well preserved, with sites such as Old Scatness in Shetland having in
the region of five meters of stratified deposits (S. Dockrill pers. comm.). Excavations
over the last thirty years, many of which have recently come to publication (e.g.
Hunter et al. 2007; Dockrill et al. 2007 & 2010), have included detailed sampling and
recording programmes allowing the recovery of large quantities of, in particular,
biological remains which aid in the interpretation of site economy and environment.
The following section will give a brief overview of the archaeology and site economy
at some of the key sites in Orkney and Shetland through time.

Mesolithic

As discussed above, it appears there is some environmental evidence for Mesolithic
human disturbance of vegetation cover on both Orkney and Shetland. Further
environmental evidence of human induced disturbance was noted for the island of
Hoy in Orkney (Blackford et al. 1996) where an increase in charcoal occurrence and
an abrupt decline in Betula and Salix was taken to indicate an ‘environmentally
significant Mesolithic population’ (ibid.: 67). However, unlike the Western Isles, for
Orkney and Shetland there is direct, if somewhat limited, archaeological evidence for
a Mesolithic human presence. In Orkney this evidence is limited to c. 20 sites where
collections of worked stone tools have been discovered, (Wickham-Jones 2006: 24). It is likely that many potential Mesolithic occupation sites have been lost to sea level rises and coastal erosion. In addition to this the study of Mesolithic Orkney has been greatly overshadowed by the prominence of the monumental architecture of the following periods (*ibid.*).

In Shetland a single coastal Mesolithic occupation site has been found and comprehensively investigated (Melton 2008). The site of West Voe, Sumburgh dates to the Mesolithic-Neolithic transition and is largely made up of a series of shell rich middens. The final phase of activity was separated from earlier phases by a thick sand layer and was associated with a dry stone wall (*ibid.*). Economic evidence came from a variety of marine molluscs and animal bones. The marine mollusc assemblage was principally made up of oysters (*Ostrea edulis*), limpets (*Patella vulgata*) and mussels (*Mytilus edulis*) (Nicholson 2005a). Other species present were razor clams (*Ensis* sp.), cockles (*Cerastoderma edule*), dogwhelks (*Nucella lapillus*), periwinkles (*Littorina littorea*), topshells (*Gibbula/Monodota* sp.) and clams (*Venerupis* sp.) (*ibid.*; Newman & Russ 2006). Mammal remains were dominated by seal bones, many of which were from juveniles, with both grey seal (*Halichoerus grypus*) and common seal (*Phoca vitulina*) represented (Worley 2005 & 2006). A small number of bone fragments belonging to terrestrial mammals were recovered, most of which could not be identified to species; a single cattle molar was found in the very latest deposits (*ibid.*). The majority of bird bones identified were from shag (*Phalacrocorax aristotalis*), other species included eider duck (*Somateria mollissima*), puffin (*Fratercula arctica*), swan (*Cygnus* sp.) and greater black-backed gull (*Larus marinus*)
A small number of fish bones were also recovered, all belonging to small or tiny fish including herring/sprat (Clupeidae), mackerel (*Scomber scombus*) and gadids (Gadidae) (Nicholson 2006b).

**Neolithic**

Melton (2008) estimated the date of the Mesolithic-Neolithic transition at the site of West Voe to have occurred around 3700-3600 cal BC. The advent of the Neolithic would have marked a huge change in Shetland society, with the introduction of farming including the cultivation of crops and the rearing of livestock animals. This change is thought to have occurred at a similar time in Orkney (Wickham-Jones 2006). Other cultural changes included the introduction of pottery vessels, the appearance of substantial stone built houses (Fojut 1994; Wickham-Jones 2006) and the construction of megalithic monuments (*ibid.*), for which Orkney in particularly is renowned.

In terms of animal husbandry cattle and sheep vastly dominate animal bone assemblages from the Neolithic, usually in roughly equal numbers (Noddle 1983 & 1986; Bond 2007a; Nicholson & Davis 2007), while pigs are present in much lower quantities (Noddle 1986; Bond 2007a; Nicholson & Davis 2007). At the site of Pool, Sanday, Orkney the preservation of Neolithic bone was generally very poor and the only other taxa identified were red deer and cetacean (Bond 2007a). At Tofts Ness, also on Sanday, as well as the animals mentioned above seal, dog and otter were also present (Nicholson & Davis 2007). A similar suite of species was present at Knap of Howar, albeit in very small numbers and with the addition of roe deer (Noddle 1983).
At the Scord of Brouster in Shetland very few animal remains were recovered, but these did include a piece of red deer antler and two post cranial bones that were identified as either red deer or cattle, suggesting the possible presence of red deer in Shetland at this time (Noddle 1986). Some evidence of cattle dairying is present with cattle showing considerably larger numbers of neonates than sheep in most cases, although not as many as are seen in later phases of occupation (Serjeantson & Bond 2007a & 2007b).

As well as the mammal resources mentioned above, exploitation of other wild animal resources continued into the Neolithic on a small scale. Bird species exploited were principally marine and included gulls (*Larus* sp.), great auk (*Alca impennis*), and gannet (*Sula bassana*) (Bramwell 1983; Serjeantson 2007a, 2007b): it is likely that these birds were exploited for both food and oil and were captured during the breeding season when they would be relatively easy prey (Bramwell 1983). A variety of fish species are found in Neolithic deposits although gadids seem to dominate (Wheeler 1983; Nicholson 2007a & 2007b). Many of the bones are from large specimens indicating that offshore fishing in seafaring boats was taking place, although onshore coastal fishing is also in evidence (Wheeler 1983; Nicholson 2007b).

In terms of cultivated cereals barley was the principal and possibly only crop. A few wheat grains have been identified at some sites (Milles 1986; Bond 2007b) but these are possibly present as a weed of the barley crop (Milles 1986). Both hulled and naked six-row barley are present (Dickson 1983; Milles 1986; Bond 2007b & 2007c), their quantities varying from site to site. At Pool, naked barley is dominant in the
early Neolithic but later on hulled barley becomes slightly dominant (Bond 2007b). However at Tofts Ness, on the same island, hulled barley is dominant throughout the period of occupation (Bond 2007c).

**Bronze Age**

The Bronze Age in the Northern Isles began in the early second millennium BC and brought with it a variety of cultural changes. Most notable in terms of material culture was the introduction of metal and Beaker pottery (Wickham-Jones 2006), but there were also great changes in religious practices and initially a move away from nucleated coastal settlements to more widely spread farms, capitalising on the success of agriculture and making use of greater areas of land (*ibid*). However, a change in the climate to cooler wetter conditions and the onset of peat formation (Butler 1998; Dickson 2000) led to a contraction of settlement back towards the coast (Fojut 1994). Building styles appear to have shown little change between the Neolithic and the Bronze Age, with the majority still being small circular structures (Fojut 1994; Wickham-Jones 2006).

Economic evidence for the Bronze Age in the Northern Isles is somewhat sparse. Platt’s (1956) report on the animal bones from Jarlshof, Shetland, although brief, shows that a similar range of species was being exploited in the Late Bronze Age/Early Iron Age as in the Neolithic period. Sheep and cattle, as ever, are the dominant livestock species and small numbers of horse, pig, cat and dog are present as well as seal, whale, and a variety of birds (mostly seabirds). Cod is the principal fish species exploited. The more modern and extensive study of mammalian remains at
Tofts Ness (Nicholson & Davis 2007) also showed little change in species present and their representation between the Neolithic and Bronze Age period. There did however appear to be an intensification of dairying activities, with an increase in neonate calf mortality (Serjeantson & Bond 2007b). Fish remains came from a wide range of species which included both large gadids and species likely to be found closer to the shore, showing that offshore and onshore fishing was being carried out (Nicholson 2007b). Evidence from plant remains shows that in the Early Bronze Age there was a mix of hulled and naked barley, but by the later Bronze Age hulled barley was most definitely dominant (Bond 2007c). A mix of hulled and naked barley also appears to have been grown at Kebister in Shetland prior to the Iron Age (Dickson 1999).

*Iron Age*

As for the Western Isles the middle of the first millennium BC brought great changes to the Northern Isles, not least in the architectural form of domestic dwellings. The introduction of the Atlantic roundhouse, followed by the more complex broch tower was a huge change in building style (Armit 2003). Internally the early Atlantic roundhouses had many similar features to their Bronze Age predecessors with the main differences being in their external appearance, particularly their monumentality which represented a show of wealth and power (*ibid.*). The brochs that followed were much more defensive in nature, being much taller and often enclosed by defensive ramparts (*ibid.*). This evolution in building style is thought to have been fuelled by an increasing population and decrease in good quality land, forcing a nucleation of settlement around the defensive broch structures (Fojut 1994).
Therefore the Iron Age appears to be marked by monumental domestic structures and an increasing centralisation of society. In terms of site economy there is a much greater wealth of evidence for the Iron Age than for the proceeding periods and a summary of some of the key points is given below.

Iron Age animal bone assemblages, as for previous periods, are dominated by the remains of domestic livestock. Cattle and sheep are almost always the dominant species with pigs playing a more minor role (Platt 1956; Noddle 1977, 1997; Seller 1982, 1986 & 1989; Rowley-Conwy 1983; Smith 1994 & 2000; O’Sullivan 1998b; McCormick 1984, 1998, 1999; Bond 2007a; Nicholson & Davies 2007; Cussans & Bond 2010 & forthcoming). The status of goats is less certain as they are often difficult to distinguish from sheep and are therefore likely to be underrepresented (Noddle 1977); however, they do not appear to have been present in Shetland (Platt 1956; Cussans & Bond 2010 & forthcoming) at this time. Horses were present and may have had occasional food value (Smith 1994; Cussans & Bond 2010), as well as being working animals.

As for the preceding periods hunting, gathering, fishing and fowling all had significant if minor roles and would have provided welcome diversity in the diet, as well as additional minerals and nutrients and a fallback in times of agricultural failure. The key wild mammals exploited were red deer (*Cervus elaphus*), seals and whales (Platt 1956; MacGregor 1974; Noddle 1977 & 1997; McCormick 1984 & 1998; Seller 1989; O’Sullivan 1998b; Bond 2007a; Nicholson & Davis 2007; Cussans & Bond 2010 & forthcoming); hare (*Lepus capensis*) may have been occasionally exploited in Orkney
(Seller 1986 & 1989). Although red deer have been noted at Jarlshof and Old Scatness in Shetland in Iron Age deposits, it appears unlikely that there was a red deer herd living on Shetland at this time. Platt’s (1956) report mentions ‘two examples of this species’ (ibid., 213) but does not specify if these are bone or antler (antler being a more likely trade item from Orkney or further afield) and at Scatness other than several examples of antler only a single first phalanx was found (Cussans & Bond forthcoming), with a distinct possibility that it may have arrived at the site as part of a traded hide. Seals are likely to have been exploited for their meat, blubber and skins and may have been hunted or opportunistically scavenged. It is difficult to say if whales were exploited as a food source but were certainly valued for their bone and probably their blubber.

Age at death data for the principal domesticates tends to suggest a mixed economy where meat, dairy products, wool and possibly traction were all important elements (Seller 1982; Smith 1994; Bond 2007a; Cussans & Bond 2010, forthcoming). An increase in the numbers of cattle neonates between the Neolithic and the Iron Age at Pool (Mulville et al. 2005; Serjeantson & Bond 2007a) and a high incidence of neonate cattle at the site of Old Scatness (Cussans & Bond 2010 & forthcoming) suggests a further intensification of dairying in the Northern Isles during the Iron Age. The use of animals for traction has been interpreted at some sites from pathologies, usually found on the bones of the feet (e.g. Bond 2007a).

In terms of fishing activity, as for previous periods, cod family (Gadidae) fish, in particular saithe (Pollachius virens), pollack (Pollachius pollachius) and cod (Gadus
The exploitation of birds again focused on seabirds, for example gannet (*Sula bassana*), cormorant (*Phalacrocorax carbo*), shag (*Phalacrocorax aristotelis*), great auk (*Alca impennis*) and gulls (*Larus* spp.) (Platt 1956; Bramwell 1977; O’Sullivan 1995; Allison 1997; Hamilton-Dyer 1998a; Serjeantson 2007a & 2007b; Nicholson 2010a). It seems most likely that the majority of these birds were exploited during the spring and summer months during the nesting season, when they would be relatively easy to catch (Bramwell 1977; Allison 1997; Serjeantson 2007a; Nicholson 2010a). Some other birds which would be autumn/winter visitors have also been identified (Bramwell 1977; Allison 1997). At a few sites domestic fowl and/or goose seem to have been present, particularly in later phases (Bramwell 1977; Allison 1997; O’Sullivan 1998a).

Shellfish were also exploited during the Iron Age in the Northern Isles. A variety of shellfish species are present but two species stand out as having been heavily exploited: the common limpet (*Patella vulgata*) and the periwinkle (*Littorina littorea*) (Evans & Spencer 1977; Hunter & Morris 1982; Colley 1983; Barlow 1984; Seller 1985 & 1989; Locker 1994; Cerón-Carrasco 1995, 1998a & 1998b; Nicholson 2007a, 2007b, 2010b & forthcoming). Fishing technologies seem to have varied from site to site as at the majority of sites there appears to be a concentration on inshore or coastal fishing, whereas at a few sites offshore fishing seems to have taken place, particularly in the Later Iron Age (Colley 1983; Sharples 1984; Seller 1989; Cerón-Carrasco 1995, 1998a & 1998b).
However despite the large numbers of these shells found at some sites, calculations of meat weight and consequent likely contribution to the human diet are low (Evans & Spencer 1977; Barlow 1984). It is not clear whether these shellfish formed a regular, albeit minor, part of the human diet, whether they were used as fishing bait, or if they fulfilled both roles (Colley 1983; Cussans 2010). Other edible species present in small numbers include mussels (*Mytilus edulis*), oysters (*Ostrea eulis*), common cockle (*Cerastoderma edule*) and razor clams (*Ensis* sp.) (Barlow 1984; Carter 1998; Nicholson 2007c; Cussans 2010, forthcoming). All of the shellfish species regularly exploited are common on rocky or sandy shores and could easily be gathered in the inter-tidal zone. On a small number of sites remains of edible crab (*Cancer pagurus*) have also been identified (Noddle 1977; Seller 1986; Hamilton-Dyer 1998b).

In terms of cultivated crops hulled, six-row barley (*Hordeum vulgare* var. *vulgare*) was the dominant crop during the Iron Age (Macgregor 1974; Boardman 1995 & 1998; Holden & Boardman 1998; Dickson 1999; Bond 2007b & 2007c; Bond & Summers 2010), although there was still some presence of naked barley (*Hordeum vulgare* var. *nudum*) (e.g. Dickson 1994; Summers & Bond forthcoming) this declines over time, continuing the trend seen in earlier periods. At the site of Pool Bond (2003) noted a crop made up of barley of varying hulledness and grain morphology and interpreted this as a mixed ‘landrace’ of barley. Oats (*Avena* spp.) appear for the first time during the Iron Age (e.g. Dickson 1994; Bond & Summers 2010) but often these cannot be determined to species and many may be simply weeds of the barley crop; however at some sites cultivated oats (*A. sativa/strigosa*) have been positively identified in later
Iron Age deposits (Bond 1998 & 2007b; Bond & Summers 2010). Flax (*Linum usitatissimum*) seeds have occasionally been identified (Dickson 1994; Bond & Summers 2010); these may have been used for food, oil or fibres. Evidence for anthropogenic soil amendments have been found in the Northern Isles where it is suggested that manure (Guttmann *et al.* 2006) and midden material (Guttmann *et al.* 2003) were spread onto the fields to improve productivity.

At some sites it is thought likely that wild plants may have been collected for food use. The crowberry (*Empetrum nigrum*) is present at a few sites (Donaldson 1986; Holden & Boardman 1998; Boardman 1998; Bond 2007b & 2007c; Bond & Summers 2010), but this may be present due to the collection of plant material for thatch or bedding. Other plants, although having edible parts, are more difficult to determine as being purposefully gathered as they occur as cereal crop weeds and may have become accidentally incorporated within an assemblage. These include wild radish (*Raphanus raphanistrum*), Brassicas (*Brassica* spp.), fat hen (*Chenopodium album*) and corn spurrey (*Spergula arvensis*) (Donaldson 1986; Boardman 1998; Holden & Boardman 1998; Bond 2007b & 2007c; Bond & Summers 2010).

**Norse Period**

At some time in the late 8th or early 9th centuries AD Scandinavian settlers from western and southern Norway arrived in the Northern Isles (Fojut 1994). There is some debate as to whether this arrival of new settlers was characterized by wholesale replacement of the native population or if there was some measure of integration between the incoming Scandinavians and the native ‘Pictish’ population.
(Fojut 1994: 69ff). However, sites such as Pool in Orkney (Hunter et al. 2007) and Old Scatness in Shetland (Dockrill et al. 2010) show that although cultural change was marked, there was continuity in settlement location. One of the clearest differences following Norse settlement was in architectural style with the introduction of the rectilinear longhouse (e.g. Hamilton 1956). There were also great changes in material culture with, for example, steatite vessels largely replacing pottery ones (Forster 2010). The economic evidence outlined below shows elements of continuity, of the introduction of new ideas and economic practices, and of the intensification of existing ones. Two key, recently published sites are used for the main basis of the description of the Viking and Norse economy in the Northern Isles: Pool on Sanday in Orkney and Old Scatness, Shetland.

At first glance the mammal remains from Viking and Norse deposits at Pool and Old Scatness appear to be very similar to those from the preceding, Late Iron Age phase, in that the species present and the percentage representation of the main domesticates are very similar (Bond 2007a; Cussans & Bond 2010). However, there are some subtle differences. At Old Scatness there is a slight reduction in the quantity of pigs present compared to cattle (Cussans & Bond 2010), a slight increase in the quantity of horse present and otter is only found in the Late Norse period (ibid.). At Pool there is also an increase in horse remains, domestic goats are identified for the first time, and there is also a decrease in the presence of red deer (Bond 2007a). More detail can be seen when looking at the age structures of the animal populations. At Old Scatness pigs appear, not unexpectedly, to be used solely for meat, but interestingly there is no evidence of a breeding population being present
at the site (Cussans & Bond 2010). During the Viking and Late Norse phases there
seems to be a greater emphasis on wool production and consequent fall in mutton and lamb production compared to the Late Iron Age (ibid.) and for cattle there is once again an increase in the quantity of neonate bones, indicating further intensification of dairying practices (ibid.). A parallel increase in cattle neonates is seen at the site of Pool (Serjeantson & Bond 2007a).

Fish and fishing are important topics for the Viking and Norse period in the Northern Isles as this is considered a time of significant intensification of fishing activities (e.g. Barrett 2005), with the introduction of new technology and an implied improvement in seamanship (Dockrill & Bond 2010: 362). From the site of Pool the vast majority of fish remains came from the Interface (Viking) and Norse periods (Nicholson 2007a). These assemblages were overwhelmingly dominated by the bones of large gadids which appear to have been specifically targeted; however, there was no evidence from body part representation for the production or import of stockfish, although some of the fish may have been dried for later consumption (ibid.). For Old Scatness, although there are some problems with interpreting changes between the phases due to differences in depositional environments, fish bone evidence suggests a continuation of fishing practices from the Late Iron Age into the Viking period with the species presence, abundance and size distributions being very similar for the two periods (Nicholson 2010b). These remains are dominated, as usual, by the bones of gadids; herring are also fairly common (ibid.). The Late Norse remains, by contrast, are dominated by much larger fish: the bones of large mature gadids, mostly cod (Gadus morhua) and saithe (Pollachius virens). This indicates that the majority of
fishing activity was boat based; it also appears likely that much of the fish was being dried as stockfish (*ibid.*).

Shellfish remains from Old Scatness also show interesting changes in the Late Norse period. Similarly to fish remains, the Viking shellfish assemblage closely resembles that of the Late Iron Age (and other earlier Northern Isles assemblages), being dominated by limpet and winkles (Cussans 2010). During the Late Norse period a similar range of species is present and limpets and winkles are still the most common species, however winkles massively dominate and the overall quantity of shells is much greater (*ibid.*). At the site of Quoygrew in Orkney, an increase in limpet exploitation in the 11th-12th centuries was interpreted as being part of the overall intensification of marine resource exploitation in the Northern Isles at this time (Milner *et al.* 2007).

Intensifications in cereal crop production are also evident during the Norse period in the Northern Isles. The pictures for Old Scatness and Pool appear fairly similar. Barley is still ubiquitous; six-row hulled barley continues as the dominant form with small quantities of naked barley present (Bond 2007b; Bond & Summers 2010). Oats become increasingly important over time and in the Norse phase at Pool oats are eventually dominant over barley (Bond 2007b). It is thought possible that the increase in oat production was linked to environmental changes particularly increased sand blow events (Bond & Summers 2010), oats being much more capable of growing on poor soil than barley (Bond 2007b). The introduction and expansion of
flax (*Linum usitatissimum*) also occurs at this time (Bond 2007b; Bond & Summers 2010) and would require the taking of even more land into cultivation (Bond 2007b).

### 4.4 Continuity and Change in the Western and Northern Isles

As can be seen from the descriptions above, the economic and settlement development of the Northern and Western Isles are very similar. As such, it is appropriate to discuss issues of continuity and change in these economies together.

In terms of continuity two main themes have been identified; the principal food species exploited and settlement location. From the Neolithic onwards cattle, sheep, and pig have been identified at almost all settlement sites, with pig always playing a relatively minor role compared to the other two species (Smith 2000). The use of wild species (including terrestrial and marine mammals, fish, birds and shellfish) also shows marked consistency, with the same principal species exploited over thousands of years of settlement. Key taxa include red deer, common seal, grey seal, whales, cod family fish, seabirds and limpets and winkles. In terms of cereals, barley is always the staple crop, and even the introduction and expansion of oat cultivation does not appear to have been to the detriment of the barley crop (Bond 2003).

Continuity in choice of settlement area is a strong theme, seen when looking at sites such as Jarlshof and Old Scatness on Shetland and Pool in Orkney. In the Western Isles Sharples et al. (2004) point out that many of the Norse settlements are found on top of Iron Age ones or very close by and that despite the clear cultural changes that arose there was ‘essential continuity of settlement location’ from the Late Bronze
Age through to the medieval period (ibid.: 42). Dockrill and Bond (2009) proposed that one of the principal reasons for the longevity of settlements in these islands was the human investment in the creation of fertile infields through careful management and manuring of soils from the Neolithic onwards.

Despite the broad comparability of site economies over time there are changes, some gradual and others more abrupt, some human induced and others environmental, all of which are significant to the changing subsistence practices of the settlements concerned. Over the course of settlement several new species were introduced. During the Late Iron Age the first domestic fowl and goose bones were identified, but these were only ever present in small numbers. It also appears that oats were introduced in the Late Iron Age although in the Western Isles they could not be positively identified as cultivated oats (*Avena Strigosa* or *A. Sativa*). In the Norse period goats make their first appearance and flax is introduced.

Changes in the pattern of cereal production are also seen. During the Bronze Age there was a change from a dominance of naked barley to the hulled variety, which then remained the dominant form throughout the period of settlement, although naked barley was still present in small quantities. During the Norse period the incidence of oats and flax increased over time indicating a significant intensification of arable agriculture and the taking in of new land for cultivation, which is also evidenced by the weed floras present in the relevant assemblages (Bond 1998; Smith & Mulville 2004). A further and very significant change that occurs within cereal assemblages is an increase in quantity over time. Bond (2002) interpreted this as a
shift from day-to-day processing of cereals to more large scale processing. Such processing is evidenced by archaeological structures, for example the corn-drying kiln excavated at Old Scatness with its final phase of use dating to the 2\textsuperscript{nd} to early 5\textsuperscript{th} centuries AD (Dockrill \textit{et al. forthcoming}). This large scale processing is possibly linked to a move to central storage and distribution of foodstuffs (Dockrill 2002; Dockrill & Batt 2004).

Another sign of agricultural intensification is the increase in cattle neonates over time in the Northern Isles, taken to indicate an increase in dairying activity (e.g. Cussans & Bond 2010). This does not appear to happen in the Western Isles; in fact the opposite seems to be the case i.e. that dairying is most intensively practised in the Bronze Age and then decreases over time (Mulville \textit{et al.} 2005).

Finally with regards to economy a major change that is seen in the Norse period is an intensification in fishing practices. This is manifested through an increase in fish remains and a specific targeting of large, mature cod family fish, indicating an increased reliance on offshore fishing (e.g. Nicholson 2010b). This change in fishing activity may also be related to an intensification of shellfish exploitation (Milner \textit{et al.} 2007).

Therefore it can be seen that there are periods of major agricultural intensification during the Late Iron Age period and again in the Norse period. It is also possible that these are linked with the periods of amelioration in climate of the early centuries AD
and between the 9th-10th centuries AD and 13th-14th centuries AD (‘the Little Optimum’) noted by Lamb (1988, from Butler 1998).

4.5 THE FAROE ISLANDS

The Faroe Islands (figure 4.6) are a small archipelago of 18 islands with a total land area of 1399km², located at 62° latitude and 7° longitude, approximately 300km north west of Shetland and 425km south east of Iceland. In contrast to the Northern and Western Isles of Scotland (and in common with Iceland and Greenland) the Faroe Islands have a relatively short settlement history with archaeological evidence providing first settlement dates for the early 9th century (e.g. Church et al. 2005; Vickers et al. 2005). Palaeoenvironmental evidence however suggests that there may have been some earlier human settlers (e.g. Hannon et al. (2005) see Section 4.5.2 below).

4.5.1 Geology, Climate and Vegetation

The geology of the Faroe Islands is fairly simple with the islands being principally made up of basalt. The islands are part of the North Atlantic Basalt Area formed during the Tertiary period during a time of extreme vulcanicity and are made up of three basalt series (lower, middle and upper) with layers of coal and tuff between the lower and middle series (Rasmussen 1982).

The Faroe Islands are characterised by their steep cliffs and hillsides (the highest point being 882m above sea level) and their numerous fjords. This highly developed
Topography has been greatly influenced by Quaternary glaciation and within the fjords, which in the main run in a north west-south east alignment, the land slopes gently down towards the sea. However where the coast is open to the full force of the ocean steep cliffs have been formed (Rasmussen 1982).

Figure 4.6 Map of the Faroe Islands showing their location and places mentioned in the text. (Illustration by D. Bashford).
The climate and weather of the Faroe Islands are influenced by a number of factors. Most of these relate to their position in the middle of the North Atlantic Ocean. Temperature is partly influenced by sea surface temperature which in turn is influenced by two main ocean currents, the warm North Atlantic Current coming up from the south and the cold East Icelandic Current coming from the north east (Hansen 1996). Air movements also have a great influence on temperature as do precipitation and wind speed. The Faroe Islands are in a position that is influenced both by warm humid air from the Azores anticyclone and colder air from the Arctic region (Søgaard 1996). Where these two meet the North Atlantic Polar front develops - a feature characterized by dense cloud cover, widespread precipitation and strong winds (ibid.). With their exposed position the Faroe Islands are subject to the full force of this front, suffering a high frequency of gales with wind speeds of over 10m/sec being present at least ten percent of the time. On a more positive note the warm air provided by the Azores anticyclone and the North Atlantic Current means that temperatures (particularly in winter) are relatively mild compared to those for other places located at the same latitude. Mean January temperatures are 6-7°C higher than their counterparts at similar latitudes, with data collected between 1961 and 1988 showing mean January temperatures in Tórshavn to be 3.2°C and mean July temperatures 10.3°C (ibid.).

Two other main factors influence the weather and climate in the Faroe Islands. Firstly, the high latitude provides highly variable day length over the year varying from just two hours in the middle of winter to 22 hours in the summer (Søgaard
High latitude also means that the angle of the sun hitting the ground is relatively shallow compared to more southerly latitudes influencing the amount of its energy that can be absorbed. Finally the steep topography of the islands has a profound effect on precipitation, as upon meeting the islands warm humid air is pushed upwards, is forced to condense and then falls as rain or snow (ibid.); yearly precipitation (most of which is rain) can be as high as 3000 mm, although on lower ground it is only about 900 mm (ibid.). The steep topography also means that some areas (particularly north facing slopes) spend prolonged periods in the shade providing substantial temperature differences between shaded and sunlit areas (ibid.).

Immediately prior to human settlement in the Faroes the vegetation primarily consisted of wet meadow communities (Hannon & Bradshaw 2000) dominated by grasses, sedges and ericaceous taxa (Lawson et al. 2008). Tree and shrub taxa present were Juniperus, Betula and Salix; other taxa included Calluna, Poaceae, Cyperaceae, Flipendula, Potentilla and Sedum (Lawson et al. 2005; Hannon & Bradshaw 2000). Blanket peat had begun to expand from 6000 yr. BP, probably as a result of climate change (Lawson et al. 2008) and was well established before the arrival of humans. The process of peat formation is one often associated (at least in part) with human interference as are woodland decline and soil erosion (ibid.: 1149). However, it would appear that prior to settlement in the Faroes these processes were already underway. Hannon et al. (2005) noted a decrease in Juniperus and an increase in heath-land taxa at around AD 250. An additional peak in magnetic susceptibility readings and a decrease in organic content of sediment cores at around
AD 400 also indicate an increase in erosion at this time (ibid.). Lawson et al. (2005) showed similar findings prior to human settlement with very little woodland being present, blanket peat covering large areas and erosion events already being established. These activities have interesting implication for the impact of human settlement on vegetation cover and are discussed below.

4.5.2 First Settlers

The first human settlement of the Faroe Islands is a topic of much debate. It is known for certain that the Vikings settled there, probably around AD 800, but there is also the possibility of the presence of Irish monks or hermits prior to this. The key historical evidence for this comes from a manuscript written by Dicuil in AD 825 (Tierney 1967) but there is uncertainty as to whether his description can be reliably ascribed to the Faroe Islands or not (Arge 1991 & 2000). There is also a variety of other evidence which has, in the past, been used to indicate the presence of Irish Papar in the Faroe Islands in advance of the Viking settlers; however, none of these are conclusive (see Arge 1991 for a summary of the arguments). One data set that has perhaps given the most compelling evidence for pre-Viking settlement has come from palaeoecological investigations. Analysis of sediment cores for the first presence of hordeum type cereal pollen grains and increases in the presence of charcoal fragments have given a number of dates prior to AD 800. Johansen (1985) was the first to publish such data from a coring site at Tjørnuvik on Streymoy. Hannon et al. (2005) reported that there was evidence of ‘continuous settlement’ from c. AD 570 from a core taken from near Eiði on Eysturoy and Edwards et al.
(2005a) noted the first appearance of cereal type pollen at cal. AD 560-660 on Suðuroy, in addition to the expansion of microscopic charcoal. Aside from such palaeoecological data, as yet no unequivocal archaeological evidence has been found to support the presence of the Irish Papar in the Faroe Islands. The presence (or not) of the Irish Papar in the Faroes is however of little consequence to this study as the only dataset of bone measurements available are from the securely dated Viking and Norse site of Undir Junkarinsfløttí on the Island of Sandoy (Church et al. 2005). As such, Viking settlement, its development and subsequent effect on the landscape are however central to this study and are thus discussed below.

Initial Viking settlement of the Faroes is thought to have occurred around AD 800 with the earliest published archaeological sites of Toftanes (Vickers et al. 2005) and Undir Junkarinsfløttí (Church et al. 2005) being dated to the 9th-10th Centuries AD. The site of Við Kirkjugarð, Sandur also had 9th century dates from its lowest occupation levels (M. Church pers. comm.). The possibility of settlement being even earlier than this was raised by a mid 1st millennium AD date from the site of á Sondum, also in Sandur, however work on this is still ongoing (M. Church pers. comm.). The arrival of humans in the Faroe Islands would have brought about many changes: these would have included the introduction of new plants and animals (some intentional and some not), the building of houses and other structures, and the management of and subsequent changes to the landscape.
4.5.3 Resources and Economy

On arrival in the Faroe Islands the Viking settlers would have had a variety of resources at their disposal. Firstly, they had access to a range of domestic (introduced) plants and animals such as barley (Church et al. 2005; Vickers et al. 2005), sheep, cattle and pigs (Church et al. 2005). The animals would not only have been a useful food source providing meat and milk but could have provided a variety of other resources such as wool, dung, skin and bone. Other animals readily available to inhabitants of the Faroe Islands were sea birds, salt and fresh water fish, shellfish and marine mammals such as seals and pilot whales. Examination of the economic evidence from Undir Junkarinsfløtti by Church et al. (2005) showed that wild resources made up a much greater percentage of the faunal remains than did domesticates and of these, birds (mostly puffin Fratercula arctica) were the most common (ibid.). So far, Undir Junkarinsfløtti is the only site in the Faroes at which extensive study of vertebrate remains has taken place (ibid.). This is mainly due in fact to the poor preservation of animal bone at many Faroese archaeological sites e.g. Toftanes (Vickers et al. 2005); however there are sites e.g. Í Uppistovubæitinum in Leirvík on Eysturoy (Arge 1997) which do have well preserved bone collections which are yet to be studied. What we do know from preliminary studies of the tooth remains from Í Uppistovubæitinum (dated to 12th-13th Centuries AD) is that sheep, cattle, pigs, pilot whale, grey seal and wolffish were present (ibid.).

Plant remains from the Faroe Islands have been more extensively studied, not least because of the more varied nature of their remains and their greater chance of being preserved as a result of burning, either accidentally (e.g. during crop processing) or
on purpose (as fuel). As discussed above there would have been a variety of plant resources available to early settlers in the Faroe Islands. These would include grass and heathlands for grazing, peat and turf for use as fuel, limited amounts of wood or scrubland and also driftwood from the beaches.

At the site of Toftanes plant macro remains showed evidence of hazel nuts (*Corylus avellana*) and crowberries (*Empetrum nigrum*), being likely food sources as well as the introduced barley (*Vickers et al.* 2005). Wood chips were found spread across the floors (presumably to absorb detritus), and rope made from juniper was also found (*ibid.*).

At the site of Undir Junkarinsfløtti on Sandoy plant remains provided evidence of the use of turf and peat as fuel, as well as hinting at a social system sufficiently organised to ensure efficient collection of such material (*Church et al.* 2005). The only evidence of plant foodstuffs present was that of barley some of which it was suggested may have been imported (*ibid.*). A few grains of oat were recovered but these were thought to likely be a weed of the barley crop. Finally a very small quantity of charcoal was found which mainly consisted of local and driftwood species with a few fragments of oak which were thought to be imported (*ibid.*). At Í Uppistovubeitinum a variety of wooden objects were found including bowls and dishes, coopered vessels, a rake, and structural timbers (*Arge 1997*).

In addition to plants and animals, a variety of mineral resources were also available to the Scandinavian settlers in the Faroe Islands. *Arge (2000)* reported that the local
stones of tuff and basalt were used to make a variety of items including spindle
whorls and lamps. Beach cobbles were often used to make line or net sinkers and
clay was used to make a local earthenware pottery. In addition to such locally-
produced items, the Norse living in the Faroe Islands depended heavily on imported
goods (ibid.), oak timber having already been mentioned above. Steatite (soapstone)
objects were one of the most common imports and included cooking vessels, spindle
whorls and weights (Arge 2000). Whetstones made of mica schist and sandstone
were also imported (ibid.). At the site of Í Uppistovubeitinum a wide variety of
artefacts were recovered including lead spindle whorls, imported pottery and some
well preserved metal and ornamental objects (Arge 1997).

It is clear from the evidence presented above that the Faroese economy in the Viking
and Norse period (and in fact this still holds true today) was heavily reliant on
imported goods due to its somewhat limited resource base. In order for the economy
to function efficiently, it was therefore necessary for these imports to be facilitated
through exportation of goods; Arge (2000) stated that the main export for the Faroe
Islands was originally homespun woollen items; later on, stockfish became the major
export.

In summary it can be seen that there were several key elements to the Faroese
Viking/Norse economy. Firstly there was the large reliance on wild resources,
especially seabirds, which appears to have been carried out sustainably as at Undir
Junkarinsfløtti high numbers of bird bones were present in all phases (Church et al.
2005). Secondly there was a great deal of reliance on imported goods from Norway
and other regions, in particular timber and steatite (Arge 2000). In order to pay for these imported goods some exports must have been made in return, and it seems that wool was one of the most likely trade goods coming out of the islands. In order to sustain and manage this, a large number of sheep would have been required and in turn these would have needed grazing. Such numbers of grazing animals are likely to have had a significant effect on vegetation cover, and in order to prevent land degradation and ensure fair access to grazing; livestock are likely to have needed close management. These topics are discussed in Section 4.5.4 below.

4.5.4 Land Management and Vegetation Change

As mentioned above sheep breeding was (and still is) of vital importance to the Faroe Islands: there is a saying (“Seyða ull er Føroya gull”) meaning “sheep’s wool is Faroese gold” (Brandt 1996). A commodity of this importance needs close management to maximise productivity. In addition to the obvious importance of gazing land the Faroese Norse also had to reserve the best land for the cultivation of barley and also some land for hay production (Adderley & Simpson 2005). Anyone visiting the Faroe Islands today will see that hay production is a very important part of the Faroese economy.

There were three main reasons that strict management of grazing lands was required; firstly to make the best use of the available grazing areas, secondly to reduce the chance of loosing sheep during the winter and finally to allow fair division of land use between farms (Brandt 1996). The current rules governing land utilization with regard to grazing were laid down in the ‘sheep letter’ (Seyðabravið) of 1298 and
are known as the *hagi-patir* system (Thomson *et al.* 2005, Brandt 1996). Previous to this there was the more simple *bœur* system and it is thought likely that at *landnám* there may have been a short period where no management of grazing land was carried out (Thomson *et al.* 2005).

The *bœur* is an enclosed area around a farm or farms and sometimes the church, which includes both the infield and outfield belonging to the farm(s). External to this area was the communal rangeland used for grazing of livestock, particularly in the summer months when shieling activity took place (Arge 2000). Shielings were mainly used for the grazing of milking livestock (Adalsteinsson 1990) and in the Faroes were gradually phased out, being replaced by the land management systems mentioned above by the 13th century; possibly becoming obsolete due to low levels of livestock relative to the carrying capacity of the land (Thomson *et al.* 2005). Modelling carried out by Thomson *et al.* (2005) has shown that the Faroese rangeland could have supported large numbers of livestock, more than were likely needed for subsistence, without having any adverse effect on the landscape. This research also showed that large numbers of livestock were still supportable when a proportion of the grazing land was incorporated into the *bœur* (*ibid.*). What is however particularly interesting in the context of the current research, is that in this model although livestock numbers could be maintained there was a decline in the modelled live body weights of livestock, indicating slightly poorer stock productivity (*ibid.*).

As it is thought unlikely that the carrying capacity of the landscape would have been reached, it has been proposed that the change to the *hagi-patir* system was not due
to a response to landscape degradation, but rather was more likely to have been made to allow fair access to grazing land (Thomson et al. 2005). 95% of the Faroe Islands is currently used for hagi grazing; each hagapatur is c. 2-20km² and can support between 100 and 900 ewes (Brandt 1996). These areas of land are further divided into strips of land (patur) and each flock of 10-80 animals is confined to an individual strip. Both the animals and the pasture are managed by a shepherd whose responsibility it is to ensure the sustainability of the pasture (ibid.). In order to do this he ensures that the flock grazes high up on the pasture in the summer to save the lower pasture for the winter; only in very poor weather conditions are the sheep allowed to seek shelter in grazing areas other than their own (ibid.). It can be seen that this system not only allowed for fair access to grazing but also maximised the potential of the pasture, ensuring that adequate grazing was available for winter as well as summer.

Thomson et al.’s (2005) modelling showed that the hagi-patir system had varying effects in different areas of the Faroe Islands. In Leirvik and Hov an improvement in production was seen whereas in Sandur there was a decline in live body weight of livestock observed in the model under the hagi-patir system compared with the bøur system. It is thought possible that here the land may have been too finely divided (due to increases in population numbers) to allow the rise in productivity noted elsewhere (ibid.).

This system of grazing and land management is unique to the Faroe Islands; in other areas (i.e. Iceland and Greenland) the shieling system continued throughout the
period of settlement (Adalsteinsson 1990). The Faroese system allowed for sustainable grazing without the need for the shieling system which, although apparently imported along with the Norse economic package (Arge 2000), was gradually discarded.

The other major part of the Faroese land management system was the cultivation of the infield, the most fertile area of land around the settlement, which was important for growing barley and hay. As mentioned above hay production has always been very important to the Faroe Islands and evidence for the storage of hay was found at the site of Toftanes in Leirvík (Vickers et al. 2005). Although it has been suggested that some barley may have been imported (Church et al. 2005) it does appear that for some time at least barley was grown in the Faroe Islands. As mentioned in section 4.5.3 a number of researchers have found *hordeum* type pollen in cores from around the Faroe Islands (Hannon & Bradshaw 2000; Hannon et al. 2005; Lawson et al. 2005; Edwards et al. 2005a; Lawson et al. 2008) and at the site of Við Kirkjugardø, Sandur, Sandoy, barley grains and chaff were found in early occupation levels (M. Church pers. comm. 2009).

In order to get the best from hay and barley yields for more than just a few growing seasons some form of soil management or improvement is likely to have been necessary. The specific question of soil improvement of the Faroese Norse infield has been studied by two groups of researchers. Adderley and Simpson (2005) modelled hay and barley outputs using soil and climate data and showed that crop yields were improved in the early settlement period before stabilising around the 12th Century.
Fluctuations in the climate were safeguarded against through the addition of manure into the soil matrix and it was thought likely that a yield of two tonnes of barley per hectare could have been achieved (ibid.). Edwards et al. (2005a) used geomorphological, palynological and pedological evidence to test the hypothesis that soils were culturally amended in the infield areas used to grow hay and barley. They accepted this hypothesis and suggested that soil improvements were made not just to improve soil fertility but, more importantly, to moderate soil wetness which can be a serious limiting factor in cereal production. Soil amendment raised the soil surface and improved drainage which would have assisted in sustaining cereal production over a prolonged period of time (ibid.).

It is clear from the above data that Norse human settlement in the Faroe Islands, as in other parts of the North Atlantic, would have had a significant impact on the landscape and vegetation of the islands. However the subject of the sustainability of the Faroese economy (Edwards 2005) has also been mentioned. So what exactly was the impact of the Norse arrival in the Faroe Islands? What changes were brought about in vegetation cover and landscape?

It would appear that the taxa most affected were tall herbs such as Filipendula ulmaria, which is sensitive to grazing (Lawson et al. 2008) and woodland species such as juniper (Lawson et al. 2005; Hannon et al. 2005; Edwards et al. 2005a; Gathorne-Hardy et al. 2007; Lawson et al. 2008) and birch (Edwards et al. 2005a; Lawson et al. 2005) which were already in short supply at the time of Norse settlement and were economically useful species which were consequently overexploited. Grazing also
brought about distinctive changes in species dominance with ericaceous taxa such as *Calluna* being considerably reduced and replaced by *Poacea* (grasses) (Lawson *et al.* 2005; Gathorne-Hardy *et al.* 2007). The most significant plant introduction would have been *Hordeum* (e.g. Gathorne-Hardy *et al.* 2007) but other accidental introductions are likely to have been made. One other change in vegetation associated with human settlement is the increase in the occurrence of the ruderal *Plantago lanceolata* (Jóhansen 1987).

In some areas of the North Atlantic (notably Iceland) the introduction of grazing animals has not only had a severe impact on the vegetation but also a knock-on effect on the geomorphology (see Section 4.6.4 below), with peat formation and extensive erosion the two most common and potentially most destructive changes that take place. In the Faroe Islands a variety of studies have shown that both of these processes, as well as a decrease in woodland cover, were already occurring prior to human settlement of the islands (Hannon *et al.* 2005; Lawson *et al.* 2005; Lawson *et al.* 2008). In addition Edwards *et al.* (2005a) predicted that there would have been significant geomorphological changes in association with the Scandinavian settlement of the Faroe Islands but found this not to be true. Instead only limited changes were seen and these were only contributed to and not caused by human settlement (*ibid.*). It seems then that in the Faroe Islands, unlike elsewhere in the North Atlantic, the landscape and vegetation were able to cope with human interference in a much more robust manner; this may also have been helped by the settlers taking on an on the whole sustainable approach to land management and economy (Lawson *et al.* 2005).
4.6 Iceland

The next geographical area to be examined is Iceland. Many similarities can be drawn between Iceland and the Faroe Islands but there are also some significant differences. Iceland is located further to the north, just touching the Arctic Circle (latitude 63°24´-66°32´ N), and further to the west (longitude 13°30´-24°32´ W) (Björnson 1964), covers a much larger land surface area and is still volcanically active.

4.6.1 Geology, Climate and Vegetation

Iceland is situated on the Mid-Atlantic Ridge and the Greenland-Iceland-Faroes Ridge, with the island itself being the approximately 103,000 km² part of the Iceland Basalt Plateau that protrudes above sea level (Thordarson & Hoskuldsson 2002: 5). Iceland is well known for its volcanic activity and is a geologically young island principally made up of igneous rock, with the oldest surface deposits being Tertiary basalts (ibid.); Quaternary lavas and tuffs are also present (Sveinbjarnardóttir 1992: 4). Due to its volcanic activity and high rates of erosion and sedimentation the landscape of Iceland has undergone huge geomorphological changes in its geologically short 25 million years (Thordarson & Hoskuldsson 2002: 5). Volcanoes are one of the most significant aspects of Iceland’s geology; the island currently supports 31 active volcanic systems which provide roughly one eruption every five years (Thordarson & Hoskuldsson 2002: 13). The majority of the volcanoes are located in the highland plateau (c. 700-800 meters high with peaks up to 2119m) which makes up about 80% of the island (Björnsson 1964). As well as volcanoes this highland interior is composed of deserts, mountains and glaciers (at c. 1600-1900m (ibid.))
In the low-lying areas around the coast arable land is now present, which is most extensive in the south and west of the island and the coast is punctuated by frequent fjords and bays (ibid.). Rivers and lakes are also prominent topographical features (Ólafsson 1979).

In spite of being capped by a number of glaciers, Iceland, like the Faroe Islands and the Northern Isles of Scotland, is relatively warm compared to other places located along the same latitude, with mean yearly temperatures being 7-8°C warmer than may be expected and winter temperatures being relatively even milder (Björnsson 1964). Once again this is due to the Gulf Stream, here flowing along the west and south coasts of Iceland (Sveinbjarnardóttir 1992: 4). However the climate of Iceland is also influenced by a cold current flowing down from the Arctic and sea ice also has some influence on the climate (ibid.). These conflicting factors are the cause of a noteworthy difference in climate between the north and the south of the country: the north having a cold and stable climate (ibid.) and the south much more changeable and stormy weather with high levels of precipitation (Björnsson 1964). Mean annual temperatures for Iceland recorded between 1931 and 1960 were +3.9°C for Akureyri in the north and +5°C for Reykjavik in the south (Sveinbjarnardóttir 1992: 4).
Over time there have been variations in weather and temperature and some work has been done using historical climate records and other proxies for severe conditions, for example incidences of famine (e.g. Bergþórsson 1969; Ogilvie 1984). Although detailed records do not go back to the settlement period it appears that the climate was likely to have been relatively mild at the time and for two to three centuries after this (Ogilvie 1984). Not only did the Norse settlers manage to travel to Iceland and remain there, but early on they were able to grow barley and a few farms were located in areas that were later covered by glaciers (ibid.). This period in time has been dubbed the ‘Medieval Warm Epoch’ (Lamb 1965, from Ogilvie 1984).
From the examination of temperature, sea ice and other proxy records it appears that up until 1780 AD there was a decadal cycle of cooling and warming in Iceland, the coolest part of a decade being followed by the warmest which in turn was followed by gradual cooling (Ogilvie 1984). As well as this there were also further prolonged periods of more severe climatic conditions. The first deterioration in climate that occurred after settlement appeared to start towards the end of the 12th century AD (Bergthórsson 1969; Ogilvie 1984) and continued until early in the 13th century. Other cold periods were noted by Ogilvie (1984) at around 1280-1300 and 1350-1380, and during the latter part of the 16th century the climate is thought to have been particularly severe. The following three centuries, known as the ‘Little Ice Age’ are thought to have been particularly cold; however Ogilvie (1984) shows that although there were some particularly cold periods during these centuries, the climate was in fact very variable with some mild periods present as well.

The vegetation cover in Iceland today is dramatically different to that at landnám (Sveinbjarnadottir 1992; Björnsson 1964) principally due to a significant decrease in woodland and large scale soil erosion, both largely influenced by human settlement. Changes in landscape and vegetation are dealt with in Section 4.6.4, it is however first important to understand the vegetation cover present at landnám.

The Sagas describe extensive woodland cover being present at the time of settlement as well as frequently mentioning the use of wood as timber and fuel and woodland being cut and burnt to make land available for farming (Kristinsson 1995). However, the entire landmass would not have been wooded as tree growth would have been
limited by high altitude towards the interior and oceanic conditions along the coast line (ibid.). Therefore vegetation cover at settlement was thought to be about 40000 km², with approximately half of this as woodland cover (Sveinbjarnardottir 1992: 4).

It seems that Iceland can be divided into two main vegetation zones; in the lowlands there was a sub-alpine birch forest belt with birch, willow and juniper being the climax vegetation and in the areas higher than 400 m above sea level there was an arctic zone (Dugmore et al. 2005).

Simpson et al. (2001) gave a slightly more detailed description of the vegetation of the district of Eyjafjallajökull, reconstructed from a variety of palaeoenvironmental data. This showed a gradient of vegetation cover with increasing altitude. Along the coast were mostly areas of sand then the lowest vegetated areas were marshy grasslands, woodland and scrub woodland were found between 300-400 m above sea level and then broad and fine leaved grasslands at 400-500 m and 500-700 m above sea level respectively. Finally, moss heath was present over 700 m above sea level.

A similar picture was seen at Mývatnssveit where at landnám the hills around the lake were covered with a mix of vegetation with forest cover thinning out over 400 m above sea level giving way to dwarf shrub heathland and arctic alpine herbaceous vegetation (McGovern et al. 2007). Of particular interest for the Mývatn region is that modern botanical studies have identified the area as having prolific vegetation and huge species abundance; Ólafsson (1979) reported that 246 species of vascular plant had been identified in the district. This is largely due to the high levels of soil
fertility in the region caused by the deposition of large numbers of midges that hatch from the lake on a seasonal basis. It is thought that a particularly large deposition can improve hayfield fertility for up to three years (ibid.).

In addition to the live vegetation present at settlement it is thought likely that due to the lack of detrivores and grazing mammals there would also have been a deep litter layer present which could have provided a great deal of woody material for use by the Scandinavian settlers (Dugmore et al. 2005).

4.6.2 First Settlers

As for the Faroe Islands, it is thought likely that prior to Scandinavian settlement Irish papar visited the island, with an account of this described by Dicuil (Tierney 1967). It is thought most likely that these people only visited Iceland over the summer months (Vésteinsson 2000) and to date no archaeological evidence has been found to support this historical account. The Scandinavian settlement of Iceland is also recorded in historical documents, namely Landnámabók (book of settlements) and Íslendingabók (book of Icelanders) (Sveinbjarnardóttir 1992: 5) however, the versions of these texts that exist today were written approximately 300-400 years after the events that they discuss and were largely written in association with the claiming of land ownership. They are therefore generally regarded as being unreliable (Sveinbjarnardóttir 1992: 5; Dugmore et al. 2000). A much more accurate method of dating landnám in Iceland is through the use of tephrochronology. The majority of Iceland was covered by the ‘Landnám tephra’; one of many layers of volcanic ash within the sediment sequence forming part of Iceland’s geology. Many settlement
sites are found just above this tephra layer with much of the archaeology directly in contact with it (Vésteinsson 2000). With the exception of a single pollen profile showing likely evidence of barley growing just before the deposition of the ‘Landnám tephra’ (Hallsdóttir 1996, from Vésteinsson 2000) no other definite evidence of human presence before the fall of the ‘Landnám tephra’ in Iceland has been found (Vésteinsson 2000). Dating this tephra layer was achieved by Grönvold et al. (1995) through its identification in the Greenland ice core (GRIP). It has been dated to AD 871±2, which interestingly is in good agreement with the Landnámabók date for Ingólfur Arnarson’s first settlement (Dugmore et al. 2000). Based on grave goods, zooarchaeological studies and Landnámabók it is thought that the first settlers in Iceland came from Norway; however it also appears from skeletal studies that there was some link with the Scottish islands (Sveinbjarnardóttir 1992).

According to Vésteinsson (2000) one of the main priorities of the first settlers was to find good quality pasture to provide fodder and winter grazing for livestock, there was also the need for the availability of good hunting and fishing grounds so that the human population could survive until the livestock herds were well established. Therefore the first areas to be settled were river estuaries where seals and fish could be caught and seasonal flooding encouraged the growth of rich meadows (ibid.). Following this, settlers took advantage of wetland areas further inland. Areas such as Mývatnsveit were originally thought to have been occupied quite late on in the settlement sequence due to their high altitude and inland location (McGovern et al. 2007); however, radiocarbon analysis gives dates from the 9th century and some of the midden sequences from this area are in direct contact with the landnám tephra
layer (*ibid.*), showing that this area was settled early on, as it provided wetland pastures and a ‘uniquely productive lake ecology’ (*ibid.*: 36). Exploitation of such areas early on in the settlement process negated the need for clearing large areas of woodland (Vésteinsson 2000); it was only as more and more colonists arrived that it became necessary to exploit wooded areas and clear these for settlement (*ibid.*). Vésteinsson (2000) notes that these settlements were quite different to those located on or near to wetland pastures: they were very evenly spaced, smaller than the earlier settlements and had less access to resources than the wetland settlements. Therefore the settlement sequence can be seen as starting on the coast, then moving inland taking in the best pastureland already available and finally moving back out along the wooded valleys and clearing these for the later settlers (Vésteinsson 2000; McGovern *et al.* 2007).

### 4.6.3 Resources and Economy

On arrival in Iceland a wide variety of resources were available to the Viking settlers. As well as the vegetation resources discussed in Section 4.6.1 a variety of wild animals were present to supplement the domestic species the settlers brought with them. Available wild animal resources included waterfowl and their eggs, fresh water and marine fish species, sea mammals and shellfish (McGovern *et al.* 2007; Amorosi 1991). In addition to this the standard selection of Scandinavian farmyard animals were introduced by the settlers (McGovern *et al.* 2007; Dugmore *et al.* 2005). Barley was also introduced to Iceland (McGovern *et al.* 2007) and a varied insect and small mammal fauna was also unintentionally introduced (Dugmore *et al.* 2005).
Use of these resources, both wild and domestic, was however not static and patterns of exploitation changed over time (McGovern et al. 2007; Dugmore et al. 2005; Amorosi 1991). It appears that at the beginning of settlement the early Icelandic farmers tried to emulate the farming practices of their Norwegian homeland (Dugmore et al. 2005); animal bone assemblages from the settlement period showing relatively high proportions of cattle compared to caprines plus the presence of pigs (Amorosi 1991). However by the 11th and 12th centuries changes had occurred in the patterns of domestic livestock being reared, with pigs and goats no longer kept (McGovern et al. 2007; Dugmore et al. 2005) and there was an increase in the number of sheep with a corresponding decrease in the number of cattle (McGovern et al. 2007; Dugmore et al. 2005; Amorosi 1991).

Exploitation of wild animal resources also showed varying patterns over time. During the settlement period birds were an extremely important resource both for their meat and eggs (McGovern et al. 2007; Dugmore et al. 2005; Amorosi 1991). Later on, particularly by the 13th-15th centuries, fish became an increasingly important resource (Amorosi 1991) and fisheries still form a major part of the Icelandic economy today (Björnsson 1964). It is also worthy of note that although exploitation of bird resources lessened after the initial settlement period waterfowl have been continuously exploited, chiefly for their eggs, in the Mývatn region (McGovern et al. 2007): this is particularly remarkable as this exploitation has been sustained for over a millennium, which could only have been attained through careful management of the resource (ibid.). Other wild animal resources were largely marine based and
included seals, whales and shellfish (Amorosi 1991; McGovern et al. 2007). These resources were not limited to the costal regions: small quantities of the remains of marine species were found at sites from the inland Mývatnsveit region (McGovern et al. 2007) indicating the presence of trade networks across the island and highlighting the fact that individual farmsteads were not isolated (ibid.). Sites in the Mývatnsveit region also made considerable use of the freshwater fishing that was available, Mývatn being noted for its arctic charr population and (ibid.) and the river Laxá for its trout (ibid.).

As well as varying over time, the presence and abundance of animal species (both wild and domestic) appears to have varied from site to site depending on farm status and environment. Amorosi (1991) noted that site economy varied between the two main climatic regions in Iceland (Low Arctic and Boreal). At the Low Arctic site of Svalbarð seals were of particular importance, although their exploitation varied over time (ibid.), while at the Boreal site of Stóraborg caprines were the dominant taxa with the presence of about half as many cattle and very small percentages of other domestic species (ibid.). However the assemblage overall was dominated by Gadid species fish with body part representation indicating the production of stockfish or klippfish (ibid.).

The site of Bessastaðir, another boreal climate site but this time of notably higher status, had a wide variety of wild taxa present. The presence of the Norwegian, or brown, rat (Rattus norvegicus) demonstrates a link with the European mainland and the presence of walrus and polar bear bones, which would had to have come from
the north west of the island, are likely to have resulted from payments of tithes or taxes (ibid.). This is yet more evidence of trade and interlinked economies across the island and beyond.

As well as times of plenty or high status, signs of stress and poverty can also be identified in the assemblages examined by Amorosi (1991). He points out the stress indicators present at the site of Sválbarð (mentioned above) from deposits dating to the 18th and 19th centuries: a high percentage of newborn lambs, a large incidence of mollusca and a high cattle to seal ratio (ibid.). The death of newborn lambs and increased reliance on marine resources point towards a lack of pasture and/or fodder for livestock and hence a lack of traditional food sources for the human population.

As can be seen from the above sheep became increasingly important to the Icelandic farmyard over time. This is not surprising when looking at Adalsteinsson’s (1990) survey of the historical uses of sheep in Iceland: they were used to provide meat, milk and wool. Almost the entirety of a slaughtered sheep was used in some way; meat and offal were preserved through a variety of different means (salting, drying, smoking and preserving in whey) providing food throughout the winter; even the bones were processed for consumption (ibid.).

Sheep milk was also a very important resource and was processed to make butter, cheese and a yoghurt-like product called skyr (ibid.). As with the preserved meat, these dairy products could be stored for a long time. In association with sheep and milking an integral part of the Icelandic economy was the sheiling. These were
dwellings often found in the highland pastures, associated with the summer grazing and milking of sheep and cattle as well as the processing of milk into the products mentioned above (Sveinbjarnardóttir 1991).

In addition to animal resources, vegetation and land resources were also of great importance. In terms of food for humans barley was grown in limited quantities (McGovern et al. 2007) on a subsistence scale (Simpson et al. 2002). *Avena* pollen has also been identified from Iceland (Hallsdóttir 1987, from Simpson et al. 2002). As well as being grown, grain was also imported into Iceland (Simpson et al. 2002) and was therefore an important foodstuff. The growing of barley in Iceland itself had all but ceased by the 15th century and according to Simpson et al. (2002) this was most likely due to a lack of labour and manure resources needed for soil improvement rather than due to any climatic variation. When soil improvements were made these included the use of bone, peat ash, manure and seaweed (*ibid.*).

Probably by far the most important vegetation resource was the pasture and grazing land surrounding each settlement. McGovern et al. (2007: 29) refer to pasture as ‘the ultimate source of wealth and power’, indicating that the ability to graze one’s livestock (particularly cattle) was of utmost importance in gaining status. Directly related to this is the need to use pasture for haymaking to enable livestock to be over-wintered successfully.

One of the other primary uses of the land and the vegetation growing within it was as a source of fuel. Simpson et al. (2003) identified several materials historically used as
fuel resources; principally these were birch, willow, peat, turf, and domestic livestock dung. Other materials occasionally used were driftwood, seaweed and fish bones (ibid.). Simpson et al. (2003) also identified many of these fuel sources as being present at the archaeological sites of Hofstaðir and Sveigakot located in the Mývatnsveit region through the use of thin section micromorphology. At the high status farm of Hofstaðir peat had been used as a high temperature (industrial) fuel source and mineral-based turf material was identified as a domestic fuel resource (ibid.). Wood, also identified as a fuel resource, was combusted at both high and low temperatures and was present in higher quantities in the later midden layers (ibid.). At the more marginal site of Sveigakot mineral-based turf and wood were both used as high and low temperature fuel resources; no evidence of peat burning was identified, but burnt cattle dung was found in the later midden layers (ibid.). These findings indicate that although domestic and industrial burning processes appear to have been carried out at both sites, different fuel resources were available to high and low status sites. The difference in peat presence between the two sites in particular was used to infer the control of peat resources by higher status settlements (ibid.).

In summary although a wide variety of economic resources were available in Iceland as a whole, these were not available to all settlements at all of the time. Availability of resources depended on location, environment, period in time and status. The economy was based on a wide variety of both wild and domestic plants and animals in addition to a variety of land resources. Of paramount importance were pastureland and livestock.
4.6.4 Land Management and Vegetation Change

The traditional view of vegetation and landscape change in Iceland is that of rapid deforestation, vegetation loss and soil erosion immediately following *landnám* and the grazing of livestock being named as the primary causal factor (e.g. Björnsson 1964; Kristinsson 1995). However more recent, detailed research and modelling has shown that this was not necessarily the case. Ólafsdóttir and Guómundsson (2002) found that climate alone could cause land degradation and identified two periods where this had occurred previous to the Scandinavian settlement, prolonged periods of cold being particularly important (more so than just a drop in temperature itself). The addition of anthropogenic activity, particularly grazing of livestock would then push a landscape system over the edge if poorly managed; however, it is thought unlikely that the sheer numbers of livestock were the sole cause of the observed land degradation (Simpson *et al.* 2001). Modelled biomass production was always sufficient to support historic numbers of livestock (Simpson *et al.* 2001; Thomson & Simpson 2007). Additionally there is historic evidence to show awareness of the problems of overgrazing and the implication of laws to limit the numbers of livestock grazing a piece of land (Simpson *et al.* 2001). Some other livestock and land management strategies have been identified in the historical literature; these included reducing livestock numbers prior to winter to ensure that remaining stock survived the winter in as good a condition as possible, the production of fodder (hay in particular) to reduce pressure on winter grazing areas, and the shepherding of
livestock to prevent them grazing sensitive areas (Simpson et al. 2001; Adalsteinsson 1990).

Therefore to what extent was the land degraded and how was this caused? It is already noted above that previous to human settlement there was a much greater expanse of forest in Iceland (e.g. Kristinsson 1995) and in some areas the pollen evidence suggests a rapid decline in birch and an expansion of grasses (Dugmore et al. 2005). However there is also some evidence (pollen and charcoal) for the survival of parts of birch forest until the later 11th century. Therefore, although some areas were cleared of woodland, there was not necessarily universal deforestation immediately following settlement (McGovern et al. 2007). Additionally in the 18th century approximately half of the farms in Iceland had access to woodland (Dugmore et al. 2005). Some studies have also shown that different areas have varying sensitivities or susceptibilities to land degradation. For example in the well studied area of Mývatnssveit Simpson et al. (2004) found that the winter grazing land around the settlement of Sveigakot was inherently more susceptible to the pressure of human settlement than the grazing land around the site of Hofstaðir.

Therefore there appear to be three main factors in determining the initiation and extent of land degradation and soil erosion: climate, landscape position and anthropogenic activity. Where there is poor climate and landscape position anthropogenic activity (chiefly the grazing of livestock) was more likely to cause catastrophic, irreversible landscape degradation such as that seen at Sveigakot (Simpson et al. 2004). As already mentioned it is not thought likely that numbers of
livestock *per se* were the cause of landscape degradation (Simpson *et al.* 2001; Thomson & Simpson 2007) but that other factors associated with grazing were the more likely causes of vegetation loss and soil erosion. Modelling has shown that the failure to remove livestock from summer grazing areas outside of the growing season (May – August/September) may have had serious consequences for landscape stability as may have poor shepherding (Simpson *et al.* 2001). In relation to this it is interesting to note that during the settlement period it was likely that, although poorer in the winter months, vegetation was able to grow all year round (*ibid.*), further indicating the role of climate in landscape degradation.

There are however some cases of successful land management in Iceland, which illustrate that landscape degradation was not an inevitable result of livestock grazing. Simpson *et al.* (2004) examined the winter grazing area surrounding the farm site of Hofstaðir, which is still active today, and although immediately after settlement the area had a higher than average soil accumulation rate (an indicator of soil erosion) for the region at that time, between AD 1477 and the present day the soil accumulation rate (and hence erosion) for the area was slightly reduced compared to the earlier rate and much reduced compared to the regional average for this time which was likely to have been affected by a deterioration in climate associated with the ‘Little Ice Age’. This indicates that grazing and land management strategies at this time were such that they were able to improve upon previous land management and allow the winter grazing area to be maintained in a better manner than the surrounding landscape (*ibid.*).
One further example of land management, not necessarily associated with grazing of livestock, is the manuring of the infields for the maintenance of hay or barley crops. As mentioned above (Section 3.5.3) the cessation of barley cultivation was possibly due to the lack of ability to manure the land (Simpson et al. 2002) emphasising the importance of soil amendments to cultivation. Possible materials used for soil amendments were bone, peat ash, manure and seaweed (ibid.). Soil micromorphological and soil chemical analyses show that although anthropogenic amendments to the soil were made in southwest Iceland (Simpson et al. 2002) and in the Mývatn area (Adderley et al. 2008) these were limited compared to some other areas of the North Atlantic, namely Shetland. Modelling of grain yields in southwest Iceland by Simpson et al. (2002) showed that although climatic deterioration in the late 13th century appeared to have little effect, a reduction in manuring levels did have a notable impact and therefore it was thought that land management strategies, rather than climatic deterioration, were responsible for the eventual cessation of barley growing (ibid.). Adderley et al.’s (2008) examination of manuring in relation to hay production found similar results i.e. that hay yields improved with the addition of manure to the infield following landnám. Modelled yields eventually reach a plateau with maximum levels of productivity only giving subsistence level quantities of hay and variations in yield between sites being mostly dependant on height above sea level (ibid.). It is also of note that variations in manuring level, compared to consistent manuring, had a detrimental effect on yields, illustrating the importance of sustaining manuring levels (ibid.). Adderley et al. (2008) also thought that consistent manuring may have had a buffering effect in years where growing conditions were otherwise poor.
One final example of a potential successful land management strategy, at least for a short time, was the use of wood as a fuel at the site of Hofstaðir. Simpson et al. (2003) found that in the later phases of midden formation (c. 11th century) there was an increase in the presence of wood ash residue suggesting that management of woodland close to this site had increased wood production for a short time at least.

The above demonstrates that land management strategies could be used successfully to overcome some of the problems of climatic deterioration, and that loss of vegetation and soil cover were not inevitable outcomes of the introduction of grazing animals into the landscape, so long as the land management strategy was suited to the particular environmental constraints of a region or area. One of the major features of good land management is the passing on of knowledge from one generation to the next (Dugmore et al. 2007). In Iceland this came up against two main stumbling blocks: firstly, that on arrival the landscape appeared very similar to that of the settlers’ Norwegian homeland whereas in reality the flora and fauna were living much closer to the edge of their biological limits and were therefore much more sensitive to environmental disruptions, for example the introduction of grazing animals (McGovern et al. 2007). Having had no previous experience of the Icelandic landscape, settlers applying the land management strategies of their homeland may have soon run into difficulties. However once these lessons had been learned, knowledge could begin to pass down through the generations. Secondly, however, the usefulness of such inherited knowledge relies on predictability or stability in the environmental conditions (McGovern et al. 2007), and if conditions become unstable
and therefore less predictable, land management practices based on memories and previous experience become less reliable. Dugmore et al. (2007) examined the GISP2 ice core proxy data for storminess, in particular the cumulative variation from the mean which allowed turning points in climate trends to be identified. These are times when ‘past trends were no useful guide to future changes’ (ibid.: Figure 2). The main dates identified where these ‘turnovers’ in climate occurred were AD 975, AD 1025, AD 1425 and AD 1525 (ibid.). AD 1425 was probably the most significant change in climate predictability and it was these more variable and unpredictable climatic conditions that seem to have characterized the ‘Little Ice Age’ and lead to increased environmental degradation at this time (McGovern et al. 2007).

4.7 Greenland

The Norse settlements in Greenland (figures 4.8 & 4.9) provide a rich and ever expanding archaeological data set. Not least of these are the large numbers of archaeozoological assemblages that have been collected since the early 20th century (Dergebol 1929, 1934, 1941 & 1943). Although in the beginning the Norse colony flourished it lasted no longer than 500 years. Part of the postulated reason for the demise of the colony was the inability of the Norse farmers to adapt from their pastoral way of life (Arneborg 2003b; McGovern 1991), a fragile system in the marginal environmental conditions offered by Greenland.

4.7.1 Climate, Geography and Geology

Greenland is the world’s largest island stretching from 59°N in the south to 83°N latitude in the north and covering nearly 840,000 square miles (c. 2,200,000 km²)
(Arneborg & Seaver 2000). The majority of the island is encompassed by the Arctic Circle, resulting in the interior being covered by a vast icecap, the only ice-free land existing around the long coastline, made up of many islands and fjords. The Norse settlements lay within these ice-free areas and below the Arctic Circle. The land surrounding the fjords was covered by large areas of moorland and mountainside capable of supporting coarse vegetation whereas in the extreme southwest a more temperate climate allowed for the presence of extensive grasslands (Banks 1975). The geology is made up of gneisses, granites and metamorphosed supracrustal rocks (Allaart 1976, from Edwards et al. 2008).

Figure 4.8 The Eastern Settlement of Norse Greenland, showing location and places mentioned in text. Disko Bay is marked in the inset. (Illustration by D. Bashford).
Settlement took place during a period of relative warmth, with reduced storminess and sea ice, known as the ‘Little Optimum’ (Bell & Walker 1992), which was greatly advantageous to the pastoral way of life, allowing the limited growth of crops and the over-wintering of sheep and goats outside. The Little Optimum lasted until about 1300 AD (ibid.) after which there was a period of distinct cooling. These cooling events were not just for one or two years at a time but for more prolonged periods (Buckland et al. 1996) and would have seriously affected the hay harvest so essential to a pastoral way of life. Even during warmer periods the arctic climate can be very harsh with almost no sunlight during the winter months and sea ice blocking shipping routes. Therefore, even in times of milder climatic conditions the Greenland Norse and their pastoral economy would have existed in a marginal environmental system.

Figure 4.9 The Western Settlement of Norse Greenland, showing location and places mentioned in text. (Illustration by D. Bashford).
4.7.2 First Settlers

According to the Icelandic scholar Arifroði Þorgilsson Greenland was first discovered by the Norse around AD 982 (Arneborg 2003b) when Erik the Red was banished from Iceland for three years and decided to sail west. At the end of his banishment Erik returned to Iceland with tales of a newly discovered and fertile land that he named Greenland (Banks 1975). The following summer he and a group of followers returned to Greenland to settle (15 winters before Iceland adopted Christianity according to Islendingabok (Arneborg 2000, 2003b). As no farming communities were present in Greenland before this time they would have had to take all of their livestock with them.

Settlers divided themselves between two main areas: the Eastern Settlement near present day Igaliko (Garðar) and further north in the Western Settlement in the area of Nuuk (Godthåb) the present day capital. Others soon followed and by AD 1009 the two settlements were full (Banks 1975). Early investigators believed that farms positioned in less pasture rich areas had been settled by the latecomers, once all the best land had been taken. However, dating evidence shows that many of the farms on poorer areas of land were settled right at the birth of the colony, suggesting that the difference was social rather than temporal (Arneborg 2003b), with those of a lower social ranking taking the poorer land.

Documentary evidence concerning the timing of the settlement of Greenland and the adoption of Christianity on the island suggests that the first Norse settlers were Pagan. The Islendingabok states that the settlers left Iceland 15 winters before the
adoption of Christianity there (Arneborg 2003b) and Erik the Reds Saga credits Lief the Lucky (Erik’s son) with the introduction of Christianity to Greenland around the year 1000 (Arneborg 2000). However archaeological evidence from a very small church at Brattahlid (thought to be that built by Lief the Luckys mother Thjodhild) suggests an earlier date for the adoption of Christianity (Arneborg 1991, 2000; Arneborg et al. 1999). Radiocarbon dates from the graves in the churchyard ranged from the late 10th century to the late 12th century and the building style of the church was suggestive of the time of settlement (Arneborg et al. 1999). In addition no Pagan Norse burials have been discovered so far, at any of the Norse settlements. This evidence suggests that the adoption of Christianity may have taken place before or at the time of the Greenland landnám.

Other scientific evidence for the date of the Greenland landnám comes from palaeoenvironmental evidence. Edwards et al. (2008) found a swift decline in Betula glandulosa pollen and concurrent increase in pollen from Poaceae and other herbs dating to AD 950-1020, which is in close agreement with the historical evidence for settlement. These changes in pollen represented a clearance of dense scrubland, possibly at least partly through burning and then replacement with grassland or steppe shortly after settlement (ibid.).

4.7.3 Resources and economy

A great deal of archaeozoological interest has been paid to the settlements of Norse Greenland, with a large number of excavated bone assemblages; however the quality of these varies greatly (McGovern 1985 & 1992). A large proportion of the evidence
from these relates to the later part of the Norse occupation and only more recent excavations were properly stratified and employed systematic sieving (McGovern 1985 & 1992). McGovern (1985 & 1992) collated much of the archaeozoological data and attempted to summarise the overall patterns in presence and distributions of animals at the Greenland Norse settlements. In terms of domesticates cattle and caprines were dominant; there was also a small presence of horse, dog and pig. Cattle, horse and pigs were more common in the Eastern Settlement and dogs and caprines in the Western Settlement (McGovern 1985 & 1992). Seal remains were very frequent, the most numerous being harp seals (*Pagophilus groenlandicus*), ringed (*Phoca hispida*) and bearded (*Erignathus barbatus*) seals were present in small numbers; hooded seals (*Cystophora cristata*) were common in the Eastern Settlement and common seals (*Phoca vitulina*), although present at both settlements, were much more numerous in the Western settlement (*ibid.*). Other wild resources included caribou, walrus and shellfish, all of which were more common at the Western Settlement, whales which were more common in the Eastern Settlement and birds and fish which were found in very small numbers across the settlements (*ibid.*). Bird species included Ptarmigan, mallard and guillemot, whilst other wild species included polar bear, polar hare (Degerbøl 1943) and arctic fox (Degerbøl 1934 & 1941). The Greenlandic assemblages are unusual compared to others from the Norse North Atlantic as they show a heavy dependence on seals and deer and very low quantities of fish bones, even at sites where sieving was employed during excavation; this is in contrast to elsewhere in the Norse North Atlantic (see previous sections) where archaeozoological assemblages are dominated by domestic mammals and fish (McGovern 1992). There is also a relatively high frequency of goats
Age data for domestic mammals suggests that cattle were largely used for dairying and caprines were utilised for a mix of meat and secondary products (ibid.).

Information gained from stable isotope data (Arneborg et al. 1999) show that there was an increased marine component in the diet over the time of the Greenland Norse settlement from c. 20% marine input near to the beginning of settlement to an 80% input towards the end of the settlement. Interestingly, the skeleton of a Bishop buried with a crosier at the site of Garðar, dated to the mid 13th century only showed a 25% marine diet indicating that he had either not long since arrived from Norway (the origin of all Greenlandic Bishops) or, that due to his high status, he enjoyed a diet made up of a much greater proportion of terrestrial resources (e.g. beef and game) than the majority of the Greenlandic Norse at this time (ibid.).

It is clear from the high input of wild resources into the diet of the Norse Greenlanders that hunting played an important part in the economy particularly in the later settlement period. In fact the northern hunting grounds located around Disko Bay known as the Norðrsetur were a crucial part of their economy (Arneborg 2003b). These hunting grounds provided walrus hide for the production of rope, walrus and narwhal tusks, and polar bear furs, all of which could be traded for imports such as iron and timber (Arneborg 2000 & 2003b). However evidence from the examination of archaeological wood suggests that there were very few imports and that most of the wood used was drift wood (Arneborg 2000).
The excellent preservation conditions found in Greenland have provided many textile remains, showing the importance of sheep for their wool (Berglund 2000). Other craft products were manufactured from wood, horn, soapstone (steatite), bone and iron (ibid.). Cereal crops were not able to be grown in Norse Greenland as there was not enough consistently warm weather for them to complete their life cycle (Ross 1997: 18).

Social hierarchy, as hinted at above, played an important part in the economy of the settlements and is also apparent in the architecture of the farms excavated to date. McGovern (1985) ranked farms according to the floor surface area of the main hall; floor surface area of other rooms such as byres and storage space also seemed to vary in accordance with that of the main hall. In addition churches were only present at the larger sites (ibid.). From this study one primary site was identified; that of the Episcopal manor at Garðar (site Ø47) having an extremely large church (cathedral) and by far the largest hall. In all, four architectural groupings were identified; at the Western Settlement only secondary, tertiary and quaternary sites were identified; the highest status of these being the Church farm of Sandnes (V51) (ibid.).

4.7.4 Settlement demise

After flourishing for approximately 500 years the Norse Greenlanders lost contact with mainland Europe and the settlement was later found to be abandoned (Arneborg 2003b). Historical sources (the Greenland Description) date the abandonment of the Western Settlement to c. 1360 (ibid.). However the archaeological evidence would suggest a slightly later date; the farm at Gården under
Sandet is thought to have been occupied until the 15th century (Berglund 2000). The last direct evidence of occupation of the Eastern Settlement is a marriage certificate dated to 1408; although it is thought the settlement survived until the middle of the 15th century (Arneborg 2003b).

What is uncertain about the abandonment of the settlement is the exact combination of reasons for its occurrence. Over the years many different explanations have been offered, the most enduring of which was the cooling in climate known as the ‘Little Ice Age’ (e.g. Bell & Walker 1992: 142). Early theories stating that it simply became too cold for the Norse to survive (see McGovern 2000). A variety of other monocausal theories have also been offered, such as conflict with the Inuit or isolation from Europe (see McGovern 1981 & 2000).

There are a number of reasons for these monocausal explanations being discredited, the most resounding relating to the cooling of the climate. The Norse were not the only group living in Greenland at the time of their extinction; Inuit were also present further to the north, their population did not however suffer when the climate cooled, pointing to the fact that there was more to the Norse extinction than cooling in climate (McGovern 2000).

Evidence for the end of settlement comes from a variety of strands. Buckland et al. (1996) noted changes in the insect fauna from within farm building stratigraphy, from heat loving indoor species to those more tolerant of the cold and finally a transition to outdoor species taken to indicate the final collapse of roofing material. They also
examined evidence from the GISP2 ice core which indicated distinct changes in atmospheric circulation (changes in calcium and sea-salt sodium) around AD 1400-1420, although this is thought to post-date the abandonment of most of the Western Settlement, with the exception of evidence from Gården Under Sandet where there is evidence that this site may not have been abandoned until the later 15th century (Berglund 2000). Buckland et al. (1996) also found oxygen isotope evidence from other ice cores to indicate prolonged periods of cold during the 14th century, which would have had a detrimental effect on growing conditions for hay and pasture alike.

It appears that the eventual demise of the settlement came from a variety of factors (McGovern 2000). Climate change would certainly have contributed but factors such as erosion, the inability of the Norse to move around in the way that their Inuit counterparts could, a decrease in demand for trade goods such as walrus ivory and possibly also poor political decisions made by those in charge (i.e. Bishops, all of whom were appointed from outside of Greenland) (ibid.). Therefore, it appears that although some adaptations were made to the Greenlandic environmental conditions e.g. increased exploitation of marine resources, these were not enough to offset the climatic changes of the Little Ice Age.

4.8 Hypotheses

Following the evidence presented in this and the preceding chapter, four hypotheses have been devised to examine some of the changes in the size and shape of domestic mammals across the North Atlantic region and the possible reasons for these. These
hypotheses do not allow for the examination of the whole collated dataset, but do allow for broad examination of large parts of it and more focused examination of selected elements. The aim of these hypotheses is to focus the collected data on a number of specific themes that have been brought to light from the discussions of Chapters 3 and 4.

The first hypothesis relates to site latitude. In Section 3.4.3 the effect of latitude on mammal body size was discussed and it was noted that below 60°N there would be a positive correlation between increasing latitude and body size, i.e. the further north an animal of a particular taxa lived the larger its body size would be. It was also noted that above this latitude the pattern would be reversed as at increasing latitudes there would be a correspondent decrease in vegetation productivity, due to increasingly poor growing conditions and hence a reduction in body size due to lower levels of available quality nutrition. Therefore it is predicted here that sites at higher latitudes, i.e. those in Greenland and Iceland, will yield bones of smaller dimensions than those from lower latitudes, for example the Faroe Islands and the Northern Isles; as such there will be a decrease in bone size with increasing latitude.

The second hypothesis relates to site status. The subject of status has been raised on a number of occasions in the discussion of the archaeology of the North Atlantic presented above. McGovern et al. (2007) proposed that the possession of pasture and hence the ability to graze ones livestock was one of the key factors in gaining or holding power or status. It is therefore hypothesised that sites of higher status will have access to greater pasture resources upon which to feed their livestock and
hence animals raised at higher status sties, within a given geographical region and
time period, will be better nourished and able to grow larger than animals at lower
status sites from the same region and time period. In short, animals at higher status
sites will be larger than those at lower status sites due to the improved availability of
nutrition.

The third hypothesis relates to agricultural intensification in the Iron Age of the
Northern and Western Isles of Scotland; a possible rise in dairy production and the
introduction of oats during the later part of the Iron Age being notable modifications
to farming practices. As discussed above it is thought likely that introduced oats
could have been grown without detriment to the established barley crop and
provided an additional food resource, some of which may have been used as fodder
for livestock. It seems likely that if true, increased fodder production would improve
levels of nutrition and hence body size of domestic livestock. Therefore this
hypothesis predicts an increase in bone size over the duration of the later part of the
Iron Age in the Western and Northern Isles.

The final hypothesis relates to environmental degradation. It was noted above that
landscape degradation in Iceland was much accelerated by the presence of humans
and their livestock and it seems that as soil erosion and landscape degradation
progressed there would be ever decreasing amounts of land available for grazing.
Likewise in Greenland as the climate deteriorated towards the end of the settlement
it seems likely that vegetation growth (or ‘annual productivity pulse’ (Geist 1987))
would have become reduced compared to earlier on in the settlement period and
again grazing resources would have become depleted. In both situations it is expected that over time there will have been reduced availability of nutrition and hence reduced bone growth.

All of the above hypotheses broadly relate to the provision of nutrition to livestock and therefore it is expected that in all cases bone breadth will be more affected than bone length following the findings of Pálsson and Vergés’ (1952a & b).