Economy and Environment in the First Millennium AD in Northern Scotland and the Northern Isles

by

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ABSTRACT:

Environmental remains taken from five, first millennium AD study sites broadly covering the Mid-Late Iron Age to Late Norse periods were analysed during the course of this research. Archaeobotanical material, including cereal grain, weed seeds, peat, seaweed and charcoal were identified and combined with other archaeological evidence, in particular animal / fish bone fragments, metallurgical finds, and the structural context.

Cereal grain discoveries together with an analysis of the weed ecology, indicated agricultural intensification occurring during the later Iron Age / Pictish period. Metalworking held an important economic position in Pictish society, and an examination of the fuel resources from the study areas indicated movement and exchange in raw resources, such as wood, charcoal, and metal ore, occurring between the Northern Isles and Mainland Scotland. With the arrival of the Norse this north – south exchange system ceases to be in evidence, and it is not until the Late Norse period that inter-regional trade on an east – west market exchange basis is seen at the study sites.

Research undertaken for this thesis indicated a period of pastoral expansion during the Late Norse period, particularly reflected by an increased need for fodder, and the necessity to produce surplus goods, such as dried fish, cereal grain and butter, for long distance trade. However, the beginnings of a pastoral dairying economy and intensification in arable productivity were seen in the pre-Norse / Late Iron Age period.

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I would like to thank Dr. Rupert Housley and Dr. Richard Jones for supervising the research during 2002 / 2003, and Ms. Hazel Moore and Mr. Graeme Wilson for supplying sample material at short notice and for taking me to some very remote places in Shetland! Professor's Christopher Morris and James Dickson supervised this research from 1994 to 2001 whilst I was a part-time student. I wish to thank my many colleagues and friends in Glasgow who have provided help and support along the way, not to mention cups of tea: Ms. Janie Thomson, Dr. Lisa Porter, Dr. Joanne Long, Dr. Collin Johnson, Dr. Jennifer Miller and Dr. Susan Ramsay. Thank you to my good friend Dr. Jane Richardson for advice on animal bone, and Dr. Damien Robinson for reminding me that although Pompeii is warm – I actually quite enjoy being in Shetland.

In addition I would like to acknowledge the support of the many members of the Glasgow Academy Tae Kwon Do club past and present, including my instructor Mr. Thomas Clarke, and the numerous students who passed through the club doors during my time with this organisation. The moral teachings and philosophy practised by the late General Choi, Hong Hi, provide a guidance to us all:

'By developing an upright mind and a strong body, we will acquire the self – confidence to stand on the side of justice at all times. We shall unite with all men in a common brotherhood, without regard to religion, race, national or ideological

boundaries. We shall dedicate ourselves to building a peaceful human society in which justice, morality, trust and humanism prevail.'

And:

'No matter how high the mountain is, it can be compared to a small tomb under the heaven. There is no reason why man cannot succeed if he desires to climb it. All too often, however, one claims it is too high to climb without even making the attempt.'

General Choi, Hong Hi. 1995 *Tae Kwon Do.* International Tae Kwon Do Federation New Zealand 24, 34.

Paraphrasing the words of Billy Connolly, I would like to add:

'Tread gently on anyone who looks at you sideways. Have lots of long lie-ins. Never turn down an opportunity to shout, 'F**k them all!' at the top of your voice. Avoid bigots of all descriptions. Before you judge a man, walk a mile in his shoes. After that, who cares? He's a mile away and you've got his shoes. Avoid people who say they know the answer. Keep the company of people who are trying to understand the question. Above all, go to Glasgow at least once in your life and have a roll and square sliced sausage and a cup of tea. When you feel the tea coursing over your spice-singed tongue, you'll know what I mean when I say. 'It's good to be alive!'

'*The Desiderata*', as revised by Billy Connolly.

Declaration of Originality

I declare that this thesis embodies original research undertaken by myself, and gives due acknowledgement where the material derives from the work of others, e.g. excavation. The research in this thesis has not been presented before.

CHAPTER ONE:

1: INTRODUCTION:

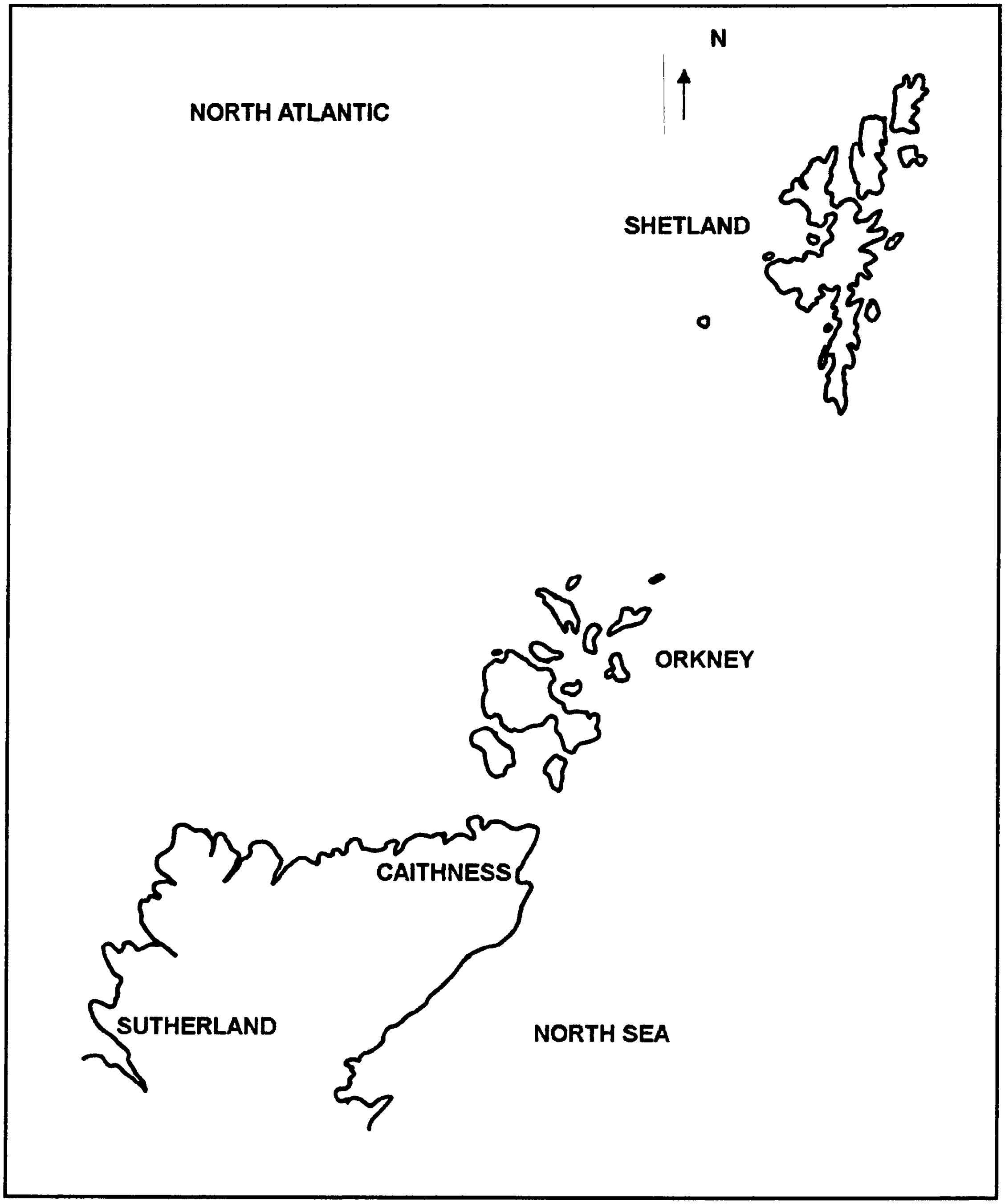
In this chapter the main themes of research into the economy and environment of northern Scotland and the Northern Isles in the First Millennium AD will be introduced. The geographical background to the study areas will be discussed in section 1.1. In section 1.2 the archaeology of the Late Iron Age, Pictish and Norse periods in these areas will be considered, with particular attention to settlement archaeology and the types of structural remains recovered. The current archaeobotanical literature relevant to this study is then presented in sections 1.3 to 1.4, concentrating in particular on agricultural economies suggested by finds of cereal grains and weeds, and on environmental evidence obtained from pollen and charcoal studies. Chapter section 1.5 then considers ethnographic material and how this may be used to further develop archaeobotanical datasets, particularly with relevance to research into the utilisation of wild plant resources.

1.1:The Geographical Setting of the Study Areas:

1.1.1: Introduction:

Fig. 1 shows a map of the three main study areas examined for the puposes of this thesis, namely Caithness, Sutherland and Shetland, shown in their North Atlantic context. Five newly excavated archaeological sites were examined during the course of the research presented here. The exact locations of these sites are presented in more detailed map form in **figs. 14**, **26**, **34** and **44**, provided in the relevant chapter for each site. Three sites were located in the Shetland Isles and consisted of a Late Iron Age / Norse settlement on Trondra and two Norse settlements on Unst. Of the remaining sites, one was a Late Iron Age and Late Norse site on the northern Caithness coast, whilst the other site was on the

Fig. 1: Geographical location of the study area (after Ritchie 1993).

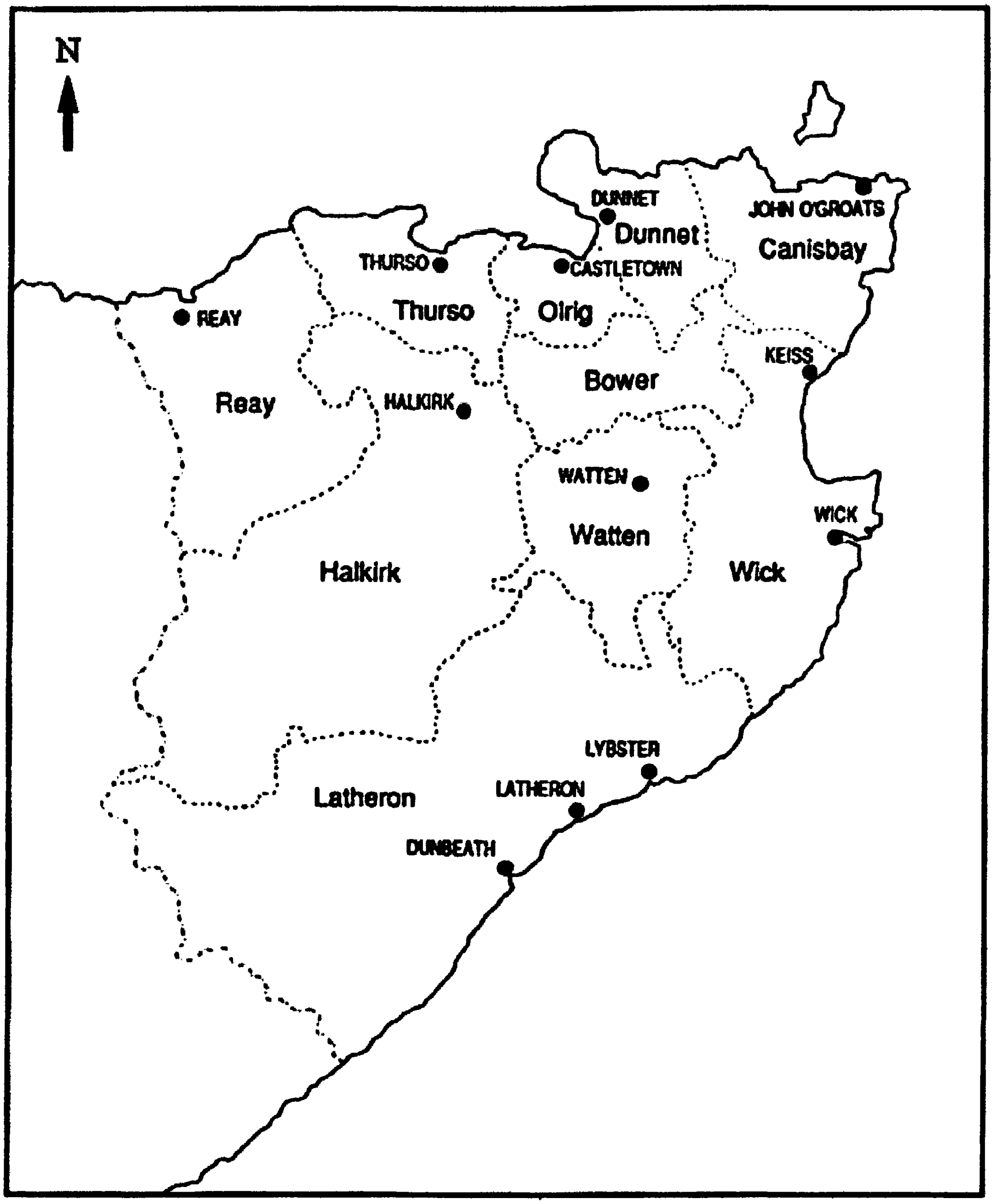


northern coast of Sutherland and contained Early and Late Norse contexts. In this section the geographical background of the studied sites will be discussed.

1.1.2: Caithness:

The county of Caithness forms a triangle of land in the far north-eastern corner of Scotland, lying to the north and east of Sutherland, and covers approximately 1,774 square km. **Fig. 2** shows the modern parish divisions of Caithness and the main areas of settlement, which will be referred to in the text. Its underlying geology consists, in the main, of sedimentary sandstone and flagstone rocks of the Old Red Sandstone Series (Omand 1989: 17). The Caithness Flow Country encompasses a wilderness of peat bog and lochans largely untouched by modern human habitation, and provides habitats for many rare species of plant life. Three large blanket bogs exist in Caithness, at Altnabreac, Achairn and Sheilton. Altnabreac bog is the largest at approximately 21,000 acres (8,500 ha) and is also the largest peat bog in Britain (Omand 1989: 24). Indeed peat bogs in Caithness cover some 60% of the landmass and may have been even more extensive in the past (Omand 1993: 106). The Scottish Natural Heritage site at Blar nam Faoileag, in the Flow Country, is classed as one of the best-preserved examples of undisturbed watershed mires in Britain. The mire contains bog asphodel, insectivorous sundews and bogbeans, in addition to providing a breeding ground for waders and moorland birds (Bennett 1989: 50). In contrast to this wilderness, the coastline, straths and lightly wooded valleys to the north and east provide fertile farmland, and are the main focus for modern settlement. At various points in the past, the extent of peat bog coverage may have placed severe restrictions on local agricultural settlement in inland areas (Huntley 1995b: 8). Although, research at Dunbeath (A. Morrison 1996) has suggested that inland peat areas may have been more settled than is apparent from modern coastal settlement distribution. Modern patterns of settlement largely reflect upon the needs of the 18th century

Fig. 2: Parishes and Settlements of Caithness (Omand 1989).



herring industry, combined with the large-scale clearances of inland hill areas for sheep farming (Huntley 2000: 243). The coastline consists of contrasting areas of high sea cliffs, such as the 90m sandstone cliffs at Berriedale, and extensive coastal sand dune systems such as those at Freswick, Keiss, Dunnet and Sinclair's Bay. Both Dunnet and Sinclair's Bay consist of a long dune range backed by sandy machair flats and with subsidiary dune formation (Omand 1993: 110). Caves and geos (sea inlets) are also a common feature around the coast cut into the sandstone and flagstone cliffs, and often provide shelter for fishing boats, such as at Whaligoe. Dunnet Links, on the north-eastern coast of Caithness, forms a protected nature reserve (SNH) of species-rich dune and links grassland covering 465ha, although areas out-with the reserve are subject to erosion by sheep and adverse weather. Calcareous shell sand together with a high water table and undulating geology have produced a great diversity of soil types in this area, providing habitats for montane species to grow at sea level (Bennett 1989: 51). An eroded section in the north-eastern corner of the dune system at Dunnet, known locally as Marymas Green, was the subject of a brief archaeological excavation (Pollard 1996a), and archaeobotanical and other evidence are presented in chapter 3.

1.1.3: Sutherland:

Sutherland forms the largest district of Scotland, covering an area of 5,700 square km, but is also one of the least inhabited with a modern population of only 13,100 (Richardson 1995: 5). **Fig. 3** shows the modern parish divisions of Sutherland, which will be referred to in the text. The northern and western part of Sutherland consists of the parishes of Assynt, Eddrachilles, Durness, Tongue and Farr, and today forms one of the emptiest areas of Europe (Gourlay 1996: 1). Vast empty beaches dominate the coastline and are broken by areas of rocky headland, whilst inland, peaty hill country is interspersed with long river valleys. The north-west is

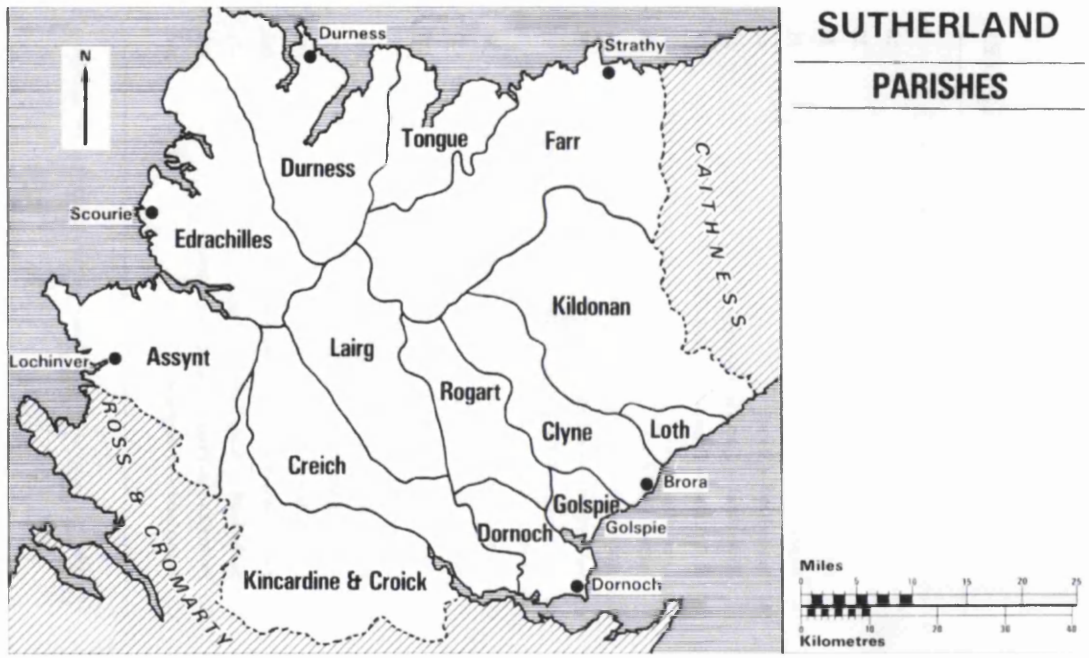


Fig. 3: Parishes and Settlements of Sutherland (Omand 1982).

characterised by a 'cnoc and lochan' landscape – low, bare, rounded hills interspersed with numerous small lochs (Gourlay 1996: 2). The mountains of Suilven, Ben Loyal and Arkle rise dramatically from the blanket bog in north-western Sutherland and the area has two Munros (mountains over 3000ft, or 914.4m), namely Ben More Assynt and Ben Klibreck (Bennet and Brown 1985: 226-228). This area is one of the wettest in Scotland with an average rainfall of 3000mm per year falling over the western mountains (Omand 1982: 74). The maximum sea temperature in August is usually around 13 degrees C. which when combined with a sea breeze produces a cooling effect on coastal districts, often combined with a persistent sea fog (haar) when the wind comes from warmer south easterly areas (Omand 1982: 78). The overall effect of climate combined with acidic soils and mountainous landscapes imposes a firm upper limit on arable agriculture.

Many rare plant species tolerate the extremes of climate and complex geology in the mountain regions of Sutherland. During the 1920's and '30's the botanist John Anthony began an exploration of the flora of Sutherland, which was finally compiled and published posthumously by Kenworthy (1976). Many notable species of arctic, alpine or arctic-alpine distribution are recorded for this district. Species such as russet sedge (*Carex saxatilis*) and rock whitlow grass (*Draba norvegica*) have an arctic distribution outside Britain, and are absent from European mountains (Kenworthy 1982: 92). In many parts of Sutherland, plant communities are dominated by grasses, sedges, rushes and mosses, with dwarf shrub species such as willow (*Salix herbacea*) being a common site on the high hills. On the north and west coasts calcareous shell sand forms machair, with short grasses and an abundance of herbs binding the sand into a flat and stable surface. In particular the ribwort plantain (*Plantago lanceolata*), the sea plantain (*P. maritima*) and species such as crowberry (*Empetrum nigrum*) and creeping willow (*Salix repens*) are important sand stabilisers even on steep slopes (Kenworthy 1982: 98).

The coastal village of Durness is located in the north-western corner of Sutherland, and is bounded on a natural headland, with the sea loch, Loch Eriboll, to the east, and the Kyle of Durness to the west. The Kyle forms an extensive stretch of estuarine mud and sand flats, approximately 1km wide and running some 6km inland where it joins the Dionard River. On the northern coast the large sandy beach at Balnakeil stretches out northwards from Durness towards Faraid Head and forms an extensive dune system. The limestone geology of Durness is unique in Sutherland and provides a fertile terrain for agriculture (Baldwin 2000: ix). On the eastern side of Durness village, approximately 2.5km from Balnakeil Bay, lies the long narrow inlet known as Geodha Smoo. This inlet was carved into the local Cambrian Limestone geology by the action of the sea over many hundreds of thousands of years, and has resulted in the formation of numerous caves along its 600m length, culminating in the famous Smoo Cave. The smaller caves along this inlet formed part of the study area for this research and are discussed more fully in chapter 4.

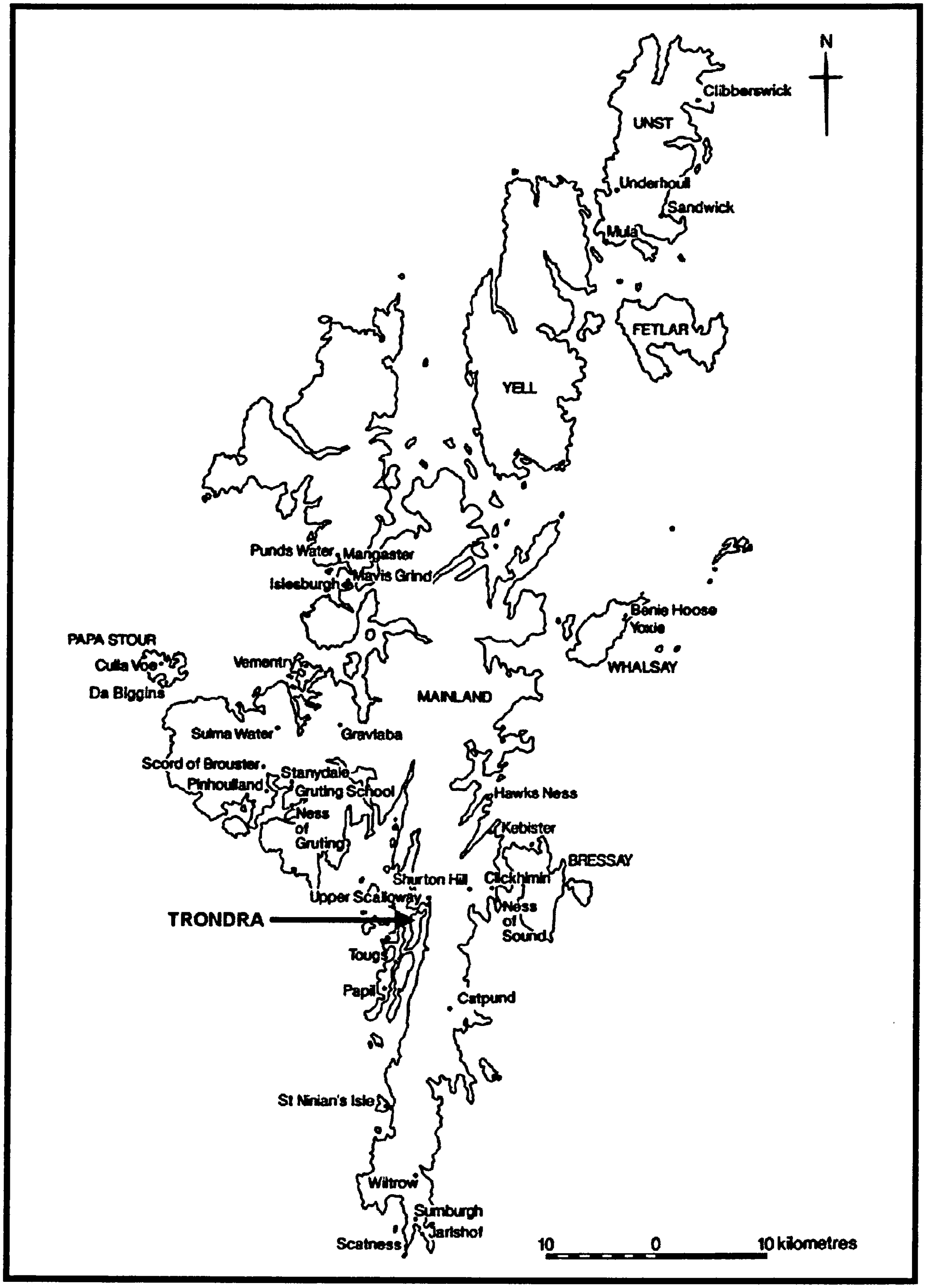
1.1.4: The Shetland Isles:

Shetland is located 957km north of London, England, 290km west of Bergen, Norway, and 1,123km south of Reykjavik, Iceland, and rests at a pivotal point where the North Sea meets the North Atlantic Ocean (Bennett 1989: 87). The Shetland islands extend for almost 100km from north to south, and although the Scottish mainland lies some 160km from the southern tip of Shetland, the intermediate islands of Orkney and Fair Isle provided stepping stones for settlement and trade routes in the past (Small 1983: 20). The Orkney and Shetland isles formed both a crossroads and a resting point for seafarers and intrepid travellers. During the Norse period the islands were an integral part of trade routes stretching as far east as the Baltic, north to Iceland and Greenland, and west to the Western Isles of Scotland and to Dublin (Graham-Campbell *et al* 1994). At the present time only about 15 of the 100 or so islands in Shetland are inhabited, the rest being made up of stacks, skerries and holms inhabited by sheep, seals, otters, rabbits and seabirds (Bennett 1989: 87). A map of the Shetland isles, including some of the place names mentioned in the text is provided in **fig. 4.**

Shetland lies mainly on a latitude of between 60 and 61 degrees north, placing the islands at the same latitude as Bergen, Oslo, Helsinki, St. Petersberg and parts of Siberia (I. Morrison 1996: 82). However, unlike these places, Shetland is warmed from the sea by the North Atlantic Drift and the Gulf Stream, which reduces the amount of snow that falls in winter. The climate is oceanic, with milder winters and cooler summers than the latitude would suggest (Birnie 1993a: 1). During the summer months the oceans act as a heat sink, preventing high temperatures, and this oceanic effect makes arable agriculture more marginal (I. Morrison 1996: 84). In addition the high oceanicity means that only a slight increase in altitude, such as at Ronas Hill (at 453 metres above sea level), results in sub-arctic conditions. Peri-glacial processes operate in Shetland at a considerable lower altitude than elsewhere in Britain, particularly where soil and peat development is restricted, such as on the serpentine of Unst (Birnie 1993a: 3). The SNH reserve at Keen of Hamar is famous for its Icelandic-type fellfield, with montane and maritime plants growing side by side (Bennett 1989: 91). Indeed, a range of arctic – alpine flora flourish in these conditions, but in contrast, arable agriculture is severely limited. The cool, damp climate of Shetland - with salt laden winds prevailing on most days and the possibility of severe gales throughout the year - combined with geological variations, places severe limitations on both the locations suitable for agriculture and on the growth of crops in these areas (I. Morrison 1996: 86).

The initial impression of first time visitors to Shetland is of a somewhat bleak and uniform topography of dark low-lying peat covered hills, and a largely rocky coastline. However this is a superficial impression of the islands, which conceal a wealth of geological and ecological variety (Johnston 1999: 16). Shetland is an area of extremely complex geology, best described by Mykura (1976). The ancient

Fig. 4: Map of Shetland, including place names mentioned in the text (after Owen and Lowe 1999).



mica schist and gneiss geology underlying much of Mainland, Yell and Unst provide an undulating landscape rising in places to over 300m. In areas of central mainland and western Unst bands of limestone interleaved amongst the schist outcrops are less resistent to erosion and tend to form broad, reasonably fertile valleys (Small 1983: 20). Many plant species flourish on the varied geology of Shetland, with communities inhabiting organic (such as heath and peat) and inorganic (scree, stony debris) soils, species of blanket bog and maritime environments, and plants inhabiting lochs, swamps and fens (Spence 1979, Berry and Johnson 1980).

The Shetland Isles are unique in Britain for the potential discovery of new and extremely well-preserved archaeological sites (Turner 1998a: 1). The known archaeology of Shetland consists of some of the most impressive and highly preserved archaeological monuments in northern Europe. This encompasses all periods, from the prehistoric, such as the magnificent Iron Age Broch of Mousa, and the multi-period remains at Jarslhof (Fojut 1986) through to more recent historical events such as the building of coastal defences during the last century. Any new work undertaken in Shetland should always be prepared for the multi-period nature of settlement in this region and modern research and excavation strategies should embrace the wealth of prehistoric to historic knowledge available from these sites. A prime example of a modern research strategy undertaken on a complex Shetland site is provided by the ongoing excavations at Old Scatness on the southern tip of Shetland. The integrated scientific, historical and archaeological research strategy employed by Bradford University should serve as an example to all future excavations in Shetland. A fuller discussion of the archaeology of this region will be given in section 1.2.

During the course of this PhD research the archaeological data and archaeobotanical remains from three sites in Shetland were examined. Two excavations were on the isle of Unst; at Soterberg, near Haroldswick, and at

Setters, located on a hillside overlooking Belmont pier. The results of this research are presented in chapters 6 and 7 respectively. The third site was located on the isle of Trondra and the results are presented in chapter 5. In this section the unique geology, flora, wildlife and biogeography of these two islands will be briefly outlined.

The island of Unst lies approximately 257 kilometres north of John O'Groats on the Scottish mainland. Unst is the third largest island in Shetland, after Mainland and Yell. It is approximately 121 square kilometres in area, and exhibits a varied geography of cliffs, sandy beaches and blanket peat bog coverage (Guy 1990). The central and eastern parts of Unst are composed of a great sheet of serpentine rock overlain by gabbro (Berry and Johnson 1980). Serpentine and steatite exist in large quantities and are a quarriable resource. The well-known steatite source at Clibberswick on Unst was worked during the Norse period, and probably utilised earlier (e.g. Turner 1998b: 95). The recorded flora of Unst inhabits many varied locations, with species ranging from marshy wetland and wet meadow types to those supported on dry hillsides and barren rock habitats (Scott and Palmer 1987). Unst also supports large colonies of seabirds: the SNH site at Hermaness is internationally recognised for its importance - supporting the largest colony of Great Skua in Northern Europe. Hermaness is also a nesting ground for tens of thousands of puffins, kittiwake, shag, fulmar and razorbills in large breeding colonies (Bennett 1989: 91).

The isle of Trondra lies off the western coast of Mainland Shetland, adjacent to the isle of West Burra (see **fig. 4**). Its underlying geology is mainly limestone of the Colla Firth group, with soils consisting of poorly drained peaty podzols (Mykura 1976). The island is generally low-lying, with its highest point at only 50m OD. The area around Burland on the west coast contains a number of small bays and stony beaches which may have provided sheltered locations for fishing boats and settlement in the past.

1.2: The Archaeological Background: The Mid-Late Iron Age, Pictish and Norse Period in a North Atlantic Context:

1.2.1: Introduction:

In this section a review of recent archaeological research in the North Atlantic will be given, concentrating primarily on excavation in Caithness, Sutherland and Shetland, with lesser attention paid to sites outwith the study area of this thesis. Whilst the Orkney Isles are included due to their pivotal location between the study sites and because of their long settlement history, lesser consideration will be given to outlying areas of primarily Norse influence such as Iceland and Greenland. The scope of this thesis encompasses a period of significant cultural and social change in Scotland: from the 'proto-historic' type subsistence economies of the mid-first millenium AD (Morris 1985, Ralston and Armit 1997, Hunter 1997), through to the developed Medieval – style trade and exchange routes characteristic of the Late Norse period in the far North (e.g. Bigelow 1985: 104, 1992: 18).

The original focus of this PhD research was to concentrate on the Pictish / Norse interface period (see 'aims and methods' chapter two). However as research progressed and with the publication of more recent material it became increasingly apparent that important changes in the economic and social realms were occuring earlier in the Late Iron Age (e.g. Armit 1990, Bond 1994a 1994b, Nicholson and Dockrill 1998). The scope of the thesis was subsequently broadened to encompass a wider consideration of the complex archaeology of the mid-first millenium AD, in order to assess the impact and extent of Norse cultural and economic influence on these societies.

This chapter will consider the pre-Scandinavian archaeology and archaeobotany of the north of Scotland and the Northern isles and discuss the changes that took place through into the Norse period in order to highlight possible adaptations that may have taken place in the subsistence economies of this period. In the following sections (1.2.2 to 1.2.4.3) a discussion of the archaeological evidence for sites for the Late Iron Age / Pictish period, and the Pictish / Norse interface through to the Norse and Late Norse periods will be given. Following this, in sections 1.3 and 1.4, the archaeobotanical evidence from these sites will be discussed.

1.2.2: Mid-Late Iron Age and Pictish Archaeology in Northern Scotland and the Northern Isles:

1.2.2.1: Introduction and Chronological Considerations:

The Iron Age in Britain is seen as a period of increased complexity and social change, with more evidence for actual settlement sites during this period than in any previous time (Champion *et al* 1984: 280). The Roman occupation of Britain from AD 43-410 touched intermittently on southern Scotland, from approximately AD 79 to the early 3rd century, but throughout this period the north and west remained outside Roman control (Keppie 1990). Indeed the Roman military hold over Scotland was often tenuous, and more significantly failed to consolidate into any kind of civil rule in the North (Ralston and Armit 1997: 218). Therefore in northern Scotland the development of Iron Age communities was not halted by the invasion of the Roman Empire. J. C. Barrett and Foster (1991: 49) divided the Iron Age of Orkney and Caithness into four chronological divisions, namely Early Iron Age, Middle Iron Age, Late Iron Age I and Late Iron Age II, covering a period from 600 BC to AD 800. **Fig. 5** is a reproduction of the chronological and structural summary of the Atlantic Iron Age proposed by J. C. Barrett and Foster (1991: 50). For the purposes of this thesis the chronology and descriptions given in **table 1** will be employed. This table includes some of the major excavated sites mentioned in the text, with changes in building typology and economic plant discoveries highlighted where data was available.

The complex societal patterns manifested archaeologically in the period of nucleated settlement / broch (or 'complex Atlantic roundhouse') building of the Middle Iron Age (Armit 1990, 1992, J. C. Barrett and Foster 1991), continued to develop and flourish in the Later Iron Age and Pictish periods until the arrival of Norse settlers during the 9th century. The failure of the Romans to conquer northern Britain enabled the continuous development of Iron Age societies over a longer period of time. In the Northern Isles this produced a complex pattern of social groups with similarities in economies, social status, and building styles. Although, in an examination of Western Isles settlement archaeology (concentrating primarily on Atlantic roundhouses) Armit (2002: 15) warned of the variations in social and cultural significance of these structures at both local and regional scales, particularly with regard to land-holding regimes and the freedom enjoyed by individual family groups. Hunter (2002: 129) re-iterated this point with regard to the regional characteristics and morphology of building style – i.e. how cellular buildings do not necessarily pre-date rectangular buildings - and the lack of exact dating of extra-mural broch settlements, which may have been contemporary with the brochs they were thought to post-date.

1.2.2.2: Orkney and Shetland:

The archaeology of the first millennium AD in Scotland is often defined through a series of supposedly well-investigated monuments that fall into the broad categories of brochs, duns, crannogs, wheelhouses and forts (J. C. Barrett 1981). Further division of 'broch' type settlements into simple Atlantic roundhouses and complex Atlantic roundhouses have since been added as a response to more recent research, although the distinction between different monument types is often somewhat blurred (e.g. Armit 1991: 183). A thorough discussion of the excavation of broch structures in Orkney was provided by Hedges (1985) and more recently in Shetland by Fojut (1996, 1998). The simple Atlantic roundhouse probably first appeared in Northern Scotland in the mid-first millenium BC with

Fig. 5: Chronological and structural summary of the Atlantic Iron Age in Orkney and Caithness (plans not to scale) (J.C. Barrett and Foster 1991: 50).

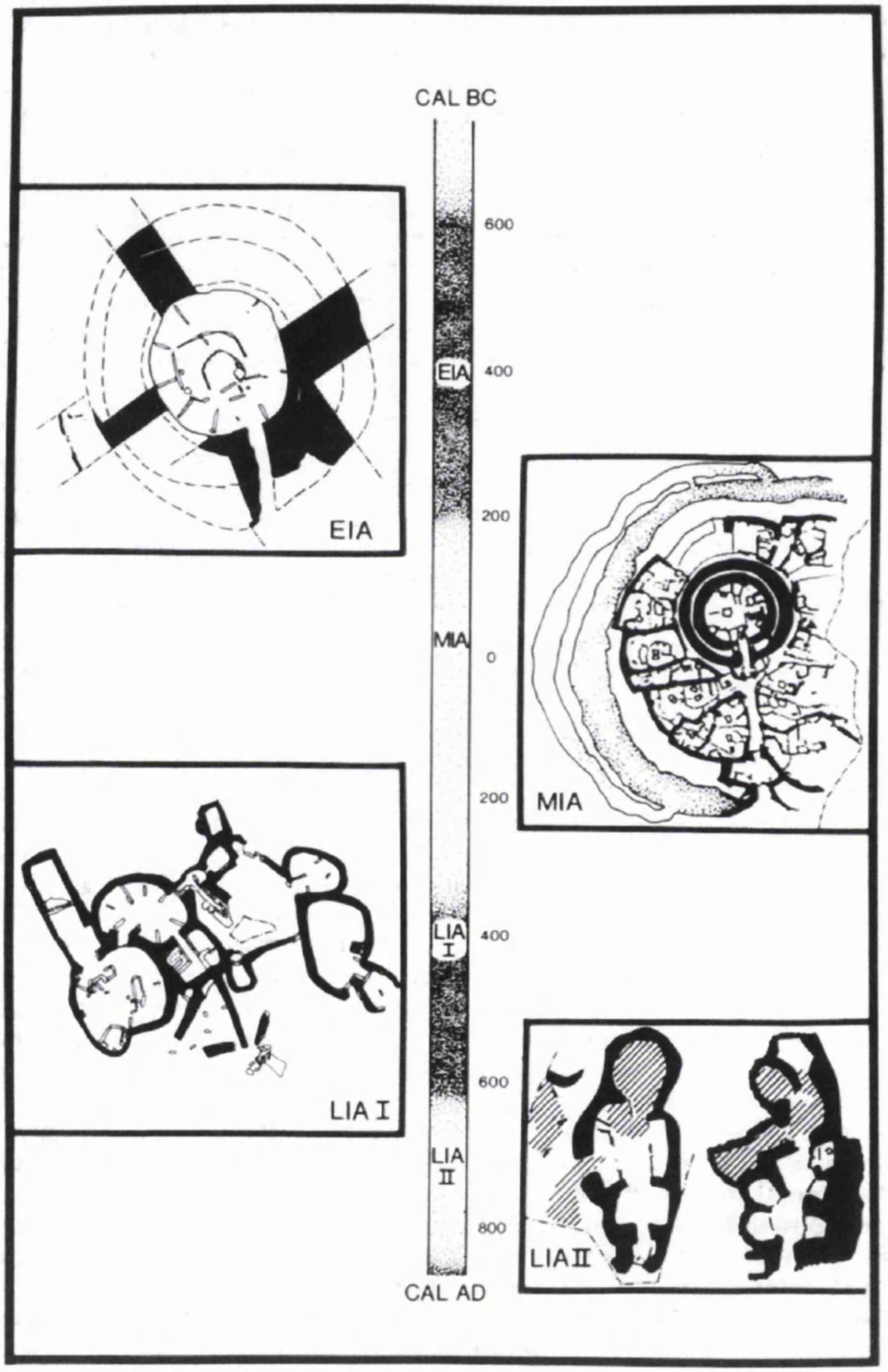


Table 1: Chronological Table of the Main Periods Described in the Text, with major structural and economic changes included.

Date	Period	Structural Evidence	Economic Plants
1000BC	Late Bronze Age	Crannogs, Burnt Mounds, Simple oval structures with hearth settings	Emmer +Spelt Wheat Hulled Barley Naked Barley
700BC	Early Iron Age	Earliest simple Atlantic roundhouses, eg. Quanterness, Bu.	Hulled 6 Row Barley Naked 6 Row Barley
500BC		Roundhouses, eg. Tofts Ness, St. Boniface, Howe. Souterrains.	
300BC		Brochs often with extramural broch settlement, eg. Howe, Gurness. Chronology often difficult.	
200BC			
	Middle Iron Age		
AD0			
AD200	Mid-Late Iron Age (Pictish?)	Post broch construction begins; roundhouses + other extramural broch settlement, eg. Old Scatness. Wheelhouses.	Hulled 6 Row Barley Naked 6 Row Barley
AD297		First ref. to 'Pictish Kingdom' by Romans	
AD400	Late Iron Age / Pictish	Single farmsteads, eg. Howe, Buckquoy. Small multi-cellular buildings, 'closing-in' of structures maybe reflecting small family units	Hulled 6 Row Barley Naked Barley
AD600	Late Iron Age (Pictish / Norse Interface)	Characteristic figure of eight structures.	Hulled 6 Row Barley Oat, Flax, Bread + Emmer Wheat.
AD800	Viking / Early Norse	Trade and eventual settlement by peoples of Scandinavian origin, bringing pottery, loom weights, steatite, eg. Old Scatness. Often re-use Pictish buildings + incorporate into longhouses, eg. Pool.	Flax Oat Hulled 6 Row Barley Naked Barley
AD1100	Late Norse	Longhouses, Jarlshof as typesite. Eg. The Biggings, Sandwick, Westness.	Hulled 6 Row Barley Black / Bristle Oat
AD1469		Danish rights to Orkney / Shetland mortgaged to King of Scotland.	
AD1500	Post Norse / Post Medieval Crofting	Post Med farmsteads show continuity of settlement / building tradition with Norse. Crofting improvements + historic records.	Hulled 6 Row Barley Black / Bristle Oat
AD1700	Highland Clearances	Fishing tenure in Shetland to pay rental causes neglect of crofting life.	
AD1800	Industrial	Major herring fishery in North. Fishing tenure disappears. Forced movement of whole crofting communities to make way for sheep Abandonment of many crofting settlements.	Common Oat intro' to Shetland.
AD1900	Industrial		
AD2000	Computer / Technological		

typical thick-walled drystone examples found at Bu (Hedges 1987), Tofts Ness (Dockrill 1988), St. Boniface (Lowe 1998) and possibly also Howe (Ballin Smith 1994). The chronology of the development of these structures into 'complex roundhouses', i.e. encompassing brochs, extra-mural broch-villages and broch-like structures, such as at Gurness, Orkney, have been considerably expanded with recent research (Fojut 1998: 7). The construction of these monuments manifests a response both to the needs of society and the constraints of the local environment. In the Northern Isles where timber was relatively scarce but good building stone was plentiful, a tradition of exceptionally skilled drystone masonry techniques is shown in the archaeology of the Neolithic period onwards, key examples being the tomb at Maes Howe and the settlement at Skara Brae, Orkney. These techniques continued to flourish during the Iron Age with the building of complex roundhouse and broch structures.

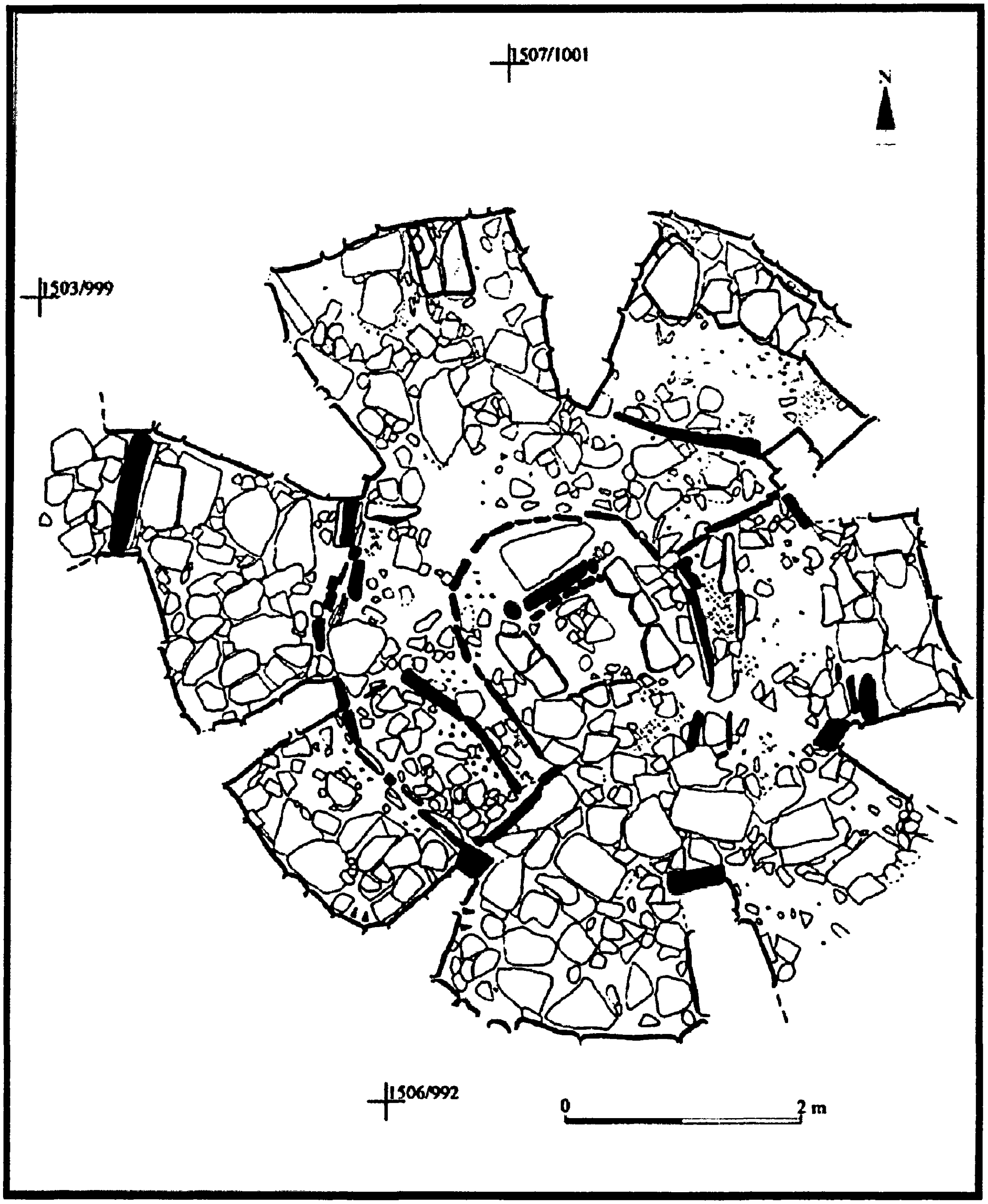
The identification of the 'Pictish' element in the Later Iron Age (approx. AD 600-800) is somewhat problematic, although the reality of the existence of the Picts is shown by symbol stones, ogam inscriptions, artefacts, and settlements (Ritchie 1985 184). Indeed, the Picts are not so much of a 'problem' (cf. Wainwright 1955) if one sees them as a continuation in the development from earlier Iron Age societies (e.g. Ritchie 1985: 185, Hunter 1986: 25). Graham-Campbell and Batey (1998: 7) described the Picts as a group of indigenous tribal societies first recorded in Scotland by the Romans in AD 297 as the 'Picti' or 'painted ones', and surviving as a distinctive culture up until the political intervention of the Norse and Scots in the 9th century.

Many early excavations in the Northern Isles failed to recognise the existence of Pictish archaeology. This was partly because the structures were often poorly built or ephemeral (Hedges 1985: 171), and partly due to the nature of early excavations where broch structures were 'cleared out' by shovel, for example at Gurness, Orkney and Jarlshof, Shetland (prior to Hamilton's 1956 excavation

(Fojut 1998: 19)). Two successive Pictish phases were excavated by Ritchie at Point of Buckquoy, Birsay, Orkney, dating to roughly 7th to 8th centuries, and will be discussed further below (Ritchie 1977). These resembled in form the traces of similar cellular houses suggested as peripheral to the broch structure at Gurness, Orkney (Graham-Campbell and Batey 1998: 13). At Howe, Orkney, oval and sub-rectangular houses were built into the ruins of the earlier broch, although the author does not use the term 'Pictish', rather the structural changes occuring from the 4th century onwards are described as Late Iron Age (Ballin Smith 1994: 9). This was in order to stress the similarities and gradual structural changes from the preceeding Iron Age phases at this site (Ballin Smith 1994: 9). From at least the start of the 4th century AD, the settlement at Howe appeared to have been occupied as a single farmstead (Ballin Smith 1994: 117). In general terms, Pictish-style houses appear to be fairly amorphous, with buildings arranged in a cellular, sometimes figure of eight pattern, and often (although by no means always) discovered as part of a nucleated settlement in post-broch contexts (Hunter 1986: 25). Excavations at Skaill, Deerness, Orkney, produced evidence for structures dating from the Early Iron Age to modern times. Gelling (1984) identified the remains of a possible rectangular Pictish structure, subsequently built over by a Norse house. However Buteux (1997) identified problems with the dating and complexity of the buildings excavated at Skaill and pointed out that this earlier structure could have been an Early Norse building. Approximately 100m south of the Norse farmstead at Skaill, an Early Iron Age roundhouse was excavated, with dating evidence suggesting that later structural modifications took place from the 5th century AD to the late 8th century (Buteux 1997: 53). Significant Pictish remains were discovered on the Orkney island of Sanday, during excavations of the multi-period settlement mound at Pool (Hunter 1990, Hunter *et al* 1993). The Pictish element at this site consisted of an extensive area of paving, and extensive re-modification of an Iron Age structure (Hunter *et al* 1993, J. Bond pers. comm.).

More recently the excavations on the multi-period settlement mound at Old Scatness on the south coast of Mainland Shetland have revealed substantial evidence for Pictish settlement in the form of wheelhouses and other cellular buildings (Dockrill *et al* 2001). The integrated scientific programme employed over a number of seasons by Bradford University at Old Scatness, involving radiocarbon accelerator, optically stimulated luminescence (OSL) and archaeomagnetic dating programmes, have allowed a closer stratigraphic phasing of many of the structures than was possible on earlier excavations where such techniques were not available (Dockrill *et al* 2001: 2). Consequently the Late Iron Age period of settlement at Old Scatness was defined by Dockrill as covering a period from AD 200-800, and encompassed extensive post-broch construction, with roundhouses, wheelhouses and figure of eight structures (Dockrill 1998: 73). **Fig. 6** shows a plan of 'Structure 11', a Late Iron Age triangular piered wheelhouse excavated at Old Scatness, showing central hearth and service area, with orthostatic divisions separating the inner areas from surrounding cells (Dockrill *et al* 2001: 11). The chronological use of wheelhouse and 'Pictish' figure of eight structures may be separated by many centuries, but this requires further dating of the hearth places and carbonised plant remains for its resolution (Bond 1998a: 92). The discovery of the silver hoard on St. Ninian's Isle, Shetland revealed the presence of a great deal of wealth in the Pictish period (Small *et al* 1973). This hoard, which was probably hidden beneath the floor of St. Ninian's chapel so as not to fall into Norse possession, was not an isolated incident; similar Pictish hoards have been found at the Broch of Burgar, Orkney, Rogart, Sutherland and Croy, Inverness (Graham-Campbell and Batey 1998: 227). Fieldwork carried out during 1999 and 2000 by Glasgow University on St. Ninian's Isle revealed that the chapel site had a history of human burial covering some 2000 years with pre or early Christian burials cut into Iron Age midden material, and post Medieval human remains recovered (Harry 2000). Excavations to the south of the chapel site revealed extensive walling and paving along with Iron Age pottery, suggesting a Iron Age wheelhouse or broch settlement (Barrowman 2000). Further hoards

Fig. 6: Plan of Structure 11, Late Iron Age triangular piered wheelhouse, Old Scatness Broch, Shetland (Dockrill *et al* 2001).



associated with Early Norse period archaeological deposits (consisting of brooches, rings and other indicators of wealth) have been found elsewhere; at Skaill, Orkney, dated c.950-70, and Burray, Orkney dated c.997-1010, to name two examples (Graham-Campbell and Batey 1998: 243).

Early excavation work at the Brough of Birsay, Orkney, during the 1930's produced a large number of Pictish and Norse artefacts, which were analysed and catalogued by Curle (1982). Amongst these finds was the impressive Pictish symbol stone portraying three warriors, which Graham-Campbell and Batey (1998: 14) suggested may have marked a significant single grave. Excavation work carried out in the 1970's and 1980's on the Brough of Birsay, Orkney (Hunter and Morris 1981, Hunter 1986) and on the mainland around Birsay Bay (Morris 1989, 1996), produced a number of Pictish structures, and evidence for burials. The sites of Buckquoy (Ritchie 1977) and Red Craig (Morris 1989) around Birsay Bay, had suffered truncation caused by coastal erosion, but the surviving remains added significantly to the data available on the Pictish period. At Buckquoy the first phases of building consisted of cellular style buildings with small cells leading off from a central area, and in one building a central stone hearth place had survived. The last phase of Pictish construction consisted of a figure-of-eight style building with a central hearth (Ritchie 1977). Excavation work at Red Craig also produced a figure-of-eight style building (Morris 1989). The nearby site at Brough Road consisted of burial cairns and cist graves, which produced burials dating to the Pictish and Early Norse periods. South of Red Craig, approximately 1.5 kilometres away, the mound at Saevar Howe produced evidence for Pictish settlement overlain by Early Norse buildings, and a probable 10th century burial ground (Hedges 1983). The accumulation of excavation data from Birsay shows that this part of Orkney was clearly important during the Pictish period as a centre of ecclesiastical wealth, and the concentrations of farmsteads in this area also show its value as agricultural land. Birsay would have been a natural target for Scandinavian settlers, and their arrival in this area is discussed in chapter 1.2.3.

1.2.2.3: Caithness and Sutherland:

In Caithness and Sutherland very few Pictish remains have been identified. The evidence for the presence of a Pictish population has relied mostly upon scattered finds of symbol stones, inscriptions, and occasionally artefacts and burials (Graham-Campbell and Batey 1998, Sutherland 1994). The relatively small extent of archaeological fieldwork that had taken place in Caithness up to the 1980's was documented by Batey (1987). Pictish burial cairns have been identified at Watenan, and possibly also at Ackergill, Caithness (Graham-Campbell and Batey 1998: 11). Settlement sites have remained fairly elusive, although in Caithness, a class of cellular monuments known as 'wags' are believed to be Pictish in origin, although the dating of these may be problematic (Gourlay 1993: 112). Examples of these structures can be found almost entirely confined to the south east of Caithness, and include the Wag of Forse, external structures at the broch at South Yarrows, and at Langwell (Gourlay 1993: 112). During excavations at Freswick Links there were clearly visible traces of Pictish cultivation marks found in plots, which had probably been manured (Morris *et al* 1995).

A gazetteer of prehistoric archaeology in Sutherland was published by Gourlay in 1996, and provided a personal list of reasonably accessible monuments in the district. A small number of fortified, possibly Iron Age or Pictish sites are known from Sutherland, including the possible dun site at Loch Borralie, Durness, and the wheelhouse or aisled dwelling at Tigh na Fiarnain, Loch Eriboll, Tongue (Gourlay 1996: 82, 85). A. Morrison (2000) discussed the presence of souterrain structures in Sutherland, and listed the forty certain or probable structures present in the district (A. Morrison 2000: 218, 219). The majority of these features are in essence simple stone passageways constructed underground. There are a few notable exceptions, such as the oval chambers found beneath hut circles in the Strath of Kildonan, the double-entranced souterrain at Fouhlin, Durness, and the possibly timber roofed passage at Cyderhall, Dornoch (A. Morrison 2000: 222, 224). The available dating evidence for these structures is minimal, and a firm chronology has yet to be established, but a roughly Iron Age, maybe also Pictish phasing in some structures has been suggested (A. Morrison 2000: 232).

A recent coastal survey carried out by Glasgow University in Sutherland (Brady and Morris 1998) highlighted the potential for the discovery of new sites, and resulted in the excavation of a previously unknown Norse settlement, and Pictish burial site at Sangobeg, Durness (K. Brady pers. comm.). There are undoubtedly many more sites of this period in Sutherland, the survey and excavation of which are hindered by the logistical difficulties of working in a landscape of peat bogs with few roads to its interior. The examination of a suitably dated mid-late first millenium site was considered a priority as part of the research for this thesis, due to the overall sparsity of available data for this remote area of north-west Scotland.

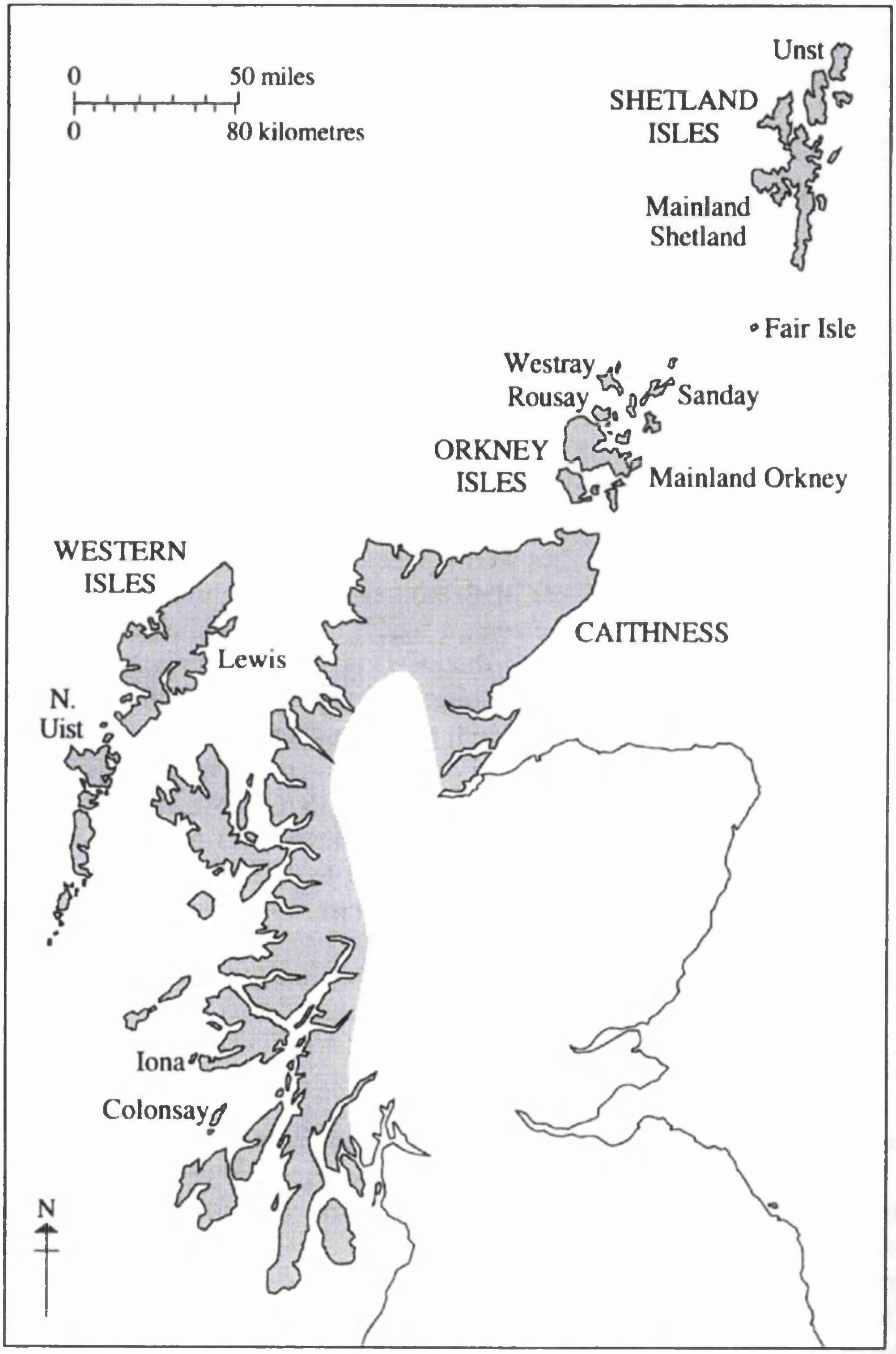
1.2.3:The Arrival of the Norse in the North Atlantic: The Pictish / Norse Interface:

1.2.3.1: Introduction and Chronological Considerations:

Graham-Campbell and Batey (1998: 2) have provided a reminder that much of the archaeology of the Pictish / Norse period cannot be accurately dated. They therefore suggested an overlap in chronology, with the 'Viking period' taken from the initial contact period with the Picts during the 9th century through to the 11th century and the 'Late Norse period' starting at around AD 1050, with the death of Earl Thorfinn. In linguistic terms the origin of the word 'Viking' is uncertain, but in Scandinavia it was used to describe a person fighting at sea, such as a pirate (from West Norse *vikingr*), and for warfare at sea (West Norse *viking*) (Roesdahl 1991: 9). The term 'Viking' therefore refers to a specific activity, such as the raiding and taking of land, but has also been used to describe a specific period in time (e.g. Bigelow 1985: 104). For the purposes of the current text the author has followed Dickson and Dickson (2000: 143), whereby the term 'Norse' refers to the settlement of all peoples of Scandinavian origin in Scotland, beginning in the 9th century and lasting until around AD 1100. The Late Norse period probably extended from 1100 until around AD 1500 in the Northern Isles, although the timing and mechanisms of eventual 'Scottification' - Scottish immigration and political influence - are largely unknown (Bigelow 1985, 1992: 15). The geographical sphere of influence of Norse activity is best summarized by **fig. 7**, reproduced from Hunter (1997: 242), which clearly demonstrates the oceanic distribution of Norse settlement, burial and place-names, although probably also reflects the archaeological bias towards research in the Northern and Western Isles.

The difference between the Pictish and the Norse periods in the north of Scotland is studied through observable changes in the archaeological record, most notably, structural typology, material culture and subsistence economies (Hunter *et al* 1993: 275). When these changes are observed stratigraphically over a period of time, they can include a shift from cellular style buildings to longhouses, changes in pottery styles and other recovered artefacts, and changes in the biological assemblage, including both animal bone and plant remains. However the reliance upon a chronlogy based upon the study of changes in building morphology and in artefact types such as steatite has become increasingly unreliable as more sites are excavated (Hunter 1997: 249). In order to observe trends over time, it is necessary to discover and excavate sites with a lengthy chronology, to ensure coverage of the Pictish / Norse interface, and to employ a multi-disciplinary approach to site analysis involving palaeoeconomics and palaeoenvironmental studies (e.g. Morris 1985: 226). Indeed Hunter (1997: 249) pointed to the 'corrective process' of analysing palaeo-environmental data in order to dispell certain myths surrounding 'Viking' introductions, such as species of sheep, horses, and wildfowl, and the nature of the modern farming / fishing economy in island environments.

Fig. 7: General area of Norse settlement and influence (Hunter 1997: 242).



1.2.3.2: Orkney and Shetland:

Ritchie's work at Buckquoy (1977) and subsequent fieldwork by Morris (1989) at Red Craig, Birsay Bay, and Hunter (1986) on the Brough of Birsay revealed Pictish style cellular buildings, which were found to pre-date subsequent Early Norse occupation in these areas. At Red Craig hearth deposits inside the excavated cellular buildings were radiocarbon dated to the Late Pictish / Early Norse period (approximately AD 600-915) (Morris 1989: 171). There is often a very distinct archaeological point at which the change from the Pictish to Norse can be seen to occur, manifest most strongly in building typology. In the case of Buckquoy, a Norse farmstead was constructed directly on top of the Pictish phases. This also occurred on the Brough of Birsay where Hunter (1986) found at least twelve Early Norse / Norse structures in the area excavated. In artefactual terms the borderline is less distinct; Ritchie for instance found Pictish style combs and pins continuing for a short time into the otherwise Norse deposits at Buckquoy, and a similar pattern both structurally and spatially was found by Hunter at Brough of Birsay (Hunter *et al* 1993: 273). The artefact assemblage recorded by Curle (1982: 49) from early excavations on the Brough of Birsay discovered,

'... a significant number of Pictish finds found in the lower Norse horizon, and one from a room in the middle Norse horizon, whereas there were no diagnostically Norse finds from the Pictish zones.'

The Pictish buildings at Saevar Howe, Birsay Bay, were also built over by Norse dwellings, which were found to contain Pictish artefacts (Hedges 1983). This evidence implied a continuing tradition of Pictish craftwork, and suggested that, although the Norse had taken control of the farmsteads and ecclesiastical power base at Birsay, the Pictish population was not completely eradicated. The Norse living at Birsay were probably acquiring their everyday items, such as bone combs and pins, from nearby Pictish communities (Curle 1982: 101). In Shetland the survival of ecclesiastical shrines from St. Ninian's Isle and the presence of stone sculpture such as the Bressay and Papil stones, were suggested by Crawford (1987: 171) as representing evidence for the survival of the native population, and a degree of its culture and beliefs, into the Norse period.

Excavations at Pool, Sanday, revealed a lengthy sequence of prehistoric settlement followed by abandonment, and then evidence for later cellular Pictish buildings, and subsequent Norse occupation (Bond 1998b: 84). Scandinavian activity at Pool appears to have started with the levelling and infilling of disused buildings with midden material. The 'interface' buildings were significant in demonstrating substantial re-use of existing Pictish buildings, with one building incorporated into a Norse longhouse, and other standing walls re-used in new structures (Hunter 1990: 189). The artefacts recovered from these layers consisted of a mixture of Pictish and Scandinavian objects suggesting that the two cultures may have existed together for some time during what Hunter termed a phase of cultural interface (Hunter 1990: 189).

On Shetland, the excavation of Old Scatness broch revealed a number of multi-cellular Pictish buildings which were found to be infilled with artefacts diagnostic to the Early Norse period (Dockrill 1998: 73). These items included pottery, loom weights and spindle whorls (Dockrill 1998), and amongst the biological assemblage finds of flax (Bond 1998a), argued previously by Bond to be associated with intensive Norse farming practice (Bond 1994a). Midden material containing Norse artefacts was found to overlay a large part of the Old Scatness excavation, although no distinctive change in structural evidence was present to suggest that Norse style houses were built here. This suggested that there may have been quite substantial re-use of the Late Iron Age buildings by the earliest Norse inhabitants of this site, and provides a warning that by following building typology alone evidence for this type of occupation would be missed.

1.2.3.3: Caithness and Sutherland:

Early Norse contacts in Caithness and Sutherland are apparent from the findings of pagan burials, as documented by Batey (1993). In the main these are concentrated in the northeast of Caithness, with Reay being a particularly notable site for its concentration of burials and Viking artefacts. Batey (2002: 187) has also suggested the re-use of Late Iron Age structures by the Norse, in partcular post-broch mounds which contain Viking artefacts, but further work and specific dating is needed to confirm some of these structures as truly Norse. The Viking habit of burying their dead in an existing mound probably provides an easier indicator to their presence than the often emphemeral structural remains one is confronted by. Batey (2002: 188) listed a small number of Viking graves in Caithness which had made use of pre-existing broch mounds, although she has had to rely upon often incomplete antiquirian excavation records for her data. These included the finding of a female skeleton resplendant with distinctive oval brooches interred in the ruins of a 'Pictish house' at Castletown.

In Sutherland possible Viking grave finds came from Keoldale, Durness, and most recently a skeleton and collection of grave goods were discovered in the sand dunes at Balnakeil, Durness (Batey 1993: 157). Evidence for interaction between Pictish and Norse peoples and Early Norse settlement evidence remains elusive in Caithness and Sutherland. The new excavation and research undertaken for the purposes of this thesis will provide a greater insight into Early Norse activities in this area, from a modern economic and environmental perspective (see 'aims and methods' chapter 2). The current published evidence for Norse settlement in Northern Scotland will be discussed more fully below.

1.2.4: The Norse Occupation and Settlement Archaeology:

1.2.4.1: Farm Mounds:

In terms of settlement location many excavations in Orkney and Shetland have shown a strong element of continuity throughout prehistory, with successive multi-period occupation occurring at the same site, often re-using building stone from an earlier structure. Multi-period sites build up over a period of millennia, with a combination of the re-use of structures and midden material, mixed with derelict buildings, rubble and rubbish all contributing to site formation processes (Bond 1998a: 81). Continuity of settlement at a given site could be merely opportunistic – i.e. a good source of stone - or could reflect larger political and economic forces at work. The latter argument is particularly relevant to the Late Iron Age / Norse transition where it is often found that Norse buildings have been constructed directly over or adjacent to earlier structures. This pattern of re-building at the same location, adopting materials such as stone and wood from previous structures, and subsequent in-filling with midden material of the abandoned areas of settlement, often leads to the production of a distinctive 'farm-mound' (Davidson *et al* 1983, Bertelsen and Lamb 1993). There has been much debate over the origins and formation of farm mounds, with some mounds probably representing a later medieval phenomenon, reflecting the increased economic reliance upon the fishing industry, and consisting mainly of the waste products from fish processing. Bertelsen and Lamb (1993: 546) stated that these two classes of site should be considered as separate phenomenon. In terms of settlement archaeology, the name 'farm-mound' can readily be applied to structures in the Northern Isles - where locations and materials are re-used over many thousands of years - for instance the sites at Pool, Sanday and Scatness, Shetland form prime examples of settlement mounds (J. Bond, pers. comm.).

Excavation of a similar mound by Owen and Lowe (1999) at Kebister, Shetland also revealed evidence for continuity of settlement, extending from the Bronze Age through to Iron Age and Early Christian periods, followed much later by a Post-Medieval house and barn. The Norse element was, however, missing from the sequence in the area excavated. In many cases settlement mounds still have active farms on top of them, e.g. on Sanday and North Ronaldsay, Orkney (Bertelsen and Lamb 1993: 547), making identification and excavation of earlier buildings difficult. Farm mounds on Sanday and North Ronaldsay constitute significant elements of the landscape, with deposits often 5 metres deep, covering a surface area of 5000 square metres (Davidson *et al* 1983: 41). The abandonment and decay of farm buildings and dwellings in the Northern Isles, is an ongoing process. Changes in economics and population numbers have resulted in the abandonment of farmsteads, which are often left to decay for many years. **Plate 1** shows a farmstead in the Parish of Midbea on Westray, Orkney, slowly being overgrown by vegetation. Many of the sites of 19th century farms may show strong continuity with earlier settlement patterns.

Farm mounds often cover large areas of land, and can easily be mistaken for natural hill features (Bertelsen and Lamb 1993: 547). Norse houses are often discovered at a slight distance from earlier settlement mounds (J. Bond pers. comm.), for instance at Jarlshof, where the long houses were constructed adjacent to earlier features. Constructing a building down-slope of earlier habitation may have provided a source of building material and an effective 'wind-break' for the occupants. In many cases there seems to have been no obvious attempt by the Norse settlers to assimilate local building styles, and the ubiquitous 'longhouse' type dwelling appears throughout the Scandinavian realm as a distinctive marker of Norse habitation. However, this could be more a reflection of archaeological bias towards easily identifiable building chronology than a true indication of early Norse settlement habits (e.g. Hunter 1997: 249). By building near existing settlements the Norse were making powerful statements, concerning both their presence as new settlers on the land, and the rights of ownership and trade in the goods produced therein.

Plate 1: Abandoned Farmstead, Midbea, Westray, Orkney. (Photo: D. Alldritt).

Plate 2: Peat Cutting on Eday, Orkney 1998. (Photo: D. Alldritt).

1.2.4.2: Aspects of Norse Settlement: The Northern Isles:

The appearance of Norse houses on the site of existing, often long established Iron Age settlements provokes many archaeological and social questions. Primarily, were native populations living there and if so what became of them? Did the Early Norse choose to take over these sites because they represented centres of power (e.g. Brough of Birsay) or because they controlled the best agricultural land (for instance at Old Scatness)? Most importantly, how can these problems be addressed with the data available in the archaeological record?

Many longhouses are either dated to the Late Norse period or not securely dated at all, and there is a distinct lack of archaeological data concerning the arrival of Early Norse settlers. In the following sections a discussion of the known archaeology of the Norse period in the study areas shall be given. The identification and dating of Early Norse structures is often tenuous and reliant on artefact typology, and modern excavation of these features is limited to a handful of sites. At Jarlshof, Shetland, the majority of the site, including the interior fill of the broch and outside courtyard, was removed during the 19th century. However, between 1950 and 1952 Hamilton excavated the buildings north-west of the broch, and his final publication in 1956 provided the most complete sequence of post-broch structures known at that date. Indeed the Norse longhouses excavated at Jarlshof became the 'type-site' upon which interpretation of subsequent structures, and in particular settlement location, were based. Hamilton (1956) proposed seven phases of Viking and Late Norse occupation, including a 'traditional' Scandinavian style longhouse, possibly dated to the 11th century, which appeared to have housed cattle at one end of the building. The sequence of building at Jarlshof was extremely complex, with extensive re-use of stone-work throughout its occupation, and indeed as Graham-Campbell and Batey (1998: 156) pointed out:

'...the structural sequence (of Hamilton) ... may have had to be either simplified or, in fact, over complicated given the dearth of written observations from the earlier excavators'.

Graham-Campbell and Batey (1998: 160) strongly urged for a re-appraisal of the evidence from Jarlshof, given its key place in determining the chronology utilised on other sites.

On the most northern Shetland island of Unst, the excavations of two Norse settlements carried out in the 1960's and 1970's, have been published to date. The first series of excavations were carried out by Small in 1962 at Underhoull (published 1966) on a Norse structure, which he believed to be 9th century in origin. The dating of this site has been questioned more recently, in particular by Bigelow (1992: 10) and also by Graham-Campbell and Batey (1998: 181) due to the presence of numerous Late Norse artefacts at the site, although initial construction phases may have been Early Norse. Underhoull consisted of multi-period occupation, with an Early Iron Age souterrain and broch-period occupation, which was abandoned prior to the levelling of the site and construction of a terrace upon which the Norse settlers built their farmstead (Graham-Campbell and Batey 1998: 182). Small (1969) published a geographical / environmental model for Early Norse settlement, proposing that prime locations would be near the sea, preferably near a shore where boats could be landed, offer viable farm land for the production of cereal crops, and consist of areas of rough grazing for animals. However, due to the lack of awareness of environmental archaeology at this time, none of the midden material at Underhoull was sampled, and so these hypotheses could not be fully tested.

Bigelow carried out the second investigation into a Norse house on Unst, at the southern end of Sandwick beach, during 1978 and 1979, where extensive environmental sampling was undertaken on the midden material (Bigelow 1985).

Radiocarbon dates taken from Sandwick placed the occupation of the longhouse from about AD 1200 to 1400. Bigelow presented much of the Sandwick post-excavation material as part of his PhD thesis (Bigelow 1984). However, a final report on this site has not yet been fully published, although some data are available from the paper published in ***Shetland Archaeology*** (1985). The artefact assemblage from Sandwick included rotary querns, whetstones and spindle whorls, whilst the palaeoenvironmental evidence included the identification of hulled barley and oats, and the presence of cattle, sheep, and large cod bones (Bigelow 1985: 119). **Fig. 8** shows the final phase of the Late Norse house at Sandwick, Unst, and in as far as can be stated with the present evidence shows the 'typical' thick stone-walled rectangular construction of a house of this period, having direct comparisons with examples from Jarlshof (e.g. Hamilton 1956).

In more recent years, the island of Unst has been the focus of archaeological attention from The Shetland Amenity Trust and both Copenhagen and Glasgow Universities respectively. Survey work and trial excavations were carried out by Ms. Anne-Christine Larsen and Mr. Steffen Stummann Hansen of the Institute of Archaeology, University of Copenhagen, between 1994 and 1996, their research objectives being focused upon Viking and Late Norse settlement sites (interim reports, Hansen 1995a and b, Larsen 1997). In 1995, a rescue excavation was undertaken by Hansen on the remains of a Norse longhouse located on the beach at Sandwick-North. This site was being progressively eroded by wave action and very little of the site remains at the present time. A preliminary report on the findings from this site was published in the ***New Shetlander*** magazine (Hansen 1996). The structures present were extremely damaged, but numerous finds of stone artefacts, such as steatite line-sinkers, spindle whorls and pottery, and a 12^{th} century bone comb were preserved. Hansen dated the site of Sandwick-North to the 11^{th} to 13^{th} centuries based upon artefact typology and the few structural remains discovered (Hansen 1996: 29).

In 1996 a trial excavation was carried out on the Norse house site at Setters, Belmont, on the south coast of Unst, with preliminary findings suggesting that the building had an Early Norse phase, dating probably to the 9^{th} to 10^{th} century, over built by a later structure, possibly 11^{th} to 12^{th} century in age (Larsen 1997). This excavation was carried out jointly between Copenhagen University and the Edinburgh based archaeological consultants, Ms. Hazel Moore and Mr. Graham Wilson. The Early Norse phases suggested by Larsen have been refuted by H. Moore and G. Wilson (pers. comm.) based upon the limited excavations undertaken, and also by J. Bond (pers. comm.) based upon its location on marginal land and the limited contextual information available. The environmental samples from Setters were analysed as part of this thesis, and a further discussion, including problems with its suggested early date are given in following chapters.

As part of the Viking and Early Settlement Archaeological Research Project (VESARP), based at Glasgow University, excavation work was carried out in 1997 on the settlement site at Soterberg, Unst. The site was directed by the Copenhagen team, and employed staff and students from Glasgow. An extensive environmental sampling programme was employed by the author at Soterberg, and the results form part of this thesis. An overall publication for Soterberg has not yet been finalised (Hansen and Larsen, forthcoming). Meanwhile Professor Christopher Morris of Glasgow University undertook a survey of the chapel sites of Unst as part of the overall Viking Unst Project (Morris and Brady 1998). This project has expanded to include other islands in the north of Shetland, including the stack at Brei Holm, Papa Stour, a possible Early Christian contemplation area, which produced both Late Iron Age and Late Norse pottery (Brady 2000).

In Shetland excavations at The Biggings, Papa Stour produced a habitation site occupied from the Norse period until the 20^{th} century (Crawford and Ballin Smith 1999). This site was remarkable in its preservation of a wooden floor dated to cal. AD 999-1214 (GU-1775). The date was taken from a single floor plank, which may

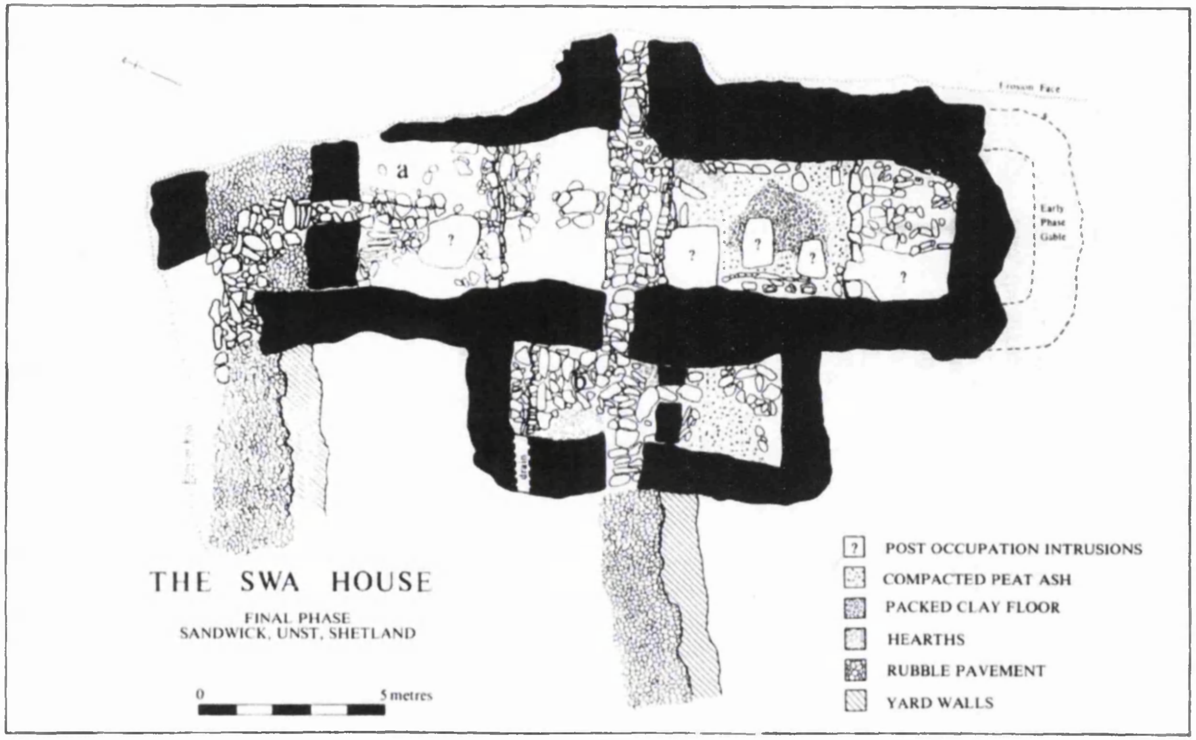


Fig 8: Late Norse house, Sandwick, Unst, Shetland (Bigelow 1985: 110).

have been re-used, the archaeological evidence pointing to its being in use for two centuries (Crawford and Ballin Smith 1999: 207). The trade implications of the presence of wood at this period are discussed further in chapter 1.4.2.2. The earliest structural phases at The Biggings were dated to the 11th century, although possible traces of earlier phases may have existed (Crawford and Ballin Smith 1999: 26). On Orkney, Late Norse settlement sites have been excavated at Brough of Birsay (Hunter 1986), Beachview, Birsay (Morris 1996), Earl's Bu, Orphir (Batey and Morris 1992) and Skaill, Deerness (Gelling 1984). A Late Norse farmstead and pagan cemetery were also excavated at Westness, Rousay (Kaland 1993), and evidence for a large Norse settlement has also been revealed on Westray at Tuquoy (Owen, forthcoming).

1.2.4.3: Aspects of Norse Settlement: Caithness and Sutherland:

Archaeological evidence for Norse settlement in Sutherland is limited, although indirect evidence in the form of place names and a Viking style burial have been recognised. In 1991 a Viking burial was found in the sand dunes at Balnakeil, consisting of the bones of a boy aged 8 – 13 years, a full size sword and other grave goods (Low *et al* 2000: 28). The remoteness and logistical difficulties of work in the interior of Sutherland has meant that most archaeological research has concentrated on coastal survey and locating sites that are within walking distance of main roads. Hence there are numerous prehistoric chambered cairns, wheelhouse, duns and broch monuments recorded along the main A838 road, but little is known of the interior of this empty land (e.g. Gourlay 1996).

A series of excavations in the Durness caves was carried out by Glasgow University, which revealed extensive evidence for Norse presence in this area, in the form of midden remains and artefacts (Pollard 1992, 1996b). The midden material excavated from caves in the Geodha Smoo, was analysed as part of this thesis, and is discussed further in chapter 4. Recent excavation work by Brady (pers. comm.) has revealed a Norse settlement near to Smoo at Sangobeg, Durness. Place name studies in northwestern Sutherland have shown the strategic significance of this coastal region in the Norse period (Fraser 1995). Fraser (1995: 93) pointed to the concentration of Scandinavian place-names amongst the fjord-like inlets in north Sutherland, and suggested that this region formed a significant area of Norse settlement, particularly given the closeness and unpredictability of sailing around Cape Wrath. Indeed the name Cape Wrath or Am Parbh, derives from the Old Norse hvarf, meaning 'turning point' (Fraser 1995: 93), with this area forming an important maritime landmark on the sea routes from the Northern to Western Isles. A study of the place-names of Strathnaver by Waugh (2000: 23) suggested that this region was probably part of the Caithness earldom, and probably settled at the same time or slightly later than Caithness itself.

Freswick Links was the first archaeological site with evidence for Norse occupation to be excavated in Caithness. A few artefacts from the site could be assigned to the Early Norse period, but the overall majority of the area excavated was dated to the Late Norse period (Batey 1987, Morris *et al* 1995). A study of the place-names of Caithness by Batey (1987: 28) suggested that Scandinavian influence was concentrated in the north east, whilst the local indigenous population were restricted inland. Ephemeral possible Late Norse structures and substantial fish midden remains were also found eroding from the cliff section at Robert's Haven, Ness of Duncansby. This site was extensively sampled by J. H. Barrett (1992) who found evidence for walling, midden remains and part of a (possibly modern) derelict boat noust.

Other evidence for the distribution of Norse settlement in Caithness comes from pagan burial finds. These sites are discussed by Batey (1987: 34-41) and Graham-Campbell and Batey (1998). In general, based upon work undertaken to date, the finding of both settlement and burial sites in Caithness follows a coastal distribution. This may reflect the overall importance of the sea to the everyday

Norse lifestyle and economy, and the necessity for settlement on fertile coastal land for viable agricultural production. As Batey (1987: 42) warned however, the pattern available is likely to be incomplete, with the evidence available biased by concentration upon archaeological sites which are threatened by coastal erosion, whilst many successful Norse farms will remain hidden beneath modern farmsteads.

1.3: Mid-Late Iron Age to Norse Period Archaeobotany in Northern Scotland and the Northern Isles Part One: Economics:

1.3.1: Introduction:

Archaeobotanical studies in Northern Scotland and the Northern Isles have tended to focus on midden remains and their associated settlements. In more recent years, research into farm mounds has attempted to combine various forms of environmental evidence, such as fish bone and carbonised plant remains into a wider economic view of the past (e.g. Bertelsen and Lamb 1993). Rarely are waterlogged plant remains encountered from sites of this period, and most of the plant evidence comes from carbonised remains. Waterlogged preservation of the level encountered at for instance, The Biggings, Papa Stour (C. Dickson 1999a), discussed below, is indeed extremely unusual. Therefore the types of plant remains one finds from various sites are influenced by conditions of preservation and deposition.

Evidence for crops, in the form of carbonised cereal grain is often encountered on sites where there is preservation of other carbonised material such as in hearth places, drying kilns, or from conflagation events. The ubiquitous *Hordeum vulgare* var. *vulgare* (six-row hulled barley) appears to be the most common multi-period cereal crop in Scotland recovered from archaeobotanical samples (Boyd 1988, Dickson and Dickson 2000: 232). Often various *Avena* sp. (oats) and the occasional wheat (*Triticum dicoccum* where identified in older reports, although more recent research has also shown the presence of bread / spelt types (Dickson and Dickson 2000: 238)) are also found in the Scottish record. Barley is a fairly hardy crop and well suited to northern climates, as it grows well on both heavy and light soils (M. Jones 1981: 105). Oats and spelt wheat can also grow on impoverished soils, although it is debatable whether wheat types (*T. dicoccum* or *T. aestivum* s.l.) ever formed substantial crops in areas such as Orkney and Shetland. In chapter 1.3.2 the archaeobotanical record (in particular where it relates to cereal crop regimes) for Caithness, Sutherland and the Northern Isles will be discussed. This section will also consider recent environmental work in the Western Isles and how this can be related to the research topics in this thesis.

Together with cereals, a wide variety of other plant remains are found on Scottish sites, including carbonised seaweed, burnt peat, various weed seeds and charcoal, which can allow a detailed economic and environmental picture to be reconstructed. The importance of identifying charcoal is considered in chapter 1.4.2 and the contribution of pollen studies in chapter 1.4.1. The recognition of gathered resources such as burnt peat, dung and seaweed in archaeological deposits, along with the study of their ethnographic counterparts and the implications this poses for archaeobotanists, will be discussed in chapter 1.5.

1.3.2: Archaeobotanical Evidence for Cereal Crop Regimes:

1.3.2.1: Caithness and Sutherland:

Huntley (1994) provided a brief period by period description of macrofossil finds dating from the Bronze Age (500-1500 BC) to the Norse period in Scotland. She noted that during the Pictish period at Freswick, Caithness, large amounts of hulled six-row barley and oats were present. This trend was seen to continue through into the Norse period. In effect the change from naked barley to hulled barley and the introduction of oats had occurred prior to the arrival of Norse settlers (Huntley 1994). In all the samples that were examined from Freswick by Huntley (1995a: 221) she observed approximately equal amounts of barley and oat grains. This suggested that crop economics were based equally on these two cereals, with few changes occurring throughout the occupation of the site. A very small quantity of wheat identified as *Triticum aestivum* (bread wheat) was also discovered. This crop is considered marginal in the north and never played an important role in the economy (Huntley 1995a) due to limitations in growth at these latitudes. However, it may have arrived at the site along with imports of barley and oats from other areas.

The publication of the final report for the Pictish / Norse site at Sangobeg, Sutherland is eagerly awaited. In the meantime Miller and Ramsay (forthcoming) have identified evidence for six-row hulled barley, together with the extensive utilisation of plant material such as turf, heather and driftwood for fuel, and the presence of brown seaweed, possibly for fuel or fertiliser. The dating and contextual integration of this material will provide interesting comparative evidence with that produced by the author at the nearby Smoo Caves.

1.3.2.2: The Western Isles:

The Western Isles do not form a direct part of the research concerns of this thesis. However similar approaches have been taken toward archaeological and environmental research in these regions during the Iron Age and Norse periods. The Northern and Western Isles are not directly comparable in terms of soils, environment and building tradition (Bond 2002: 179). However there are visible archaeological patterns reflecting human response to survival in marginal island environments, and similarities in the constraints placed on agricultural intensification, which suggest comparisons can be made (e.g. Bond 1998b, Bond 2002: 179). The way ethnographic records are used, and the development of similar environmental archaeological techniques for research in the Western Isles, have direct comparisons to the approaches taken by researchers in the Northern Isles.

Research and excavation have been undertaken in the Western Isles by both Edinburgh and Sheffield Universities. Church (2000, 2002) has carried out PhD investigations into the Late Iron Age archaeobotanical remains from Lewis, with a particularly interesting find of possible thatch from Dun Bharabhat, Western Lewis, revealing the presence of two-rwo and six-row hulled barley. Interestingly he also pointed to the localised use of driftwood as a timber resource, removing the need for longer distance trade networks in small household units (Church 2002: 75). At the AEA / NABO conference held at Glasgow University (March 2001) recent research in the Western Isles was presented. A particularly interesting paper by H. Smith and Mulville highlighted to this author the similarities in island biogeography and human response as re-iterated by Bond (2002: 179). Small islands in the Western Isles were able to survive difficult marginal environmental conditions by adaptation and management of local resources and external trading (H. Smith and Mullville *in press*). H. Smith (1999) analysed the plant remains from Dun Vulan, Lewis and found mostly six-row hulled barley (plus very small amounts of common oat and rye which were probably weeds), which she suggested, from ethnographic comparisons, was probably grown on dung and seaweed fertilised 'blacklands' inland from coastal machair. The more fertile machair was more suited to flax production, which increases in the archaeobotanical record during the Norse period in the Outer Hebrides (H. Smith and Mulville *in press*).

1.3.2.3: The Northern Isles: Overview:

Various case studies from the Northern Isles will now be examined, concerning issues of general subsistence means, agricultural practices, differences between Orkney and Shetland, and changes over time. In Crawford's (1987: 149) book entitled ***Scandinavian Scotland*** she pointed to the maritime nature of Norse settlement, and the way access to the sea for resources and communications was very important, whilst also emphasising the necessity for good quality fertile soils for cereal crops during the initial settlement phase. Bigelow (1992: 14) suggested that the first Norse settlers may have exploited the best arable lands on Orkney first, followed by Shetland's limited arable lands, then returning to capitalise on secondary Orkney lands.

The influence of the local Pictish population upon Early Norse settlement decisions is not fully understood, nor is the extent to which the Norse incursions induced agricultural changes and alterations in land ownership, but more evidence is accumulating as new data are published. If Early Norse settlement was concentrated mainly in coastal areas, then it would be fairly straightforward for food and other supplies such as timber and peat to be distributed by boat around the islands in exchange for other produce. Cereal crops grown in fertile coastal areas and processed into a dried form could be shipped to less fertile areas in exchange for fish, peat and other commodities. Dried produce would be less likely to waste on a short sea journey of a few days than fresh produce and it would be far quicker and easier to transport goods by sea than a similar distance over land.

1.3.2.4: Orkney:

In the Orkney Islands, a substantial source of published environmental data comes from the various Birsay Bay excavations. Ritchie's (1970-71) excavations at Buckquoy revealed a Pictish settlement succeeded AD 800 by a Norse farmstead (Ritchie 1985). Cereal crops of bere barley and oats in Pictish layers at Buckquoy suggested early arable agriculture which continued into the Norse period. The botanical remains analysed by Donaldson and Nye (1989) from Birsay Bay produced *Hordeum vulgare* sl. (barley), as did the samples by Donaldson (1986a) from Brough of Birsay. These grains are thought to have been cultivated locally (Hunter 1986).

Bond (in Hunter *et al* 1993: 281) found an increase in the numbers of oats in the Norse period deposits at Pool, Sanday, where it was suggested that more land was being used to cultivate oats than barley. The Pictish period at Pool produced a peak in hulled barley, with a small amount of oats and naked barley also present, flax appeared for the first time at the Pictish / Norse interface, and by the Norse period oats had increased substantially to become the dominant crop (Bond 1998b). The best land was probably reserved for growing flax – a plant of considerable economic importance during the Medieval period – which will be discussed further in 1.3.3. The later phase 8 (Late Pictish / Early Norse) samples from Howe, also produced higher proportions of oats than in previous periods (C. Dickson 1994). At both Bu and Howe brochs, naked barley also continued to be recorded into the Late Iron Age (C. Dickson 1987 1994). The importance of the changing balance between oats and barley will be discussed further below and in 1.3.2.5.

Iron Age and later carbonised plant material analysed from St. Boniface Kirk, Papa Westray fitted the generally uniform pattern of cereal types found in sites of this period. Boardman (1998: 158) found both hulled and naked barley grains, with some identifiable to six-row types, from the Iron Age phases, and various oats (cultivated and wild) and flax from the later 'farm mound' deposits (mostly post-AD 1100). Similarly C. Dickson (1983: 114) discovered six-row barley, oats and flax from the Norse house floors at Saevar Howe, near Birsay on Mainland Orkney. This uniformity is seen throughout the sites that have been excavated and is not confined to a few areas or sites of obvious power.

At Tuquoy on the island of Westray, Boardman and Nye found six-row hulled barley, oats and flax from the Norse house deposits (pers. comm. in Owen 1993, Owen forthcoming). However, no Pre-Norse deposits existed at Tuquoy to provide comparative material. At the Norse mill site at Earl's Bu, Orphir, Orkney, Huntley identified large numbers of oat grains, with evidence for the cultivated variety, and recognised the presence of six-row hulled barley and flax in some of the Late Norse contexts (11th to 15th centuries) (Batey and Morris 1992: 38). Huntley believed that the presence of large numbers of oats made these deposits more similar to Freswick Links than to other high status Orcadian sites, such as Birsay Bay where barley dominated the assemblage. However the presence of probably locally cultivated flax at Earl's Bu is similar to other Orkney sites, such as Saevar Howe, Birsay, and Pool, Sanday (J. Huntley pers. comm. in Batey and Morris 1992: 38). Dickson and Dickson (2000: 175) summarised the differences in crop types in the north of Scotland and Northern Isles during the Norse period, by dividing them into two groups based upon the available published evidence. The first group consisted of sites with a greater number of hulled barley than common oat, namely, Barvas Machair, Lewis and Brough Road, Birsay. The second group of sites had a higher abundance of common oats and consisted of Pool, Sanday, Beachview, Birsay (AD 1000 – 1300), and Earl's Bu, Orkney (Late Norse). The exception was Freswick Links, which had equal numbers of oats and barley throughout the period of occupation.

By analysing the various components of a plant assemblage it is often possible to detect farming strategies and provide some indication of the uses of land around a settlement. At Brough of Birsay, the most commonly found weeds of cultivation, included *Spergula arvensis* (corn spurrey), *Stellaria media* (chickweed) and various *Chenopodium* sp. (goosefoot) all found in association with cereal grain. The samples analysed from the Early Norse phase, contained larger proportions of *Avena* sp. (oat) grains, together with the above weeds, which suggested its cultivation as a separate crop, rather than as a weed of a barley crop. Hence, Donaldson (1986a: 219) suggested that the various corn spurrey and chickweed found in association with the oats indicated weeds growing amongst the crop on local sandy soils, rather than a crop imported from elsewhere. Assemblages containing a large proportion of these types of weeds also suggest that the cereal crops were harvested quite low on the straw, which may provide evidence for the necessity of producing fodder for animals.

1.3.2.5: Shetland:

By the Later Iron Age in Shetland the importance of oats as a cereal crop in their own right rather than just a weed of barley fields became more prevalent, and wheat grains are occasionally recovered. This was evidenced in the Late Iron Age contexts at Kebister (C. Dickson 1999b) and Upper Scalloway (Holden and Boardman 1998). In the Iron Age deposits from Scalloway the most abundant cereal species recovered across the whole occupation of the site was six-row hulled barley, with lesser amounts of oats present. However, a change in proportions amongst the cereal crops was visible throughout time and followed a similar pattern to that observed by C. Dickson in the deposits from Howe (1994). In the Middle Iron Age at Scalloway only low numbers of oat grains were found. However, by the Late Iron Age (dated to cal. AD 687-885 from recovered grain) the quantity of oats recovered equalled that of barley, and this cereal was probably being grown as a crop in its own right by this date. The authors suggested that at this date the cultivated species of oats recovered would have been *strigosa*, but this is assumed from historical records of the crops presence in Shetland, rather than actually being able to identify this species. The problem with oat identification will be discussed further below and in chapter 2.2.4.3.1.

Similarly in the earlier periods of occupation at Kebister, on the eastern seaboard of Mainland Shetland, C. Dickson (1999b: 241) found both hulled six-row barley and cf. naked barley, which appeared to have been the only cereals grown at this site prior to the Iron Age. In the Iron Age and later deposits she identified the introduction of *Avena strigosa* (black or bristle oat) and the continued use of six-row hulled barley. More recently the analysis of potentially Iron Age cereal remains from midden material on St. Ninian's Isle has produced barley only (with some six-row) with no oats present (Miller and Ramsay 2002), although further dating of these deposits is required.

Interestingly further north on the island of Papa Stour, C. Dickson (1999a) identified both six-row hulled barley and naked barley grains from the Norse *stofa* at the Biggings. It was suggested that the Norse farmers may have brought seed corn with them to the island, and may even have re-introduced naked barley as a viable cereal crop throughout the Northern Isles (C. Dickson 1999b: 113). The Norse site of Sandwick on Unst also produced hulled barley and oat grains, together with rotary quernstones. Bigelow (1985) suggested, that these crops were grown locally for direct consumption by the occupants of the site, but it is equally possible that they were shipped from elsewhere in an unprocessed state.

At Old Scatness Broch a detailed analysis of the carbonised plant remains radiocarbon dated to the Pictish / Norse interface period has produced interesting results. Large quantities of six-row hulled barley, together with hulled barley chaff in the form of lemma bases and rachis internodes, and much lesser amounts of cultivated oat grain and chaff, were recovered from structure seven (a Late Iron Age / Pictish wheelhouse structure built inside the broch) from samples radiocarbon dated to cal. AD 788 – 942 (Alldritt and Bond 2001: 41). A very small amount of both *Triticum aestivum* (bread wheat) and *T. dicoccum* (emmer wheat) were also recovered from the Pictish / Norse samples. In samples from structure eleven (Late Iron Age / Pictish wheelhouse) dated to cal. AD 781 – 1018 cereal grain was present in abundance, with recovery of cultivated oat grains equalling and sometimes surpassing the amount of barley recovered. These changes may reflect differing areas of deposition of cereal processing waste, or could suggest an intensification and diversification in cereal grain agriculture, similar to the oat increase at Scalloway and Kebister, occurring during the Late Iron Age.

A major increase in agricultural intensification occuring in the Late Iron Age was strongly suggested by Bond (2002: 177) who cited large increases in cereal grain quantities recovered from both broch (Howe and Scalloway) and non-broch (Pool and Pictish structures at Old Scatness) related sites in the Northern Isles. The quantities of charred grain involved suggested a large-scale processing and storage operation with grain held in central places in the later Iron Age, perhaps forming a direct development from the initial centralisation begun by the broch settlements (Bond 2002: 182).

1.3.2.6: A Note on *Avena* sp. in Shetland:

In Shetland *Avena strigosa* (black or bristle oat) along with *Hordeum vulgare* var. *vulgare* (six-row hulled barley), formed the major crops throughout the Medieval period, until *Avena sativa* (common oat) was introduced in the 18th century. *A. strigosa* can be found growing as a relict crop on the island of Unst to the present day, and is capable of tolerating extremely harsh conditions such as poor soils and waterlogging. Indeed this species was noted to be growing in a completely waterlogged field on Unst accompanied by a drowned sheep (Hinton 1991).

The separation of oat species is extremely problematic and it is often difficult to know what authors are referring to when it is stated that 'cultivated oat' has been found. Clarity in description is needed in archaeobotanical reports if one is to understand whether by 'cultivated' they mean *strigosa* or *sativa*. It also doesn't help matters if one instantly assumes that because a set of carbonised oat remains was discovered on Shetland, they must immediately be of *strigosa* type, as they could equally be *sativa* imported from elsewhere. A discussion of the identification criteria currently in use for oats will be given in chapter 2.2.4.3.1.

1.3.3: Other Economic Indicator Plants: Flax:

Other plants of economic importance are often found preserved on Pictish and Norse period sites. Probably the most important of these plants is flax, which thrives in the cool moist climates encountered in the Northern Isles. It can be grown for its fibres, which require long periods of soaking (or 'retting') in water in order to extract the fibres from the plant. It can also be used for food, fodder for animals, lamp-oil and paint.

On Orkney, evidence for cultivated flax (*Linum usitatissimum*) has been recorded at Birsay (Donaldson and Nye 1989: 266), Saevar Howe (C. Dickson 1983: 114), Howe (C. Dickson 1994) and Beachview, Birsay (Nye 1996: 185). Bond and Hunter (1987) provided an extensive discussion on the traditions of cultivation and processing of flax crops dating from the Norse period through to the 18th century in Orkney. In the Orcadian climate flax was most likely grown for its fibres, as a suitably wet environment is necessary for the 'retting' process to extract the fibres from the plant (although this can be done in small pools or ponds) whilst cool summer days favour the plants growth (Smyth 1988). Linen fibres rarely survive on archaeological sites (Korber-Grohne 1991: 94) so it is often difficult to ascertain whether flax was used for linseed or fibres, as it also grows as a field weed and can be used for fodder (Donaldson and Nye 1989: 266). Gerraghty (1996: 45) suggested that the small immature seeds found in Viking contexts in Dublin had been harvested whilst the seeds were slightly under-ripe when the fibres would be at their softest for linen production. In order to interpret the growing and utilisation of flax for its fibres one ideally needs to find linen processing implements within an archaeological context.

Interestingly in the Pictish / Norse layers at Pool, Sanday, flax has its first appearance at the interface between the two cultural periods (Bond 1994a), a fairly late introduction at this site, which contrasts with its first arrival in the Early Pictish period (phase 8 structures) at Howe (C. Dickson 1994). Dickson and Dickson (2000: 176) suggested that the Pre-Norse flax at Howe could have been introduced by early trade contacts with Norse people. However, Bond (1994a) pointed out that this plant was probably far more intensively farmed during the Norse period. Carbonised flax seeds from two Late Iron Age contexts at Upper Scalloway, Shetland were radiocarbon dated to cal. AD 669-786, and no remains were found in the earlier contexts at this site (Holden and Boardman 1998: 99). This represents the earliest dated record for flax in Shetland discovered to date. The authors did however point to the general under-representation of (carbonised) flax in archaeological deposits, as flax used for oil is not milled and therefore not subject to drying and accidental spoiling by carbonisation.

Direct evidence for consumption of linseed was found by Bell and C. Dickson (1989) from Warbeth Broch, Orkney, where the analysis of human coprolites produced fragments of flax seeds and capsules. Fragments of barley were also found and it was suggested that these plant remains had been consumed in the form of a barley broth. Uncooked linseed has a laxative effect, which can be removed by boiling, however the seeds may be an accidental inclusion in the broth (Dickson and Dickson 2000: 104).

The first evidence for the presence of flax cultivation in Shetland prior to the 18th century was discovered in Pictish / Norse deposits at Old Scatness (J. Bond pers. comm.). Although to date only a limited amount of work has been carried out on the plant remains from Old Scatness, a recent assessment by the author and Dr. J. Bond has produced some interesting dated results (Alldritt and Bond 2001: 37). Cultivated flax was recovered from the midden infill of the Late Iron Age / Pictish wheelhouse, structure eleven, in deposits radiocarbon dated to cal. AD 781 - 1018, placing these remains in the Early Norse period, and possibly at the time of first cultural contact. The Late Iron Age wheelhouse, structure six, also produced tentatively early evidence for cf. *Linum* in a deposit radiocarbon dated to cal. AD 660 – 889.

1.4: Mid-Late Iron Age to Norse Period Archaeobotany Part Two: Environment:

1.4.1: Pollen Evidence for Past Woodland Environments:

1.4.1.1: Introduction:

A limited amount of research has been carried out in the north of Scotland and the Northern Isles into the development and extent of woodland coverage over the past ten thousand years. This work has focused primarily on pollen analysis, most recently reviewed by Huntley (2000) for the northern Mainland. Attempts have also been made to reconstruct the environmental conditions around various archaeological sites, mainly from charred wood remains found *in situ*, for instance in hearths and fireplaces. This provides direct evidence for the utilisation of the woodland resource by the inhabitants of a site, in addition to giving some indication as to which species might have grown within the site catchment area. When evidence from pollen diagrams is analysed in conjunction with plant macrofossil evidence it may then be possible to ascertain a general picture of the landscape within which an archaeological site existed. This may include, for instance, areas of peat bog or heathy moorland, or perhaps areas of forest or scrubland, all of which would have been optimised as a resource base by the local inhabitants. In this section the evidence from pollen analysis will be discussed whilst in chapter 1.4.2 charcoal identification will be considered together with the implications this has for long distance trade and exchange routes.

1.4.1.2: Pollen Studies in Caithness and Sutherland:

One of the earliest pollen analytical studies to take place in this region was carried out by Durno (1958) at five sample sites in Caithness and eastern Sutherland. Two of these sites were in the highland region of eastern Sutherland (Loch Na Moine and Cnoc A Bhroillich) and three were in Caithness (Braehour, Flows of Leanas and Quintfall). Of all these sites, the Moss of Quintfall is the closest to Dunnet Bay – approximately 9km from the authors' study area at Marymas Green – and showed the fluctuating presence of alder, hazel and birch during the past. However none of Durno's pollen diagrams was radiocarbon dated, and the phasing was based upon the author's judgement. More recently Peglar (1979) published a radiocarbon-dated diagram for the Loch of Winless, which showed overall very low values for tree pollen. However, a small elm decline was noted in Peglar's diagram at c.5000 BP, pasture land is recorded at c.4000 BP, and grasses and weeds at c.2500 BP, so there is evidence to show that this part of Caithness was not entirely treeless in the past (e.g. Huntley 1995b: 8). Inferring human influence on the landscape is slightly more difficult, given the absence of cereal pollen, and peaks in charcoal in pollen diagrams may suggest human activity or natural fires (Huntley 2000: 241).

Huntley (1995b) undertook an important pollen analytical study in relation to archaeological excavations at the Norse site of Freswick Links on the eastern coast of Caithness, which deserves detailed discussion. A peat core was taken from the Hill of Harley, approximately 1.5 kilometres west of the Freswick Links excavations, and very low frequencies of tree pollen were recorded throughout. Species present included pine (probably as a result of long distance transport and not locally growing), and birch, alder and rowan, which may have been growing locally in sheltered valleys (Huntley 1995b: 11). This diagram is important because it was dated, it can be related directly to an archaeological site, and it encompasses the Norse occupation. Trees were never a large feature in this landscape, willow scrub was apparently present from 6000 BP to 3000 BP, and pastoral farming, closely followed by arable first appeared around five thousand years ago. Cereal cultivation became continuous and pastoral farming more extensive during the Iron Age (Huntley 1995b: 15). However the Viking and Norse dated pollen sections showed little evidence for cereal cultivation around Freswick

Links at this time, although carbonised cereal grains were found on the site. This led Huntley (1995b: 16) to conclude that the large quantities of grain found on the site during the Norse occupation may have been imported from elsewhere, or grown in fields remote from the pollen site. A similar site-related pollen investigation was carried out by M. Smith (2000), from a series of pollen cores taken in the Lairg area of Sutherland, in an attempt to assess human impact on local and regional vegetational, although the results of this study are not yet fully published. Pollen examined from on-site contexts at Lairg suggested the possibility of floral tributes deposited at the site (Tipping and Carter 1998).

1.4.1.3: Pollen Studies in Orkney:

A small number of pollen diagrams exist for Orkney Mainland, with the early work of Moar (1969) and Davidson *et al* (1976) suggesting that extensive birch and hazel scrub existed in west and central mainland by the mid-Flandrian. On the east coast, at Deerness, Donaldson (1986b) found evidence for local birch woodland with lesser amounts of hazel and willow. Diagrams by Keatinge and J. Dickson (1979) and more recently by Bunting (1994) from the west coast of Orkney, near Skara Brae show quite similar results for the Post-Glacial period. Prior to the elm decline these authors show the presence of birch and hazel scrub, with pine, willow, hazel, oak and alder in smaller amounts. Although Bunting interpreted her results as a dense and extensive woodland canopy (1994), whilst Keatinge and J. Dickson (1979) found much lower amounts of tree pollen. These differences in results may be because Bunting studied pollen from two sheltered basins, whilst the previous authors samples came from Loch of Skaill, which was closer to the sea and more likely to suffer from salt spray restricting growth of vegetation (C. Dickson pers. comm.). Around 5900 BP there was a marked and permanent decline in tree pollen at Bunting's site at Quoyloo Meadow, and a concurrent increase in herbaceous taxa, with heathland, arable and pasture land all shown. These changes are attributed to Neolithic farming activities (Bunting 1994).

The formation of blanket peat bog on the hills of Orkney began around 3400 BP (C. Dickson 2000) probably as a result of increased climatic wetness and high grazing pressure (Keatinge and J. Dickson 1979). Evidence from charcoal (discussed more fully in chapter 1.4.2) found from later period archaeological sites, such as Howe (C. Dickson 1994) has shown the presence of willow, alder and birch during the Iron Age on Orkney. However, the decline in woodland vegetation appears to have been most severe and rapid during the Neolithic (C. Dickson 2000). The industrial practices of the Iron Age would probably not have relied upon naturally occurring woodland species, rather they would have required a certain degree of woodland management policy to supply enough fuel for furnaces in a landscape already depleted of trees. The potential role of peat in these processes will be discussed in chapter 1.5.3 and chapter 8.

1.4.1.4: Pollen Studies in Shetland:

Butler (1999: 3) provided the most recent summary of the extent of knowledge on the past environment of Shetland, based upon the results from pollen analysis and fossil plant remains preserved in lake and peat deposits. Investigations began in 1907 with the identification of plant macrofossils made by Lewis, which established the existence of past woodlands in Shetland. The first complete Holocene pollen profile for Shetland was produced from Murraster, west Shetland by Johansen (1975), and more recent work includes Whittington and Edwards (1993, 1999) for Papa Stour, and Birnie (1993b) for Garths Voe, north Mainland. In the immediate Post-Glacial period Shetland was colonised by birch, willow, hazel, alder and oak (Bennett *et al* 1992).

Development of woodland at the start of the Holocene was probably to a much lesser extent than in other parts of Europe, and was most likely open and light in character (Butler 1998: 5). The most dramatic changes in the environment of Shetland have occurred during the later Holocene, between c.5000 BP and c.3000

BP, when the landscape changed from being largely wooded to virtually treeless (Butler 1999: 5). All the pollen investigations undertaken on Shetland have shown a substantial disruption of the vegetation at some point after 5000 BP, with variations in time and rapidity between sites (Bennett and Sharp 1993: 19). The fertile soils utilised by early farmers on Shetland gradually became leached and acidified, resulting in the spread of blanket peat and great increases in the prevalence of acid soils. Heath and acid grassland became the norm, and increased climatic deterioration throughout the Bronze Age may have resulted in the abandonment of many settlements in hill country and a general concentration of later settlements in more fertile coastal areas. At Saxavord on Unst, Edwards (1974) quoted a date of 3733 ± 85 BP for the beginning of blanket bog formation, although peat growth must have occurred at different times in different areas.

By the Iron Age the vegetation of Shetland may have been very similar to today with few trees, and rough grassland and moorland predominating (Butler 1999: 7). During the Norse period at The Biggings, Papa Stour, Whittington and Edwards (1999: 103) recorded a distinct lack of tree and shrub pollen and a completely open landscape of grassland and heath, with *Calluna* (heather) and *Empetrum nigrum* (crowberry) present.

1.4.2: Charcoal Evidence: The Importance of Driftwood and Long Distance Trade, and the Presence of Native Species:

1.4.2.1: Introduction:

Charcoal remains discovered on archaeological sites provide the most direct evidence for the woodland species available to, and utilised by, human populations in the past; although may not accurately reflect the immediate environment of a site. When considering coastal sites in particular and sites in the Northern Isles in general, it should come as no surprise that a substantial quantity of the charcoal and wood found on archaeological sites is non-native, and has arrived on the islands as driftwood. In the more recent historical past, much of the wood used in house building is re-used timber from shipwrecked boats (Donaldson and Nye 1989). Driftwood would have been an extremely valuable and fairly common resource to be collected from the seashore. Finds of *Pinus* (pine), *Quercus* (oak), *Picea* (spruce), and *Larix* (larch) on Orkney and Shetland are probably all driftwood and many of these species can still be found when walking storm beaches today (author's observation). At Birsay, Donaldson (1986c) suggested pieces of *Alnus* (alder), *Quercus* (oak) and *Pinus* (pine) may all have been collected from local storm beaches. Of the possible species arriving by this method, *Picea* (spruce) probably originated in North America or Norway, *Pinus sylvestris* (Scots pine) from the Scottish mainland, and *Larix* (larch) from Scandinavia. However, archaeological finds on Orkney of species such as *Salix* (willow), *Betula* (birch) and *Corylus* (hazel) probably represent locally growing low lying scrub vegetation (C. Dickson 1994).

1.4.2.2: Evidence for Driftwood and Long Distance Trade:

Picea has been identified from eighteen sites in the Northern and Western Isles of Scotland, and is not a native species (J. Dickson 1992). These eighteen sites include the Pictish and Viking settlements at Saevar Howe, Orkney (C. Dickson 1983a) and finds from the 16th century house at Kebister, Shetland (C. Dickson 1999b). Both *Picea* and *Pinus* could also have been imported during the Norse period for construction purposes. At Brough of Deerness, very small fragments of carbonised *Salix* (probably native willow) were found, together with *Alnus* (alder) which probably arrived as driftwood (Morris and Emery 1986). The excavations at Tuquoy, Orkney, produced finds of *Larix* (larch) and *Picea* (spruce), which were found to contain boreholes produced by marine molluscs, providing fairly unrefutable evidence that these timbers arrived as driftwood (Owen 1993: 332). However, of more economic importance were the finds of ready cut and shaped

Pinus (pine), imported to provide building materials. The long distance transport of timbers for use as building material has relevance across the whole sphere of influence of the Norse in the North Atlantic. Large quantities of raw materials were transported on the sea routes to the treeless landscapes of Iceland and Greenland during the Norse period.

Excavations at the Viking settlement of Argisbrekka on Eysturoy (Faroe Islands) produced abundant quantities of driftwood including spruce, larch and white pine, believed to be of Siberian origin, which were utilised structurally in house construction and for the manufacture of household utensils (Malmros 1994: 552). Oak (*Quercus*) was probably deliberately imported for use in house building. Species present on the site which were probably growing locally included *Juniperus* (juniper), *Betula* (birch), *Salix* (willow), and *Corylus* (hazel). Interestingly, rolls of birch bark were also found at the site and may have been used as roofing material (Malmros 1994: 553). Wooden artefacts included a turned plate of *Alnus* (alder) wood, and a knife handle of *Fraxinus* (ash). The Faroe islands represent an interesting case displaying an area where the over-exploitation of woodland resources and the pressures caused by grazing animals in the past have prevented woodland regeneration and contributed to the deforestation visible today.

The series of excavations at The Biggings, Papa Stour, Shetland, produced some very rare finds of timber flooring, constructed of planks with joists and beams. Crawford and Ballin Smith (1999) dated this floor to the late 10^{th} or early 11^{th} centuries AD, and suggested that when suitable timbers were available (perhaps even imported with a particular construction in mind) then traditional Scandinavian style building methods would be used. *Pinus sylvestris* (Scots pine) was found throughout most periods at The Biggings, and it has been suggested that these pieces were imported from Norway or Mainland Scotland, as it is not a species native to Shetland. The finds of *Quercus* (oak) may also have come from southern

Norway, along with silver birch (*Betula pendula*), (C. Dickson 1999a). Oak was unlikely to arrive as driftwood as it is a dense hardwood and would not readily float over a large distance, therefore it is more likely to represent an imported species. Birch bark, probably utilized as roofing material, was also found at The Biggings. The closest ethnographic parallels available for this use are to be found in Norway and the Faroe islands, where birch bark is used beneath roofs constructed of turf to provide both waterproofing and insulation (Crawford 1985). Other imported woods found at the site included beech (*Fagus*) and ash (*Fraxinus*), probably from Scandinavia, whilst other trade links were suggested by finds of bark fragments of cork oak (*Quercus suber*) a native of the western Mediterranean and Portugal (C. Dickson 1999a). It is difficult to prove conclusively whether a species was imported or arrived as driftwood unless it contains boreholes caused by marine ship worms, e.g. *Teredo* sp. which indicate the wood may have been in seawater for some time.

1.4.2.3: Evidence for Native Species:

By the Iron Age the presence of scrub woodland on Orkney seems to be reduced to alder, birch, and willow (C. Dickson 2000). From the Iron Age settlement phases at Howe, C. Dickson (1994) identified over 1000 grammes of carbonised *Salix* (willow). The later Pictish phases at Howe also produced *Alnus* (alder), *Fraxinus* (ash) and *Sorbus* (rowen) charcoal. On Papa Westray, Orkney, Crone (1998) found a similar range of species, albeit in much smaller quantities, during the excavations of Iron Age and later features at St. Boniface. Very small amounts of carbonised willow, hazel and birch were recovered, and their low frequencies probably reflected the lack of trees on the island, whilst other species such as spruce and pine were probably driftwood (Crone 1998: 162). Similarly Green (1968) recorded alder, Scots pine and willow charcoal from the Iron Age phases at Clickhimin Broch, Shetland, although the pine was probably driftwood from the Scottish mainland. The Iron Age settlement phases at Kebister also showed the exploitation of available scrub woodland resources, with birch, hazel, willow and alder charcoal all identified (C. Dickson 1999b), although again other finds of oak and pine probably represented either imports or driftwood.

A very rare find of a waterlogged pit containing wooden artefacts and roundwood pieces was discovered during the excavations at the Early Norse settlement at Tuquoy, Westray, Orkney. In the main, most of this wood, such as pine and spruce, appears to have either been imported or arrived as driftwood (as discussed above), but a small quantity of the wooden fragments probably reflects locally growing species. Possible native species identified from the pit were *Salix* (willow), *Betula* (birch) and *Corylus* (hazel) (Owen 1993). Interestingly all of the willow fragments were either twigs or branches which had been shaped into twine possibly for the manufacture of household objects or roofing material (Owen 1993: 331). This has parallels in the Late Pictish / Early Norse material analyzed from Birsay Bay where the bulk of the charcoal recovered was identified as willow twigs and branches of 1-2cm diameter and smaller (Donaldson and Nye 1989: 262). A trace presence of willow was also found in one sample from Papa Stour, Shetland (C. Dickson 1999a). Ethnographic parallels exist for the manufacture of domestic and fishing baskets from tree roots (Fenton 1978: 262) and with willow being fast growing and malleable it probably played an important part in everyday life in the Northern Isles.

Archaeological sites from Caithness exhibit a similar range of scrub woodland species to those found on Iron Age and Norse period sites in the Northern Isles. At Freswick Links, Nye (1995) found evidence for birch-hazel woodland and willow scrub, with pine, alder and a little oak also present as charcoal.

1.5: Wild Resources: Ethnographic Studies and Archaeobotany in Northern Scotland:

1.5.1: Environmental Archaeology and Ethnographic Studies:

The use of ethnographic parallels has greatly enhanced the understanding of Northern Scottish archaeology. In particular the works of Fenton (1976, 1978) and Firth (1974) have influenced the studies of many environmental and archaeological researchers in the Northern and Western Isles. These documents provided an interesting record of everyday rural life in the Northern Isles, and have greatly expanded our knowledge of traditional crafts and farming methods, such as the infield - outfield system, utilised in the recent past. The use of wild plant resources as raw materials for numerous purposes, including: construction and roofing materials, fuel stuffs, manure, weaving and basketry, etc. has been closely documented by Fenton (1978) and more recently recorded by Holden (1998). An integral part of the research for this thesis concerns the archaeobotanical implications that can be implied from the study of ethnographic data. In particular chapter 1.5.6 discusses the re-cycling of material around farmyards and the difficulty this poses for archaeobotanists searching for 'laws' governing patterns of deposition in plant remains (e.g. Hillman 1981, Veen, van der 1989).

Many researchers have utilised ethnographic data in the pursuit of patterns and answers to archaeological questions. Whilst data of this kind can be invaluable one should always beware of projecting 18th / 19th century practices too far into the prehistoric past, particularly with regards to land use, division of labour and management of crofting areas. The historian and Shetland archivist Brian Smith provided stark warning of this in ***Toons and Tenants*** (2000) with regard to the relationship between the fishing industry and farming practice. Severe fevers and famines afflicted Shetland in the 1600's, local governments collapsed, leaving landowners in charge of law and order, and as a result of the failing economy, German merchants ceased to trade with Shetland. Within a small number of years the ownership of land was in the control of several merchants, who bought bankrupt estates and devised fishing tenure as a means of binding their tenants to the land (B. Smith 2000: 70). In this way tenants who would normally undertake a mixture of fishing and crofting were effectively forced to fish full-time to pay rent to their merchant landlords. The economic reliance upon fish continued into the 1900's with the herring fisheries, and although the relationship between landlord and tenant had changed by this point, the perception of Shetland as a society of fishermen had become indelible. Bigelow (1992: 18) too warned of the assumption that Shetlanders have always been 'fishermen who farm', when the production of surplus for exchange is a peculiar factor of historic period economies, but should be seen as distinct from prehistoric economic subsistence patterns.

Irvine and I. Morrison (1987) also warned against the reliance upon stereotypes of 'traditional folk life' which in many cases rely upon the memory of recent generations. In archaeological terms it is important to be aware of these 'traditions' and not allow the economics of the recent past to effect our interpretation of the relationship between fishing and farming in prehistoric societies. This is particularly relevant to environmental archaeology where data interpretation is based upon the recovery and quantification of biological remains, including cereal grain, animal bone and fish bone.

1.5.2: Optimizing Resources in a Marginal Environment:

The deliberate gathering of wild plant resources from the surrounding area of a settlement would provide the inhabitants with highly valued raw materials. The plant remains discovered on many Scottish sites reflect the need to maximise the collection of wild resources in order to sustain life in often very marginal conditions. The issue of marginality in archaeology has been discussed by Coles and Mills (1998); they emphasised the need for study of the inter-relationships between environmental, economic and social systems, rather than taking an environmentally deterministic approach. Bond's study of the economic evidence from Pool showed that the environment of Orkney was not so marginal as to be unresponsive to changes in subsistence patterns between the Pictish and Norse periods (Bond 1998b: 88). Equally, cultural and political marginality in modern times should not be transposed onto the past, and social responses to environmental marginality can be extremely unpredictable (Armit 1998: 31).

In the far north of Scotland and on the islands, optimizing resources would have involved the sustained exploitation of peat and heath habitats, for fuel and pasture, and the use of coastal resources for seaweed, shellfish and fishing. Naturally occurring local plants were used for various purposes such as fuel, food, roofing and building construction, packing materials, bedding, basketry and weaving. In this section the use of these materials in the past will be discussed, based upon ethnographic sources and the evidence discovered from archaeological excavations. A consideration will also be made of the potential for recognising the preservation of these materials on archaeological sites, and the implications this has for the range of species recovered from archaeobotanical assemblages (e.g. C. Dickson 1998).

1.5.2.1: Peat, Turf and Dung:

1.5.2.1.1: Introduction:

Peat and heathland environments form a major part of the landscape of the north of Scotland and the Northern Isles. Indeed, approximately 10% of the land area of Scotland as a whole is covered by peat at the present time (Price 1983), although this figure would have undergone fluctuations at various times during the past. Peat is defined as:

'...a surface organic layer not less than 30cms thick and containing 80% organic matter (dry weight)',

(Price 1983: 7). In regions with few trees or other obvious sources of fuel or building material it is perhaps understandable how peat and turf first came to be used. In Orkney the Norwegian Earl Einar Rognavaldsson became known as 'Torf' Einar in the Orkneyinga Saga, apparently for his innovative use of peat as fuel at 'Torfness' (Tarbet Ness), Dornoch Firth, firewood being extremely rare (Palsson and Edwards 1981: 29). This example serves to show the value placed by the Norse upon peat as a collectable, controllable commodity. The use of peat throughout the Iron Age and Norse periods is attested by various archaeobotanical and soil thin section studies. These include C. Dickson's work at Howe (1994: 137), Bond's analysis from Scatness (1998a: 83), Nye's work from Freswick (1995: 224), and Carter's at Upper Scalloway (1998: 100), amongst numerous others.

1.5.2.1.2: Fuel:

Fenton (1978) provided a thorough description of both the uses and control of peat and turf in Orkney and Shetland, during the recent past. Peat was a valuable and highly regarded commodity, which, although fairly widespread, would require an estate owner's permission to be cut. In addition the availability of fuel forms an important limiting factor upon the extent of human settlement and activity (Carter 1998: 99). Peters *et al* (in press) demonstrated the use of well-humified peat as a major fuel source at seven sites on Lewis. Mosses and peat areas served a number of purposes, and in addition to being cut for fuel were often used as pasture for horses, cattle and geese (Firth 1974: 2). Deep areas of peat produced dark blue turves, considered the best for fuel as they burnt slowly and reduced down to white ashes (Firth 1974: 2). In many cases during the 18th - 19th centuries this kind of peat was sold, leaving the local population with the rough, turfier or sandier peats (Fenton 1978: 217).

Ethnographic sources indicate that mossy turf gave out a great heat and a strong sulphurous smell, producing ashes of a deep terracotta colour, whilst light spongy peats were the least favoured as these ignited easily, producing white ashes, and quickly wasted away in the fire (Firth 1974: 2). Peat was cut with a tusker or a moor spade depending upon its depth. Sandy, shallow peat could quite easily be cut with a spade, although this had the result of leaving the moorland barren and unproductive (Fenton 1978: 220). Deeper peat required a tusker, and once cut the peat was laid out flat on the surface of the heather to dry, and subsequently stacked in small groups before being formed into a larger herring-bone stack (Fenton 1978: 221). **Plates 2** and **3** were taken by the author in 1998 and show this process still taking place on Eday, Orkney at the present time.

Peat and turf could be burnt directly on a household fire, used as fuel for a corn drying kiln in cereal processing, or converted into a form of 'peat charcoal'. Peat charcoal was produced for smelting purposes in Orkney and Shetland. It was 'made' by digging a wide shallow pit (approx. 180cm diameter by 36cm deep) in dry ground, and placing subsequent layers of peat into the hole to form a cone-shaped heap which was then set alight. This was allowed to burn for about two to three hours after which it was covered with earth to cool (Fenton 1978: 237). This practice may explain the appearance of friable burnt vesicular material on Iron Age and later sites. Tylecote described peat charcoal as light and very brittle, of a blue-grey appearance, and stated that it produced less heat than coal, but was a cleaner product to use for smelting / smithing processes (Tylecote 1986: 225). The friable burnt organic material (labelled 'burnt vesicular (coal or other?)' in the results tables) recovered from Setters and Soterberg, Unst, during the course of the research may represent material such as described. Church and Peters (*in press*) have demonstrated that fires using peat as a main fuel source exhibit very poor preservation and carbonisation conditions for plant macrofossils, which may explain the highly vesicular nature of some cereal grain recovered from hearth contexts.

1.5.2.1.3: Building Materials:

n addition to fuel, peat and turf were also used for construction purposes, and as indicated by Buckland *et al* (1993: 510) the lack of suitable building timber in many Norse settlement areas greatly affected the types of construction techniques that were adopted. Turf could be formed into house walls by stacking interlocking pieces into a herring-bone pattern, with this construction often placed upon a foundation of stone to prevent it sinking into the ground. Examples of this have been well documented by Buckland *et al* (1993) in Norse Icelandic house sites. Turf used as building material is generally known as fale, fail or feal in Scotland (Walker and McGregor 1996: 12). Turf was also used as a form of thatch for roofing, and could be stacked between wall layers to provide insulation.

During the analysis of the archaeobotanical remains from the Norse buildings at The Biggings, Papa Stour, C. Dickson (1999a) recovered a variety of plants of grassy and heathy places, which she interpreted as indicators of turf material. Highly organic heathy turf used as fuel to supplement peats may result in the remains of heather charcoal, carbonised seeds of heath and grassland species, and fragments of burnt peat becoming incorporated in hearth settings on archaeological sites (C. Dickson 1998: 109). C. Dickson (1999a: 114) also recovered large amounts of birch bark from The Biggings, and suggested - based upon ethnographic sources recorded for the Faroe islands in Johansen (1985: 22) - that the roofs at The Biggings *stofa* probably consisted of layers of birch bark with turf laid over the top. This is slightly different from other cases in Scotland, where turf is usually used either as the basal layer, with other materials placed over it, or as the sole roofing material (Holden 1998: 22). On sheilings and outhouses turf was usually laid vegetation side up, forming a kind of 'living turf structure' (Holden 1998: 22), whereas in living quarters where turf was used as a basal layer, it was usually placed vegetation side downwards. This could result in smoke and soot blackened plant material effectively becoming preserved by charring, and may

Plate 3: Stacking peat to dry, Eday, Orkney 1998. (Photo: D. Alldritt).

Plate 4: Abandoned Farmstead, Marwick, Orkney Mainland, 1998. (Photo: D. Alldritt).

explain the presence of carbonised heath and peat land seeds on some archaeological sites. **Plate 4** shows the use of a combination of roofing materials on an abandoned farmstead in the Parish of Marwick, Mainland Orkney, with turf laid over a flagstone roof, supported on a wooden framework.

It was also possible that temporary benches were constructed within dwellings from stacks of turf, which would be used as seats until they crumbled away (Fenton 1978: 191). When the technique of 'fale and divet' was used for building, a thin layer of grass turf was inserted between each fale course (Walker and McGregor 1996: 14), and one could reasonably foresee seeds of grass land and heath land species being introduced into the archaeobotanical record this way. In either of these scenarios plant material would eventually become incorporated into the floor layers of a house, both during its occupation and further with its subsequent decay.

1.5.2.2: Cow Dung:

Peat, turf and dung were employed for many different purposes around a habitation, and were often mixed together. Firth (1974: 13) commenting on the construction of house walls in Orkney, offers a decidedly unsympathetic description,

'...plaster on the walls was of the coarsest description possible, and decidedly unsanitary, being composed of clay, scrubbs (husks of oats) and cow shaurn (cow dung)'.

Layers of peat would be placed on the floors of houses and byres as a substitute or supplement to hay (Buckland *et al* 1993: 518). This material, once combined with cow dung could be gathered and applied to a variety of purposes. The mixture could be molded together and applied to walls as packing materials as described by Firth, above. It could also be middened along with seaweed, for later use as fertilizer to be spread on agricultural fields, or in areas where peat and other fuel was scarce it could be used as fuel for the hearth. Fenton (1978: 207) documented the use of cow dung for fuel, in particular on the islands of Sanday and North Ronaldsay, Orkney, where peat was scarce. Dung was collected from the cattle byre or from pasture and dried out before being burnt, and it was often mixed with straw or turfy earth to form 'coo's scones' (Fenton 1978: 208). The movement of material and recycling of material around the farm (see **fig. 9** presented below) and the implications this has for the interpretation of archaeobotanical remains will be discussed further in chapter 1.5.3.

1.5.2.3: Heather and Other Heath Plants:

Plants belonging to the Heather family (Ericaceae), such as *Calluna vulgaris* (Ling) would have been used quite commonly in the past for bedding and flooring material and for thatching. Donaldson and Nye (1989) also recorded the use of heather for dyeing, fuel and in ale production. Fenton (1978: 260) recorded a strong tradition of basketry and weaving in the Northern Isles, often using heather binding or straw from black oats to make a *cubbie* (heather basket) of various sizes. Other styles and sizes of baskets were woven from a variety of plant fibres, including dock stalks, bent grass, mugwort, sedges and various twigs. A fragmentary basket survived from the Later Iron Age deposits at Howe (C. Dickson 1994) constructed of heather stems and young shoots. Ethnographic studies reveal that other heathland plants were also used, and Fenton (1978: 264) noted that shoots of *Empetrum nigrum* (crowberry) made particularly strong ropes to be used for thatching. Rushes, known as 'Floss' (*Juncus effusus*), bent or marram grass (*Ammophila arenaria*), willow, and heather were all used for making simmens (ropes), mostly for holding down thatch on house roofs and also for making *kishies* (large baskets used for carrying peats).

Often carbonised heather roots and twigs, and other seeds of heathland species may become incorporated into archaeological deposits as an indirect result of the collection of turves for fuel, as discussed in section 1.5.2.1.3. C. Dickson (1994, 1998) tested this hypothesis by collecting modern turves from an Orkney heath, breaking them down and then sieving them in the laboratory to establish the types of seeds that would be recovered. It was found that numerous fragments of heather including stem, roots and seeds, sedge rhizomes, and seeds of crowberry, bell heather, sedges, tormentil and woodrush were all present in the sample (C. Dickson 1994: 137). This illustrated that the gathering of turves for various purposes as illustrated above, be it for building or fuel, could result in the eventual deposition of these species into the occupation layers on a site.

1.5.2.4: Seaweed:

Seaweed is a valuable source of manure for fields, containing more nitrogen and potassium than animal manure, and is particularly good for sandy soils which are potassium deficient (Fenton 1978: 274). It can also be used as food for animals and man. Seaweed can be divided into two broad groups, based upon the ease with which it can be collected. The first group consists of types that grow on the shore, or that are washed up during winter storms, which can be fairly easily gathered from the beach, and the second group consists of those which are permanently underwater, requiring specific cutting tools for their harvest (Baldwin 2000: 122). Fucoid types (e.g. wracks) and *Laminaria* (tangles) were commonly gathered from storm beaches, whereas some types of tangle and oarweeds would require wading into the sea and cutting (Baldwin 2000: 124). On the Orkney island of North Ronaldsay, the sheep are contained on the beach by a boundary wall, and exist by consuming seaweed. This grazing pattern does not seem to harm the animals in any way, indeed it probably provides them with a highly nutritious diet. Seaweed was also used in the manufacture of lye, mostly used for cleaning sheep fleeces, and for making soap (Singer *et al* 1956). Lye was made by burning seaweed and percolating water through the ashes. To create soap one added lime and fat or oil to the mixture of water and ashes, and boiled it all together. In addition the ashes from seaweed could also be used in glassmaking.

Fenton (1978: 65) recorded the use of stone lined pits known as 'kelp kilns', where seaweed, in particular *Fucus* and *Ascophyllum*, was burnt and reduced to alkaline ash (kelp), often with peat or straw added to the dried seaweed to make it burn more effectively. This formed a major industry during the 19th century in Orkney and Shetland, requiring a large amount of labour, to the extent that fishing and farming became somewhat neglected. At The Biggings, Papa Stour, and on the Brough of Birsay, Orkney, carbonised seaweed fragments were found in shallow pits, dug into clean sand (C. Dickson 1999a, Hunter 1986). At both these sites the seaweed was most likely being burnt for its ashes. A thorough discussion of the production of kelp is given in Thomson (1983).

Seaweed produced particularly good manure if it was allowed to ferment, and this process was best facilitated by the production of a midden. Byre manure made up of cow dung and peat, was layered onto the farmyard midden along with seaweed, ashes, and sometimes mossy turf to form a compost for the fields. Straw formed an integral part of manure derived from cattle dung in byres, as this was necessary to soak up the water content of the manure (Fenton 1978). Archaeobotanical remains of material originating as byre manure may therefore contain a mixture of wild grass and heath indicator weeds as well as dung, straw, peat and ash remains. Fish and fish offal was also sometimes added to this mixture during manure preparation (Fenton 1978: 282). In Sutherland, Baldwin recorded the use of a mixture of seaweed and dung, or seaweed alone, on crops of oats and potatoes, and in hay fields, from the 1800's to 1900's, and also the use of slag as a dressing on hay fields from the early 1900's (Baldwin 2000: 127).

1.5.3: Implications for Archaeobotany:

The collection and uses of natural resources, gathered from environments surrounding settlement in the rural farming areas of the north of Scotland, has wide ranging implications upon the deposits that are recovered during archaeological excavation. The interpretation of structures and occupation surfaces depends upon an understanding both of building technology and materials used in the past, and upon often extremely complex site formation processes. Further to this, the interpretation of archaeobotanical material recovered from these sites requires recognition of the subsistence practices that may have been used in early farming communities. Plant material was extensively collected and put to many uses in the past, as can be glimpsed from the ethnographic records described above. The practice of middening, recycling material from different sources, and general movement of materials around the farm poses many problems for archaeobotanical and other palaeoecological interpretation, as indicated by Buckland *et al* (1991, 1993), see **fig. 9**.

In areas with few natural fuel resources other than peat, recycling of combustable material from corn drying kilns, byres and hearths would have been an essential task. Similarly regions with poor soils or that were farmed intensively would be reliant upon the manure produced from midden materials. Add to this the fact that many houses and byres were also constructed out of plant material, such as turf for roofing and mixtures of dung, straw and peat 'mortar' for packing between building stone, and the potential sources of plant remains found during excavation becomes vast. An interesting indicator of the scale of recycling that could take place around a farm was given by Fenton (1981) in his description of the 'leepie-hole' in Shetland. The hole would be located alongside the hearth place in both longhouses and byres, and would be filled with ashes from the fire and other domestic refuse, which could include the waste from corn drying kilns. When this was full it would be transferred out onto the midden for fermenting with cattle dung, straw and seaweed, prior to being applied as fertiliser on the fields. Firth (1974: 22) stated,

'...though the barn floor was only of clay it was kept scrupulously clean. In this the farmers of the olden time far surpassed those of the present day',

The barn areas were probably clean because waste material was regularly swept out onto the midden.

Analysis of midden materials preserved as archaeological deposits can provide valuable information on the scale of recycling of natural resources around a settlement. It can also provide some indication of the economic forces in action at the time, in terms of the type and amount of material that has become incorporated. As already stated this can include cereal grain, peat and heathy turf fragments, animal manure, seaweed, fish and animal bone. Plant remains recovered from occupation surfaces and other contexts within structures may relate to activities taking place within that particular area, for instance chaff fragments found as a result of cereal processing. Equally, given the considerations described above, plant material may have arrived in a particular context, or on the site as a whole, as an indirect result of the collection of other resources. In the past many concretions of material such as burnt peat and dung, peat charcoal and other vesicular burnt materials may have been overlooked or mis-interpreted during the excavation of settlements. Indeed, in some cases non-carbonised turf and peat fragments would simply decay leaving only the more resilient seed, heather and geological component to become incorporated into the soil matrix (e.g. C. Dickson 1999a). Studies of the ethnographic uses of plants therefore provide an extremely valuable tool in the interpretation of archaeobotanical assemblages. In chapter 8 the interpretation of middening and manuring practices taking place on the study sites will be largely reliant on comparisons with the ethnographic material discussed above.

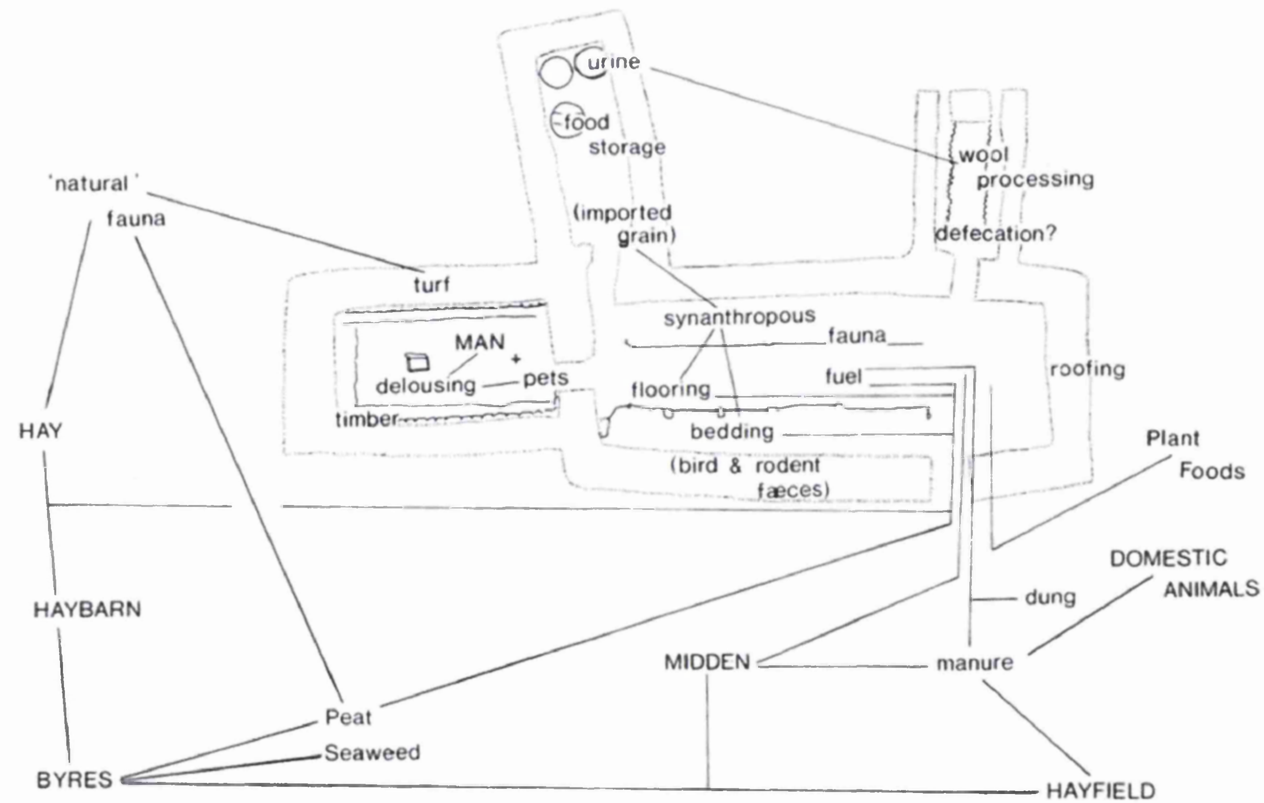


Fig. 9: Interpretation of movement of material around the Norse farm (based upon the invertebrate fossil record) (Buckland *et al* 1993: 513).

Chapter Two:

2: Aims, Objectives and Methodology:

2.1: Aims and Objectives of the Research:

2.1.1:Introduction:

The research presented in this thesis began in 1994 with a literature search and an initial desk based assessment to ascertain the potential for the discovery and excavation of new archaeological deposits relating to the Pictish / Norse interface. The author also approached the directors of ongoing excavations within Glasgow University Archaeological Research Division in order to assess the potential of existing archaeobotanical assemblages and to propose means by which further research assemblages could be generated. The aims of the research are discussed below in chapter section 2.1.2. In sections 2.1.3 and 2.1.4 a consideration of the rationale behind the choice of excavation sites, including their locations and dating, will be given. The objectives of research into the economics and environment of the Late Iron Age to Norse periods encompassed by the research sites will then be discussed in 2.1.5.

2.1.2: Aims of the Research:

The main research aims of the thesis can be summarised as follows:

1) The identification of new and ongoing archaeological excavations which could be used to attain environmental material related to the Late Iron Age and Norse periods in Northern Scotland and the Northern Isles. In particular, the thesis

would seek to concentrate on sites with good archaeological preservation covering the Pictish / Norse interface.

2) The initiation and integration of a research-led environmental sampling programme developed around on-going excavations, and incorporating new sites as the opportunity arose. This was in order to provide a modern multi-faceted approach to sampling strategy, which would allow a range of environmental and economic questions to be addressed. Key factors in this would be the presence of the author on-site throughout the excavations and, where possible, processing of all the samples by the author or by assistants trained by the author. The attainment of contextually secure and stratigraphically significant bulk environmental samples would form the main concern of the on-site specialist. These samples would primarily be for archaeobotanical purposes but flexibility would permit other types of remains where encountered to be sampled.

3) Where existing (pre-excavated) archaeobotanical assemblages were available, an assessment of the archaeological and environmental potential would be undertaken, and where judged suitable the assemblages would be analysed and the resulting data incorporated into the thesis.

4) Identification and analysis of all carbonised plant material including charcoal recovered from the sites. In addition to this, where possible (and if not already done by other specialists), a consideration of the other catagories of environmental material recovered from the sites, including mammal bone, fish bone and marine shell was undertaken. This aimed to develop an overview of the economic and environmental considerations relevant during the Late Iron Age to Norse periods. Speciation of animal and fish bone was not carried out as this was outwith the author's expertise, however these catagories of remains were listed (counted and weighed) for comparative purposes. Gross

quantification of marine shell (counting and weighing) was also made, with species identifications included where possible.

5) A comparison of two different environmental processing methodologies for the recovery of carbonised plant remains. Where possible (given differences in soil type, availability of samples etc) a comparison would be made between the recovery of material processed by flotation and of material processed by laboratory methods.

2.1.3: Geographical Selection of the Research Areas:

It was initially intended that the research would concentrate only on the Orkney and Shetland isles, and be closely focused on the Pictish / Norse interface period, a time of distinct cultural change in this region (e.g. Morris 1985, Hunter *et al* 1993, Bond 1994a). As the research progressed it became obvious that such a closely defined analysis, in terms of both date and geographical area, would be difficult to attain within the limited time frame available for PhD research. The excavation by GUARD of two potentially Pictish / Norse dated sites on the north coast of Scotland provided an excellent opportunity to widen the geographical scope of the thesis to include Caithness and Sutherland, areas of limited research and excavation within the Norse period (J. H. Barrett 1992). Indeed previous to this time Freswick Links (Morris *et al* 1995) and Robert's Haven (J. H. Barrett 1992) were the only known Norse dated settlement sites to have been excavated in Caithness, when this thesis began, and even less was known about Sutherland during this period (e.g. Pollard 1996b). The GUARD site at Smoo Cave, Durness, Sutherland had already been excavated when the author became involved, and the samples had been processed. The material from this site is presented in chapter 4. Investigations at the site at Marymas Green, Dunnet Links, were proposed as part of Highland Archaeology Week (September 1996). This excavation allowed the author to be involved as both excavator and on-site specialist, thus enabling a research led sampling strategy and post-excavation analysis of the environmental material to be developed. This material is presented in chapter 3.

Island biogeography, and the limitations it imposes upon local and regional subsistence economies, were first discussed with relevance to Northern Isles archaeology by Small (1969) and Bigelow (1985, 1992). These ideas were further developed by Bond (1994a), and have since been the subject of more recent research (H. Smith and Mulville *in press*, Bond 2002). The isolation and environmental constraints imposed by island living often mean that the pressures to adapt are at their greatest, and this can be applied to both human life and to the flora and fauna (Johnston 1999: 2). The study of island environments and economies presents a microcosm of human settlement and adaptations to marginal conditions (Bond 1998b, H. Smith and Mulville *in press*). With this in mind, and whilst undertaking the analysis of the Marymas Green and Smoo Cave material, the author continued to seek out and identify suitable sites and assemblages in the Northern Isles.

During 1996 the Shetland Amenity Trust were developing a research design concentrating on Viking settlement on the island of Unst (Turner 1996 unpublished), based around the large quantity of proposed Viking style houses surveyed by Hansen (1995a and b). In 1996 Professor C. D. Morris initiated the development of VESARP (Viking and Early Settlement Archaeological Research Project), which directly involved the Department of Archaeology, University of Glasgow in undertaking new research and excavation in the Shetland isles. With the encouragement and under the supervision of Professor Morris the author supervised the on-site environmental programme during 1997 at Soterberg, Unst (presented in chapter 6) and also undertook an analysis of previously sampled material from Belmont, Unst (presented in chapter 7). During the course of this research the author continued to excavate in the Shetland islands, supervising the 2001 environmental programme for Bradford University at Old Scatness, and excavating for EASE archaeology unit at Cruester burnt mound, Bressay, and at the site of Burland, Trondra. It was by working closely with EASE that the author was able to rapidly procure a large assemblage of carbonised plant material from Burland, Trondra in 2002, when it became apparent that more archaeobotanical data was required for the thesis. The material from Burland is presented in chapter 5.

2.1.4: Chronological Considerations:

Why choose to study the economy and environment of the Late Iron Age to Norse periods? As already described in chapter 1.2 the period from the mid-first millennium AD to the arrival of Scandinavian settlers' saw a period of fundamental change in northern Scottish societies (e.g. Dockrill 2002). By the Late Norse period the economy of this area had changed beyond recognition and become an important part of the wider 'Medieval' world of trade and exchange (Bigelow 1992, J. H. Barrett 1995).

C. Dickson (1994), Simpson *et al* (1998) and Smith (1994) amongst others have argued that considerable economic and environmental changes took place during the Late Iron Age. Many phenomena initially believed to be of Norse influence have been shown to have Iron Age precedents. Recent research in the Northern Isles has suggested an increase in the scale and complexity of arable production through time, with several major changes in fertilising material becoming particularly apparent in the Iron Age, which appear to reflect changes in the economic base (Guttmann 2001). During the Iron Age there appears to be a major expansion in arable agriculture, with a concurrent change from the use of domestic midden material as fertiliser to the widespread use of animal manures (Simpson *et al* 1998). Late Iron Age arable intensification and expansion can be tested by the collection and analysis of suitable archaeobotanical data.

2.1.5: Overall Research Objectives:

It was believed that the excavation of new archaeological material for the purposes of this research would result in the production of large quantities of environmental data. As stated by Boyd (1990 for 1989), within a framework of integrated archaeological science, overall research objectives are essential in terms of site interpretation and optimising the information available from environmental samples. In the words of M. Jones:

"Our strength as an academic discipline lies in the questions we can answer..., not in the rules that we follow or the approach that we take, but instead in the destination to which we aspire".

(M. Jones 1990 for 1989: 71-72). Arguably scientific documents tend to emphasise technique rather than application (Bell 1992: 21), although this inbalance is being remedied by more recent integrated scientific research agenda's such as that at Old Scatness (Dockrill 1998: 62, 2002: 154).

In the following the five objectives of this PhD research are discussed:

1) A contextual analysis of the environmental data from the excavated sites.

The integration of environmental material into overall archaeological site interpretation has become an increasing concern in recent years. Many environmental archaeologists have attempted to show that environmental data, no matter how small, can be used for a wide range of analysis including site formation processes (Green and Lockyear 1994). However, amongst other specialists there still remains a distinct awareness that if they are not present on-site their material will be biased by poor recovery techniques, lack of sampling strategy and lack of contextual detail (Gamble and Bailey 1994: 81). Indeed, after some 20 years of research in England, Scotland and Iceland, Buckland concluded that most requests made to environmental specialists by archaeologists were still of the "what shall we do with this bag of soil" variety, reflecting in part a reluctance to accept the increased financial 'burden' of correctly costing an integrated palaeoecological programme (Buckland 1992: 6).

As Bell (1992: 25) suggested, the environmental archaeologist should be present as much as possible on site, and ideally be involved in the day-to-day running of an excavation project. The author strongly agrees with this and endeavoured to be on-site as much as possible, as supervisor and often also as excavator during the digging of the study sites. The material sampled and analysed for the purposes of this research was, as far as it was in the author's control, recorded, excavated and processed following the stringent guidelines described in chapter sections 2.2.2 and 2.2.3. Since one of the main aims of the research was to initiate an extensive environmental sampling programme focusing on individual, closely defined, contexts, stratigraphic integrity would provide the foundation upon which post-excavation analysis of the carbonised plant material and other environmental data would depend. Together this would enable an integrated environmental research programme to be developed as further sites were excavated and sampled.

2) Changes in crop regime and agricultural intensification in the second half of the First Millennium AD.

Recent research has suggested that the Later Iron Age in the north of Scotland and the Northern Isles saw a period of agricultural intensification, in particular with the expansion and development of arable agriculture and with the introduction of new crop species (C. Dickson 1994, Bond 1998b, Simpson *et al* 1998). The recovery and identification of archaeobotanical data from the research area will enable a thorough investigation into changes in the cereal crop economy occuring at this time. In particular, it was thought that a specific analysis of the weed and 'wild' flora accompanying cereal grain in these deposits may help to indicate the type of environments being exploited and the potential use of fertilisers.

3) The economic importance of wild resources: including peat, heath and maritime environments.

Ethnographic sources have illustrated the wide ranging utilisation of plant material and other wild resources, from environments such as peat and heathland during the past (see chapter 1.5). The littoral and marine environments also constituted an important resource for inhabitants living in the coastal regions of northern Scotland and the Northern Isles. Excavation of sites in these areas often produces large amounts of carbonised 'wild' plant material, and this should be incorporated as an important part of any investigation of sites in the North Atlantic. Equally the important economic role of fish resources has been established in a number of Norse North Atlantic contexts, with fish forming a key source of animal protein and a tradeable resource (J. H. Barrett 1995).

By addressing the issues of exploitation, control and management of wild resources, this research would attempt to integrate the various strands of environmental data available from the study sites, such as animal and fish bone, with the carbonised plant evidence in order to provide a more integrated palaeoeconomic interpretation. The relationship between cereal grain deposition and the occurrence of seaweed, peat and charcoal will also be considered. For example, was peat specifically used in corn dryers, whilst charcoal was reserved for industrial processes? Are there any discernable differences in the deposition of 'wild' resources and cereal grain across the study sites? Does this pattern vary dependent upon the type of site and contexts being analysed, for instance between settlement sites, midden deposits or metalworking sites? If so can specific activity areas be discerned by integrating the archaeological and environmental data?

4) The woodland resource: local and regional impact and evidence for woodland management.

Chapter 1.4 saw a review of the archaeobotanical evidence for past woodland environments. Studies into the environmental impact of climate and man in the north of Scotland and the Northern Isles have tended to focus upon pollen studies. Whilst this material shall be used for comparative evidence, the production of a new pollen diagram for the study area was outwith the scope and aims of this thesis. Rather the author intended to concentrate on the identification of the charcoal remains excavated from the study sites, in order to ascertain the species exploited by the site's occupants. This would then be set within a wider framework of trade and exchange, considering questions such as which wood species may have been traded, and which species could have arrived as driftwood. Further questions for consideration include, was it necessary to impose control over the use of potentially limited woodland resources during the Late Iron Age / Norse periods? Which subsequently leads to the important issue of the specific use of wood charcoal for metalworking. In areas of limited woodland was access to peat the defining factor in choice of fuel resource?

5) Changes in land use and subsistence patterns over time.

By analysing the deposition patterns of carbonised plant remains and other environmental material in midden and settlement contexts throughout the various study sites it may be possible to discern temporal changes in land use and subsistence strategies. In particular an examination of the weed flora and cereal grain presence in the samples may indicate changes occuring in arable and pastoral farming practices, perhaps also the use of more marginal land with increased settlement pressure in the Late Norse period.

A comparison of the archaeobotanical and fish / animal bone data is an integral part of this study, particulary with reference to depositional patterns within middens. By integrating the environmental and archaeological data it may be possible to answer questions of significant economic importance. For example, does the depositional pattern of midden material over time suggest a neglect of crop fields and a concurrent move to fishing in the Norse period? Or was a cereal grain economy of equal importance to a pastoral / fishing subsistence pattern? Can changes be seen in the types of cereals grown (as in point 2) and in their relative importance as an economic resource from the Late Iron Age to Norse periods? How does this reflect wider settlement patterns and the social manifestation of power and control over land and resources?

2.2: Methodology:

2.2.1: Introduction:

In this section firstly a discussion of the sampling strategy employed at the study sites will be given, considering some of the reasons for the selection of contexts to sample, and the need for consistency and relative efficiency in the employment of sampling methods. Secondly the methodology utilised for sample processing will be discussed, which included bulk sample flotation and laboratory sieving methods. Thirdly the identification criteria used to speciate carbonised cereal grain, weeds, charcoal and other non-botanical environmental material will be discussed. The thesis is not intended as a guidebook to the identification of carbonised plant or other material. However the relevent literature and comparative material which were used to aid identification of the research presented here will be discussed, and illustrations of the various plant remains discovered from the sites will be provided. Finally the methods of data presentation will be discussed.

2.2.2: Sampling Strategy:

2.2.2.1: Introduction and Overview:

Initial sample collection is one of the most important elements of environmental archaeology, and strict methodological criteria must be adhered to in order to prevent contamination of the samples and subsequent errors occuring in the data. It is essential that archaeologists working in the field understand why they are collecting various items of data, and why they are taking samples from particular contexts. As Orton (2000: 1) cynically observed:

"...one might note the existence of piles of 'samples' in dark corners of archaeological stores, whose main role seems to be to get in the way for several years, and then to be thrown away."

Sampling programmes should be geared towards addressing specific research questions, rather than taking random samples in the hope that in the future they may be useful.

During the course of the research for this thesis a number of different sites, with variations in soil types, quantity of stone, and deposition of carbonised material were encountered. These required the formulation of a number of different sampling strategies in order to optimise the recovery of carbonised plant and other environmental remains. However, despite these inter-site differences, the main aim of the overall sampling strategy was to recover a representative sample of charred plant remains from each secure and stratigraphically significant context. Where animal, bird, fish bone and marine shell were preserved the sampling strategy would also attempt to recover a representative group of these remains from secure and significant contexts.

In achieving these aims the environmental archaeologist is faced with two problems. 1) What constitutes a representative sample of plant remains? 2) How can this be achieved by on-site sampling? There has been much debate concerning this issue, which will be summarized only briefly here (Orton 2000 provides a broader theoretical / statistical discussion of sampling methods in archaeology than there is space for here; likewise Dincauze 2000, specifically for environmental archaeology, and Hastorf and Popper (1988) for archaeobotany). Van der Veen and Fieller (1982) suggested that for an accurate (to 98% within 5% confidence limits) representation of the species population as a hole, one should aim to get about 550 identifiable plant fragments per sample. Greig (1989) regarded this as a minimum and many archaeobotanists identify much larger amounts of plant remains per sample, particularly on sites in southern England. Van der Veen and Fieller (1982) also suggested an optimum sample size of at least 20 litres, whereby all or part of this would be processed to reach the desired quantity of plant material.

However, these 'ideal' figures are not easily transposed to Scottish archaeobotany. Archaeological sites can vary enormously, on some sites it may be necessary to process just a few litres to collect large numbers of fragments, on others only a few remains may be recovered even if the entire context / site is sampled (Greig 1989). Because sites vary tremendously in botanical representation, it is necessary to deal with each situation as an individual sampling problem (Toll 1988: 36). It is often impossible to attain this 550 fragment ideal for species representation, with many Scottish archaeobotanical samples containing only a handful of remains, resulting in an analysis based upon presence / absence of carbonised material in the samples (J. Miller pers. comm.). C. Dickson's (1994) analysis of plant remains from Howe produced less than 100 carbonised cereal grains in total from the most abundant phase, but this does not render this important study invalid, when comparisons can be made between intra-site phases and material from other sites. Dickson and Dickson (2000: 288) indicated that the sparseness of cereal grain on many Scottish sites meant that large or numerous samples may be required for site analysis. Green has also pointed to the importance of negative as well as positive evidence when interpreting archaeological site-based problems such as patterns of refuse disposal (Green 1979: 40), although the statistical interpretation of absence, in particular, should not be pressed (Dincauze 2000: 342). Indeed, whilst preservation by waterlogging can produce many thousands of remains, carbonised plant material is often preserved and present in much smaller quantities, so it is also necessary to consider taphonomic processes when sampling and interpreting environmental remains (Dincauze 2000: 331). Rather than obsessively pursuing an ideal quantity of species / fragments of bone, plant, shell and so forth, it is probably more important to sample strategically, and to carefully record exactly how sieving and sampling were conducted, so that inter-site comparisons can be made (J. H. Barrett *et al* 1997, Green 1979).

Strategic sampling practice employed during the course of this thesis consisted of targeting sampling areas, which were chosen (largely by judgement and experience of the author and various archaeologists involved) to maximise data recovery. "Judgement samples" selected from well-defined features which are dateable and productive have been shown to give an equally good recovery of information when compared with stricter mathematical approaches, such as sampling in quadrants (Greig 1989: 22). These sampling areas included: midden material, hearths and ashy or other charcoal rich deposits, and possible occupation surfaces or floor deposits. Areas of obvious charcoal blackening are often just ashy staining in the soil, and may not produce much material (Greig 1989): the author targetted darker sandy and silty type archaeological sediment as offering good preservation conditions for carbonised plant remains. Features such as drains and pits were also considered a high priority for sampling purposes, although these were only found at one site (Burland, Trondra).

During the research the author attempted to install a high degree of awareness of waterlogged preservation conditions amongst the archaeologists involved, and of the need to sample and sieve this material utilising different methods to those employed for carbonised material. However no suitably anaerobic conditions for the preservation of waterlogged material were encountered on the sites where the author was present. To this extent the choice of sampling areas could be said to be dictated by the means of preservation: i.e. the evidence was preserved by carbonisation therefore to optimize recovery one should investigate hearths, middens and so forth (Green 1979: 40). Individual site-specific strategies and sampling quantities are discussed in the relevant chapter for each site. However, in this section the overall sampling requirements and methodologies will be considered.

2.2.2.2: Sampling of Midden material:

Two of the research sites produced large quantities of stratified midden material to depths of over 1 metre. At Smoo Cave it was not possible to distinguish individual contexts within the midden (Pollard 1992), whilst at Marymas Green the boundaries were somewhat easier to define. Both these sites were sampled using a column cut through the deepest portion of the deposits in a continuous sequence. The material from Smoo was trowelled out from the section in spits, effectively producing a series of small 'bulk' style samples of c.2-5 litres, which were bagged and sieved by flotation. Other larger bulk samples of c.10-14 litres were also taken at this site. The author was not present at Smoo and therefore could not influence the methods employed. However, at Marymas Green, when presented with a similar midden 'problem' to that at Smoo, the author decided to use this 'bulk' column method, but observing stratigraphic boundaries, so that a series of contextually defined samples of c.10 litres each were taken. This was excavated through the thickest extent of the midden. In addition smaller column samples were taken utilising metal sampling tins from other areas of the midden section. Column samples are particularly useful for large homogenous deposits such as shell middens, but where layers or discrete features are concerned it is preferable to sample these using traditional excavation methods.

Thinner spreads of midden material encountered across the sites were sampled by bulk methods rather than in columns. This particularly applied at Burland, Trondra, where an abundance of ashy, peaty deposits, of varying thicknesses, were sampled. In addition to the recovery of plant material, these spreads were specifically sampled for evidence of metalworking in the form of slag and hammerscale, which are often missed during excavation due to the small size of the evidence.

2.2.2.3: Sampling of 'Structural' Contexts: including hearths and possible occupation surfaces:

Bulk soil sampling was chosen as the best rapid excavation strategy for obtaining maximum recovery of environmental data from 'structural' contexts within buildings, such as floor deposits, hearth places and ashy spreads. Discrete burnt spreads closely associated with hearth places were considered as particularly important in defining specific activity areas, for instance cereal drying / processing, domestic cooking, and industrial activities such as metalworking, taking place on site. Bulk samples representing the B.S. (bulk-sieved sample) category of Dobney *et al.* (1992) were taken from each archaeologically significant context, comprising a minimum of 20 litres of sediment per sample where this was feasible. Dickson and Dickson (2000: 287) also suggest a sample size of around 20 litres as being the most advantageous. In practice bulk samples taken during the research varied from 5 - 60 litres dependent upon the context and individual site supervisor when the author was not present. Indeed the adoption of the 10 – 14 litre standard sample size has probably arisen because this also happens to be the standard size of most buckets used on archaeological sites; it facilitates an easy sampling instruction to give to busy site directors, and is an economical amount to take in terms of processing and storage. Orton highlighted the problem of specifying the precise volume of soil needed to yield an assemblage of a required size, especially as the density of remains per volume is only apparent after the sample has been taken and processed (Orton 2000: 148).

Where bone preservation is noted during excavation, then sample sizes of 60 litres are preferred for thorough recovery of these ecofacts (I. Mainland pers. comm.). It is a fine balance between sampling sufficient sediment in order to recover significant quantities of data, and over-sampling to the extent that field, sorting and identification costs are prohibitive. For instance J. H. Barrett (pers. comm.) stated that if moderate or frequent quantities of fish bone were encountered then it was necessary to sieve large volumes of sediment in order to produce statistically meaningful data. However, if very little bone was encountered then it was not usually worth sieving large volumes of soil in order to attain occasional fragments.

Structural contexts specifically *avoided* during bulk sampling consisted of areas containing a high degree of mixing or contamination. In particular contamination in shallow features arising from topsoil and material 'trickling down' in hollows within wall fills (now or in the past) which would destroy the stratigraphic integrity of a sample. For this reason stony and heavily voided deposits were not sampled, and areas between and within walls were particularly avoided. The author has argued with numerous archaeologists over the value of sampling material from within wall cores. Many archaeologists believe that if these contexts are sealed below other contexts (sediment or stone) then they are stratigraphically secure. This ignores the fact that dry stone walling naturally has voids (and often root-holes from plants) where material not necessarily contemporaneous with the occupation of the structure can collect, and that these features may have been exposed to the elements for some time before being covered by subsequent deposits. In addition dry-stone walls are often attractive nesting and burrowing areas for small mammals and birds, which can introduce a range of contamination, including from droppings and often the bones of the animal itself when it expires. For these reasons the author has avoided sampling these types of deposits.

2.2.3: Sample Processing:

2.2.3.1: Introduction:

Two methods of sample processing were utilised during the course of the research. Large bulk soil samples were processed using a Siraf style flotation machine (French 1971), described in section 2.2.3.2. These samples consisted of the midden rich ashy silt from Burland, the heavy clay from Setters and Soterberg, and the silty midden material excavated in spits from Smoo. Bulk samples and column samples from Marymas Green, consisting of light silty sand were processed by washover-type techniques in the laboratory. This process is described in section 2.2.3.3. In order to compare the relative efficiency and recovery of material from bulk flotation and laboratory methods, a set of subsamples was taken from the Burland material during flotation. These subsamples were returned to Glasgow for laboratory processing and are discussed more fully in chapter 5.3.3.

2.2.3.2: Flotation of Bulk Samples:

2.2.3.2.1: Introduction:

Flotation is a relatively quick and efficient method for the day-to-day processing of large quantities of bulk soil samples taken during the course of an archaeological excavation. It can be used to process samples from a large range of soil types, although samples of sandy or silty and ashy type soils can be processed more rapidly than clay-rich soils. Sandy and silty type soils release carbonised material extremely quickly from their surrounding matrix. Recovery tests run on flotation systems have shown that different flotation equipment and methods produce varying amounts of damage, contamination, recovery and loss of plant remains, and also vary in the consistency of their results (Wagner 1988: 23). Experimental work by de Moulins (1996) has also shown that Siraf-style flotation tanks do not collect all the burnt fragments present in a sample. Indeed, in clay rich soils de Moulins demonstrated a loss of up to 50% of carbonised material. When chosing to process the samples utilising flotation methods it is important to consider these factors, and balance the potential losses against constraints of budget, time and efficiency.

Dickson and Dickson (2000: 288) also suggested examining a portion of the dried residue to check for any unfloated carbonised remains. The author feels this is a necessary practice as heavier fragments such as burnt peat and charcoal are often recovered from the residue and do not readily float. Total sorting of all the residues from the study sites was undertaken as a result of this, and to facilitate the collection of bone, shell and artefacts. In this section a description of flotation processing methodology shall be given.

2.2.3.2.2: List of Equipment:

1) Flotation tank.
2) Large sheet of plastic mesh of >1mm, cut to fit diameter of tank.
3) Metal Endicot sieves. Mesh sizes >1mm and >300μm were preferred.
4) Hose pipe.
5) Sundry equipment: bulldog clips, plastic sample labels (plant tags), blue absorbant anti-static laboratory paper, rubber gloves, paint-brush, waterproof marker pens, plastic bags, recording sheets.

2.2.3.2.3: Processing Method:

A metal flotation tank measuring approximately 1.20m in height and 0.70m diameter was used to process the bulk samples. This was constructed from a metal oil drum, sealed against rust using hammerite paint, and modified to allow water to be pumped in from one side via an on/off valve. **Plate 5** shows an example of this type of flotation tank, in this case in use by the author to process samples on Unst. The tank had a shelf cut into its top edge on the opposite side to the on/off valve and a small ledge attached, so that carbonised plant material and excess water could flow out at a steady rate into an attached nest of sieves. **Plate 6** demonstrates this point. A further valve was fitted 0.10m from the base to allow the tank to be emptied rapidly during operation.

The tank was emptied of silt and cleaned thoroughly between the processing of each different context to prevent cross-sample contamination. Similarly all sieves, meshes and brushes coming into contact with individual samples were also scrubbed clean. All samples processed by this method were either floated on their respective site or returned to the GUARD facility at Glasgow University. High standards of cleanliness were maintained throughout, in order to avoid the:

"Contamination by wind-blown plant material and abandoned remains of messy diggers' lunches..."

referred to by Dickson and Dickson (2000: 287).

The author set up the flotation tank using an internal plastic mesh of >1mm held in place with bulldog clips, with which to hold the sample, and external Endicot sieves of >1mm and >300μm sizes to catch the flot. The smallest Endicot sieve size used to process the samples varied slightly between sites: the author uniformly used >300μm, but when the Smoo cave samples were processed the archaeologists used mainly a >500μm sieve. Whilst this range of sieve sizes is adequate at retaining most of the carbonised seeds likely to be encountered, it may slightly

Plate 5: Flotation tank, Unst, Shetland 1997: (Photo: D. Alldritt).

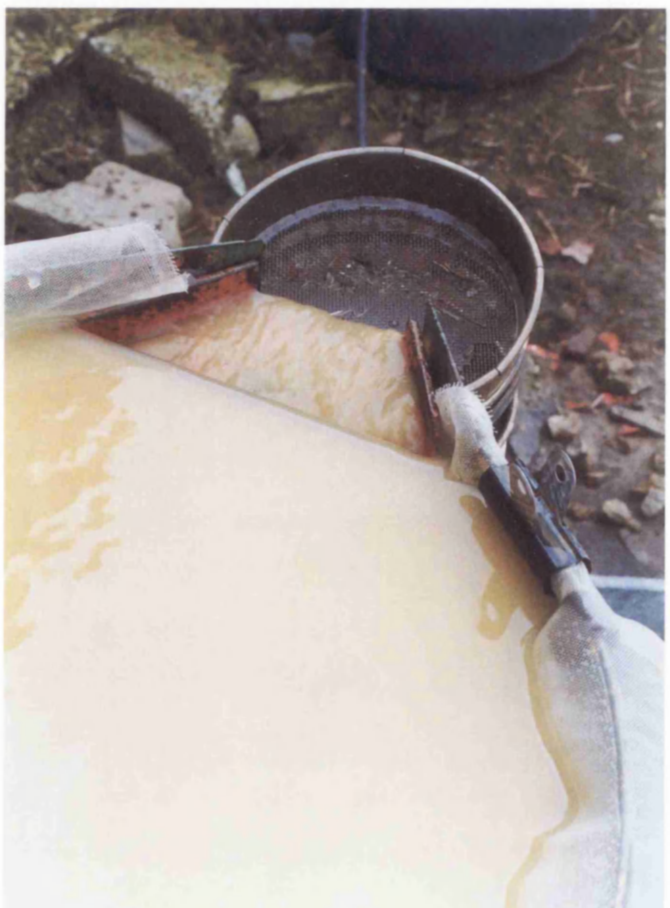


Plate 6: Sample processing, Unst, Shetland 1997: (Photo D. Alldritt).

influence the capture of some of the smaller species, such as small-seeded wild grasses, and hinders the cross-comparison of these types of smaller seeds between sites.

Each soil sample was processed individually by placing into the >1mm mesh inside the tank. Water was pumped into the tank via a hosepipe, maintaining a steady rate in order to disaggregate the soil. The samples were gently hand-washed by carefully breaking down the soil matrix, taking care not to press any material against the mesh where it might become damaged. Floating carbonised material and any remains adhered to the edges of the mesh were encouraged over the edge of the tank into the awaiting sieves. Where the processed samples were particularly productive a variety of carbonised plant material, including weed seeds, cereal grains, burnt peat and charcoal fragments were recovered in the sieves. This material is referred to as the 'flot' throughout the text.

Heavier elements in the samples, such as pottery, bone, lithics, and often also burnt peat and charcoal were caught and retained in the >1mm mesh inside the tank. This part of the sample is referred to as the 'residue' in this text. The samples were thoroughly processed, until no sediment remained in the >1mm mesh and no further material would float. Once this stage was reached the tank was partially emptied to expose the residue. The residue was then removed from the tank within its mesh, hosed down to remove any suspended silt, and emptied into a labelled plastic bag. The flot material was also gently rinsed in clean water, then emptied out onto anti-static absorbant paper with the aid of a soft paint brush, wrapped, bagged and labelled.

Flot and residue materials were, with the exception of Burland, returned to Glasgow University for drying and sorting. The residues were laid out on individual wooden trays and air-dried in laboratory conditions. The flots were dried in a cabinet under low heat. Residue material from Burland was dried and sorted on-site, whilst the flot material was dried in an airing cupboard and delivered to Glasgow for sorting. Dry residues were systematically weighed and then sorted by eye with material extracted using heavy forceps. The flot material was sorted utilising a low powered binocular microscope, with typical magnifications of x10 and x20, and plant macrofossils extracted using lightweight watchmakers' forceps. All sorted materials were either bagged or stored in labelled glass tubes to prevent damage, in preparation for further identification (see section 2.2.4).

2.2.3.3: Laboratory Sieving of Column, Bulk and Sub-Samples:

2.2.3.3.1: Introduction:

The samples taken during the excavation at Marymas Green, Caithness were not processed with a flotation machine, but were instead returned to the laboratory for sieving. All catagories of sample from this site - including column, bulk and spot varieties - were wet sieved under laboratory conditions. This situation arose for two reasons. Firstly logistical and budgetary considerations - it was not possible to set up a flotation tank on-site, and no funding was available to process the samples using GUARD facilities. Secondly as an ideal opportunity to test potential variations in species recovery using different processing techniques. Dr. J. H. Barrett had extracted test material from the midden at Marymas Green, during his 1994 assessment. This had been processed through a flotation tank and the plant remains passed to the author for assessment as a potential site suitable for inclusion in this thesis. By processing comparative midden material from the 1995 excavation in the laboratory it was hoped that any differences in recovery might be highlighted, as indicated by Wagner (1988) and de Moulins (1996). Two of the bulk samples from Marymas Green were accidentally floated by GUARD staff, and these are indicated in **table 3** (chapter 3). Results from processing and a comparison of the material recovered are presented in chapter 3.

It was attempted to process a selection of subsamples from Soterberg utilising laboratory methods, in order to test recovery, but this proved untenable due to the heavy clay nature of the samples (see chapter 6.3.3). As a further test of comparative processing methods, a selection of sub-samples from Burland, Trondra were also processed by laboratory washover-type methods. Criteria for sub-sample selection and discussion of the results from this site are provided in chapter 5.3.3. In this section the processing techniques used in the laboratory will be discussed.

2.2.3.3.2: List of Equipment:

1) Sink unit – with silt trap fitted.
2) Metal Endicot sieves. Mesh sizes >1mm and >250μm.
3) Plastic grid, plastic buckets (graduated in litres) and rubber hose.
4) Sundry equipment: plastic sample labels (plant tags), plastic trays, blue absorbant anti-static laboratory paper, rubber gloves, waterproof marker pens, plastic bags, recording sheets.

2.2.3.3.3: Processing Method:

Samples were processed in the laboratory using methods similar to those described by Kenward *et al* (1980) for the processing of waterlogged material. Some slight modifications were made to the technique to account for the retrieval of carbonised remains and the presence of large quantities of fish bone and shell in some of the samples. The author took the decision to use a >250μm mesh as the smallest sieve size for laboratory processing, to facilitate the capture of smaller seeds and chaff elements. This sieve size had caused the author blockage and overflow problems in the past when used with a flotation tank on material not related to the study sites. However it was easier to watch for overflow when used manually. At an interpretive level it should therefore be remembered that the laboratory sieved material was processed to >250μm, whilst the floated bulk samples were processed to >300μm and >500μm.

All surfaces and materials to be used during processing were thoroughly cleaned to prevent cross-sample or cross-site contamination. Equipment was also scrubbed and washed using cold water between samples. Laboratory processing methods used for bulk and column samples, and sub-samples, were identical; except that some of the larger samples had to be processed in small amounts with frequent breaks in the sieving to remove fish bone and shell, whilst the majority of sub-samples could be processed rapidly with a single sieving. The continual halting, emptying buckets and sieves, and restarting of the process meant that sieving some of the larger bulk samples took many hours.

The processing began by firstly measuring the volume of a small amount of sample or total sub-sample in a graduated plastic bucket. A second empty bucket was placed in the sink and covered with a plastic grid, with the nest of sieves placed on top of the grid. Sieve mesh sizes consisted of >1mm and >250um types in order to separate larger material, seeds and cereals, from finer seeds and silt. The sink bucket was used to reduce the amount of sediment entering the sink plumbing. With an appropriate fitted silt trap this precaution would not have been required. Large amounts of silt were produced during the processing, most of which was captured and held in suspension in the sink bucket. This was allowed to settle before decanting the cleaner water away, then the waste silt was dried, bagged and disposed of.

With the aid of a flexi-rubber hose the sample was washed out of the measuring bucket and directly into the sieve nest for gentle manual disagregation using water. At this stage any stone or large bits of bone were removed from the bucket and / or sieve and placed on trays to dry. In practice few stones were present which reduced the potential damage which could have occurred to the carbonised plant remains. However large quantities of marine shell were recovered, and these required thorough cleaning with watchmakers' forceps in order to remove trapped sediment whilst in the >1mm sieve. In hindsight, and if larger stones were present, the author would probably also have used a >4mm mesh as the top sieve in order to catch larger material and to keep this separate from carbonised plant. Sieved material was frequently emptied out onto large plastic trays covered in absorbant blue laboratory paper as processing took place; this was done to keep the amounts in the sieves at any one time to a minimum, with the intention of reducing potential damage to the plant remains.

Recovered environmental material was allowed to air-dry under cold laboratory air conditioning. Once dry, fish, mammal bone and marine shell were removed from the trays by eye and bagged separately for later analysis. The remaining material was dry sieved into >1mm and >250μm portions and sorted using a low powered binocular microscope at magnifications of x10 to x20. Plant macrofossils were stored in labelled glass tubes ready for identification.

2.2.4: Identification Criteria:

2.2.4.1: Microscopic Identification:

The carbonised plant material from each sample was identified with the aid of a low powered binocular microscope typically at magnifications of x10 and x20. This was sufficient magnification for the determination of most seeds, cereal grains, chaff, peat, seaweed and other fragments. A high powered Zenith metallurgical microscope was used to identify the morphological characteristics of charcoal, and to distinguish cell patterns on some seeds. Magnifications on the Zenith varied from x50 to x200 depending upon the detail required for identification of different fossil woods.

2.2.4.2: Plant Nomenclature:

Carbonised plant macrofossils, including seeds, nutlets, achenes, fruits and so forth are all referred to in the text as seeds in order to avoid confusion, with the exception of cereal grains which will be distinguished as such. Latinised names are used as standard throughout the text and raw data tables, but the formal authorities (e.g. L. for Linnaeus) are not given. Common names are also used in the text for ease of discussion, for instance, barley, oats, wheat, but where these have been distinguished to species (e.g. cultivated oat) it will be stated as such. The author has used the *cf.* abbrieviation for tentative identifications, usually because the material was poorly preserved or degraded, or because the genus or species could not be confidently separated based upon the available material and within the scientific guidelines available. The abbrieviation *sl.* (*sensu latu* – 'in the widest sense') is also used throughout the text where species cannot be confidently separated. This would apply for instance, in the case of *Hordeum vulgare* sl. (barley), where the diagnostic features needed to separate into var. *vulgare*, var. *nudum* or var. *distichon* cannot accurately be viewed in the carbonised specimen (Zohary and Hopf 2000).

Plant nomenclature referred to in the text follows Stace (1997) for vascular plants other than cereals, which follow Zohary and Hopf (2000).

2.2.4.3: Cereals and Seeds:

All cereals and seeds recovered from the study sites were identified in the Hopkirk Laboratory, Division of Evolutionary and Environmental Biology, University of Glasgow, with the exception of the material from Burland, Trondra, which was identified in the Department of Archaeology. The extensive modern plant reference collection, compiled by Mrs. C. and Professor J. H. Dickson at Glasgow University, was used throughout the research.

For identification of seeds the author referred to Beijerinck (1947), Schoch *et al* (1988) and to modern plant reference material, as well as the knowledge of Dr. J. Miller, particularly in regards to the identification of *Carex* sp. (sedges). *Ranunculus* species were separated by comparison of cell patterns to modern material, in particular the separation of *R. repens* from *R. bulbosus*, which are very similar in terms of gross morphology. Seeds of *R. repens* are typically 2.5 - 3.8mm, with rounded cell pits and a short curved beak; *R. bulbosus* tends to be 2 - 4mm, very finely pitted, with a short hooked beak. Separation of these species is problematic without adequate modern reference material and the consultation of experienced colleagues. The texts of Stace (1997) and Scott and Palmer (1987) were also frequently referred to during the course of the research.

Cereal grains and chaff were identified by comparison with modern material and Jacomet (1987). With the consultation of various colleagues and journals the author also compiled a small carbonised cereal collection (mostly oats and barley types) from well preserved archaeobotanical material, with which to compare other remains. Carbonisation can result in shrinkage and often, extreme distortion of the morphological features required for accurate identification. Cereal remains can be extremely difficult to identify accurately, and differential carbonisation and preservation can result in material that looks very different from its modern counterpart (Dickson and Dickson 2000: 288). The author was systematically trained in cereal grain identification by Dr. G. E. M. Jones at Sheffield University, utilising carbonised archaeobotanical assemblages and the unpublished student identification guides produced by G. Hillman. The identification criteria provided in the following sections are based upon these guidelines and notes taken during the authors' time at Sheffield University. This training was continued under the guidance of Mrs. C. Dickson at Glasgow University, where a fuller appreciation of Scottish archaeobotanical material was achieved. Whilst Jacomet (1987) provides extensive information on the separation of barley and wheat species it should be remembered that her research is based upon Continental European material

(Netherlands and Germany) and may not be directly comparable with material found in the north of Scotland (J. Miller pers. comm). The level of identification attainable in the studied material varied greatly. In the larger assemblages it was relatively straightforward to separate out different barley varieties and distinguish them from oat, and rarely wheat, whereas with smaller assemblages and poorer material often the only assignable category was indeterminate cereal. Where indeterminate cereals were counted the author has distinguished between grains with and without embryo ends, in order to quantify fragmented material and prevent multiple counts of the same grain.

2.2.4.3.1: Oats:

The name *Avena* is a genus covering some 25 species, some being weeds and others cultivated (Dickson and Dickson 2000: 234). Jacomet (1987) is extremely sparse in information regarding oat separation – an important issue in Scottish archaeobotany – with chaff differences only briefy mentioned. Oat cereal grains are notoriously difficult to separate into species types based upon the presence of grain alone. Grains are distinctly long and narrow, have a fairly circular cross-section and a shallow or absent ventral groove, typically 4 - 7.5mm in length and 1.5 - 2.5mm in breadth. The size range of *Avena sativa* (common oat), *A. strigosa* (bristle or black oat) and *A. fatua* (wild oat) overlaps considerably (Dickson and Dickson 2000: 234). The author found a number of large, well preserved oat grains at Marymas Green, the largest measuring 6.0mm x 2.0mm. Whilst it would be tempting to use this large size as a basis for the presence of cultivated oat it is not a reliable indicator of species and the recognition of oat grains to the species level does not seem possible (Dickson and Dickson 2000: 288). However if chaff fragments are present and the basal area suitably well preserved it may be possible to separate wild and cultivated varieties based upon the detailed descriptions in Renfrew (1973: 89-98). Wild oat has a distinctive horseshoeshaped abscission scar at the base of the floret (spikelet base), whilst the cultivated oat has a slightly pointed or flattened floret base with no scar. **Fig. 10** illustrates wild and cultivated oat florets, together with typical grain sizes recovered from Marymas Green, Caithness.

Further identification problems with oat types arise from the presence of *Avena strigosa* (bristle or black oats) as a main cultivar in the Northern Isles in the past. This is generally regarded as indistinguishable from other cultivated species, and more work needs to be done on finding distinguishing criteria for this species. Separation of types is not helped by current archaeobotanical literature which tends to assume that if a large 'cultivated-type' oat is found in an archaeological context in the Northern Isles then it is probably black oat. *Avena sativa* is the common oat, but its name has become synonymous with 'cultivated oat' – which indeed it is – but the blurring of names does not help the problem of distinguishing what types were growing where. In current publications the distinction between types seems to be based on geography rather than morphology, and it is widely regarded that common 'cultivated' oat was not introduced into Shetland until the 18th century (C. Dickson 1999b).

2.2.4.3.2: Barley:

Barley identification is also a somewhat complicated area with various levels of identification of its numerous species types utilised in the archaeobotanical literature, including 2, 4 and 6 rowed, naked and hulled and dense and lax-eared descriptions all adding to the confusion (Greig 1989: 54). Some of these descriptions have been found to be impossible to justify based upon morphological criteria alone. The author has followed the nomenclature of Zohary and Hopf (2000) for hulled and naked barley, six-row and two-row types. Two-row and six-row barley types were frequently considered as two separate species and some workers still use this nomenclature (ie *Hordeum distichon* (two-row), *Hordeum* *vulgare* (six-row)). However this division is genetically unjustified and the main cultivated barley types represent races of a single crop species: *Hordeum vulgare* (Zohary and Hopf 2000: 60). The description of species as dense eared and lax eared (fertile lateral spikelets) has also recently been revised as all cultivated barleys have been found to be fully infertile (Zohary and Hopf 2000: 60).

Hulled barley grains are tightly enclosed by palea and lemma, which more or less fuse the grain and chaff together, while naked grains are not so firmly fused and easily thresh free. Barley grains are fairly plump in appearance with no dorsal ridge and are gently tapering at both ends, typically measuring 3.5 – 7mm in length and 2 – 4mm breadth. Hulled barley is typically angular in cross-section with longitudinal ridges on the dorsal side, and running parallel to the ventral groove on the opposite side. It has convex ventral and dorsal surfaces. Naked barley is rounded in cross-section with no longitudinal ridges and a convex ventral surface. It has a shallow ventral groove, whilst on the dorsal surface horizontal lines or wrinkles are sometimes visible. Some barley grains may appear twisted about the longitudinal axis; if these are present in a ratio of 2:1 (twisted: straight grains), then the species is six-rowed (*Hordeum vulgare* var. *vulgare* or *nudum*); if all grains are symmetrical then it is probably two-rowed (*Hordeum vulgare* var. *distichon*). Although Jacomet (1987: 24), indicated that the theoretical ratio of 2:1 does not actually occur. All grains of two-row barley are straight, lateral grains of six-row barley are twisted, so technically the presence of twisted grains in any number should indicate the species is six-rowed.

Barley cereal grains recovered from the study sites were mostly of the six-row hulled variety, with some naked grains also present. The raw data tables for each site distinguish between symmetrical and twisted grains, and incorporate a range of identification levels dependent upon preservation and morphology of the material examined. An illustration of four grains of six-row hulled barley recovered from Burland, Trondra is provided in **fig 11**. Occasional barley chaff fragments

Fig. 10: Oat species from Marymas Green, Caithness: (l-r: *Avena fatua* floret, *A. sativa* grain and floret, *Avena* sp. grains) (Alldritt 2003).

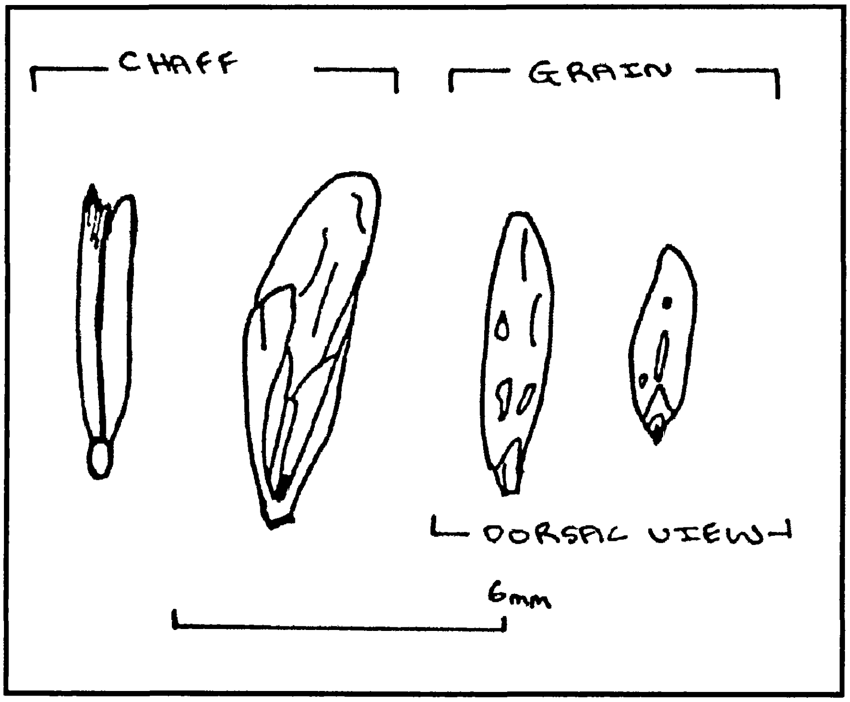
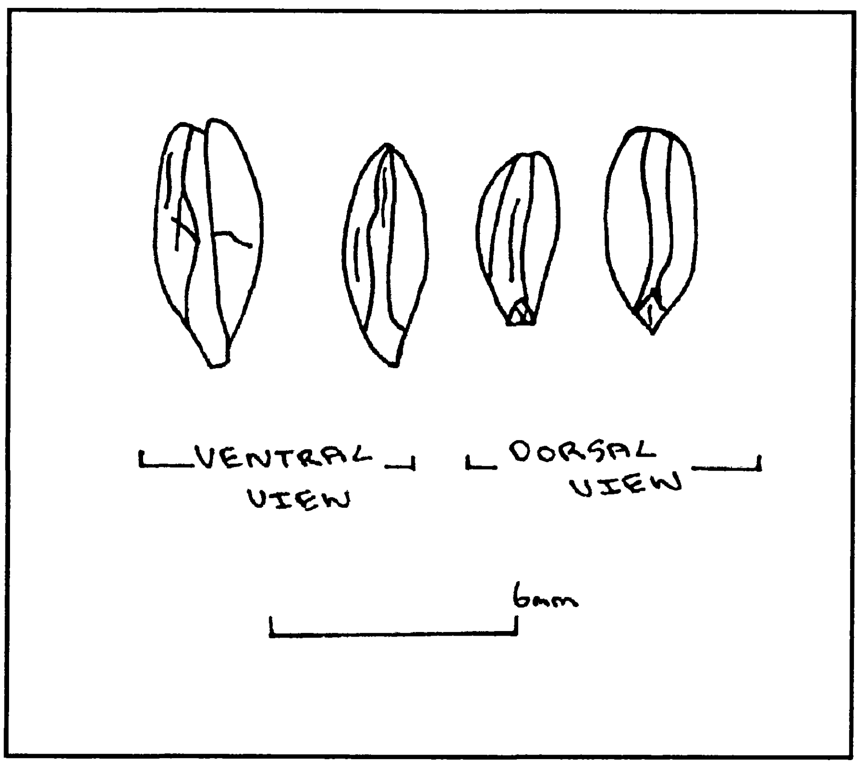


Fig. 11: Six-Row Hulled Barley from Burland, Trondra: (l-r: *Hordeum vulgare* var. *vulgare*) (Alldritt 2003).



were also recovered. These were in the form of spikelets, and where visible, slim, furrowed depressions seen in the lemma base indicated that these were from six-row barley (based upon Jacomet 1987). Occasional rachis internodes distinguishable as barley only were also found.

2.2.4.3.3: Wheat:

Wheat species are particularly difficult to separate based upon the morphological criteria preserved in archaeobotanical assemblages, due in part to the large number of closely related taxa and thousands of years of farming selection (Hillman *et al* 1996 for 1995). The author used the nomenclature system of Zohary and Hopf (2000) in describing the few wheat types that were recovered from the study sites. It cannot be stated strongly enough that with the small number of specimens recovered from the samples - albeit including some well-preserved specimens - identifications proposed can only be tentative.

Hillman *et al* (1996 for 1995) provided a system of guidelines for the classification of wheat, indicating that the system of nomenclature should always be stated, and that comparisons with modern wheat taxonomy should be made with care. They also concluded that wheat grain was far more problematic to identify than wheat chaff, with grain morphology varying greatly between regions and periods, and more likely to become distorted by charring. For instance spelt wheat cannot be identified satisfactorily by grains alone – the rachis fragments are also required for confirmation. Under Zohary and Hopf's recommendations *Triticum aestivum* sl. is bread wheat in the widest sense – i.e. it includes spelt as well. This presents a convenient streamlined version of the biological species system (Hillman *et al* 1996 for 1995: 197) although it should always be remembered that there is often a great deal of overlap in the characteristics of individual wheat species.

Two potentially different types of wheat were recovered from the study sites. These were named as cf. *Triticum aestivum* sl. (cf. bread / spelt wheat), and cf. *Triticum dicoccum* (cf. emmer wheat). Occasional grains were also asigned to cf. *Triticum* sp. (wheat) where it was clear that no further differentiation could be made. Wheat species have a slight or strongly marked dorsal ridge and a distinct ventral furrow. Emmer wheat from a one-seeded spikelet has a convex ventral surface with a deep ventral groove and rounded cheeks. Two-seeded types have a flat or concave ventral surface. The embryo is set at a very steep angle to the vertical (c.80 degrees) and the grain has a strongly defined dorsal ridge. The specimen recovered from Smoo cave had a slightly convex ventral surface suggestive of one-seeded type wheat, although that may have resulted from slight distortion from carbonisation, and its inclusion here is tentative.

Bread wheats have a more generally rounded appearance, with a rounded ventral surface and only a slight dorsal bulge. The grain is often widest at the embryo end. Hillman *et al* (1996 for 1995: 205) cautioned against using the term 'compact' to define grain characteristics as this could become confused with nomenclature, and preferred to use terms such as 'short and round grained' when describing morphological properties in wheats. The possible bread wheat types recovered from Burland, Trondra were quite well-preserved, did not appear to be distorted by carbonisation, and had the wide embryo and short rounded 'squat' appearance characteristic of *T. aestivum* sl. No wheat chaff was recovered from any of the study sites.

Fig. 12 illustrates the carbonised emmer wheat recovered from Geodha Smoo, Sutherland. **Fig. 13** shows the four possible bread / spelt wheat grains identified from Burland, Trondra, together with a modern reference grain of *Triticum aestivum* sl. for comparative purpose.

Fig. 12: cf. *Triticum dicoccum* (cf. Emmer Wheat) from Geodha Smoo, Sutherland (Alldritt 2003).

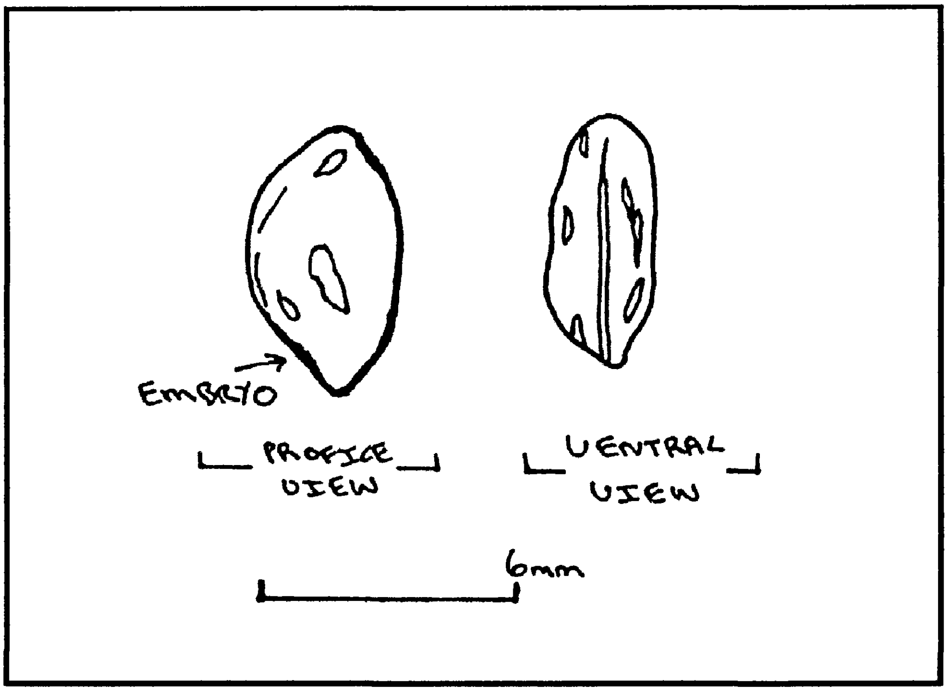
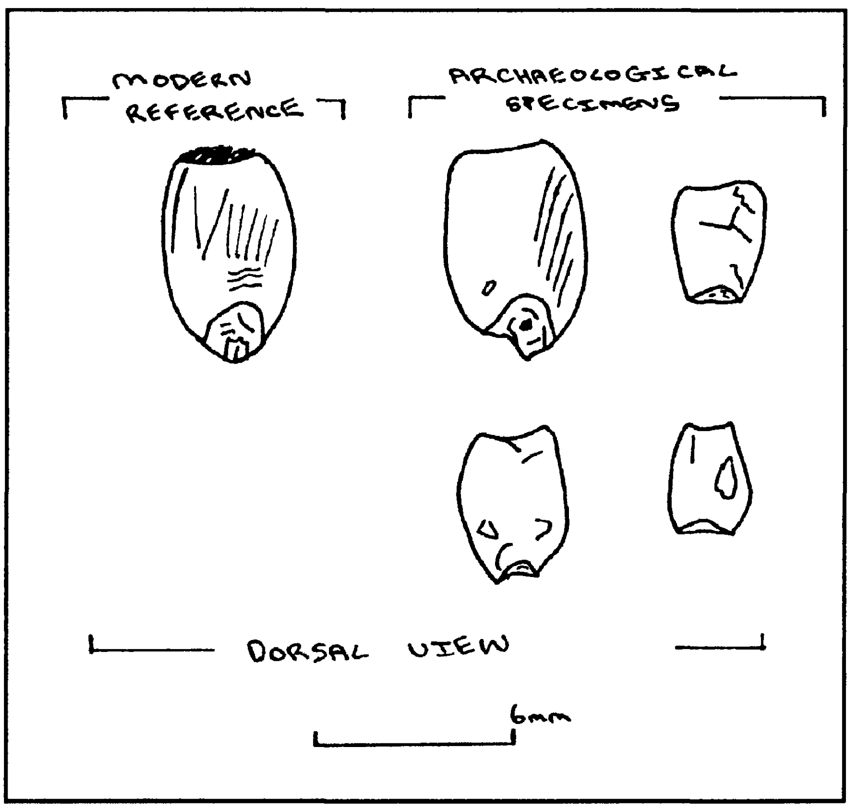


Fig. 13: cf. *Triticum aestivum* sl. (cf. Bread / Club Wheat) from Burland, Trondra: (l-r: modern reference *Triticum aestivum* sl., the four grains from Burland) (Alldritt 2003).



2.2.4.4: Charcoal and Other Carbonised Material:

All charcoal fragments recovered from the study sites were identified using a Zenith microscope at magnifications of x50 to x200. The extensive photographic references presented in Schweingruber (1990) and the text of Jane (1970) were utilised to determine charcoal identifications. The majority of charcoal recovered during the research was small and fragmentary and did not preserve the diagnostic features necessary for accurate identification. However occasional pieces, measuring greater than 5mm x 5mm, could be identified to genus, occasionally species, such as in the case of Scots Pine. The presence of driftwood on northern sites can confuse the issue of speciation somewhat, with a wider range of species than are native to Scotland arriving from North America and Scandinavia (Dickson and Dickson 2000: 286). However coniferous type wood is often easy to distinguish from deciduous types by the presence of resin pits / canals and often numerous small cross-ray tracheid pits in well-preserved pieces, even if it is not possible to determine exact species.

Abundant fragments of carbonised peat and other amorphous organic burnt material were also recovered. Peat from the sites was compared with material collected and carbonised by Mrs. C. Dickson in the Glasgow reference collection. Peat fragments were generally determined by their crumbly burnt organic appearance, having visible remains of vascular plant in an otherwise amorphous structure. Shiny black organic burnt material, with a smooth amorphous appearance and no apparent visible plant structures was also recovered. Some fragments had a vesicular smooth appearance whilst others were smooth solid structures. This is possibly remains of dung or other organic material, but its identification in the tables has been listed as 'burnt vesicular (dung or other?)' as it is unclear from microscope analysis alone exactly what this material is. Mrs. C. Dickson undertook a small experiment in the carbonisation of dung from humans and milk-fed lambs and calves and concluded that a number of substances originally of a thick creamy or viscous appearance, such as honey, could look rather similar when burnt (Dickson and Dickson 2000: 99). Wet dung was found to form vesicles, whereas dry dung did not. Other material from the research sites resembled burnt coal or coke in appearance and was highly friable and crumbly. This material has been described in the tables as 'burnt vesicular (coal or other?)', and may include peat that has been 'charcoaled' and then burnt for fuel as described in chapter section 1.5.2.1.2. The accurate distinction between burnt peat, burnt dung and other amorphous carbonised material probably requires investigation by alternative methods of analysis, rather than simply relying upon gross morphological characteristics.

Carbonised seaweed was determined by morphological comparison with modern reference material that had been collected and burnt. The recovered fragments were not determined any further than 'carbonised seaweed'.

2.2.4.5: Non-Botanical Remains:

All marine mollusc shells listed in the tables were identified by the author using Dipper and Powell (1984). This field guide provided drawings and measurements of the marine shells commonly found around the coast of Britain. Identified species were both counted and weighed for inclusion in the tables. Whole shells and fragments of shell were counted separately to avoid confusion in the numbers of species present.

Fish and animal bone were quantified by weighing and counting only. Species determination of these remains was outwith the experience of the author. Animal and bird bone recovered from Marymas Green was identified by Dr. J. Richardson (West Yorkshire Archaeology Service) and is included in the results section for this site as this information has not been published elsewhere. A brief separate analysis of some of the marine mollusc shell and fish bone recovered from Geodha

Smoo was also carried out (Cerron-Carrasco 1996a, 1996b) and this is included in the discusion sections.

Small sphericals of slag and other fragments of metalworking waste were recognised by comparison with photographs and descriptions in Tylecote (1986).

2.2.5: Data Presentation:

The environmental material recovered from the study sites is presented in raw data form in a series of tables for each site. These tables are either in gatefold form or incorporated in to the text, and each set of tables is included at the end of the relevant site chapter. Small summary tables of the data from each site are included in the 'discussion of results' sections for ease of interpretation. The raw data tables list plant macrofossils in taxonomic order based upon Stace (1997), no other interpretation was placed upon them at this stage. The plant material was then interpreted into ecological groupings based upon Stace (1997) and Kenworthy (1976) for Sutherland, Stace (1997) and Nature Conservancy Council (1989) for Caithness, and Scott and Palmer (1987) for Shetland, for interpretational purposes. Plant taxa were split into catagories according to their principle habitats though they are not necessarily exclusive to them. The summary data tables reflect these ecological groupings, i.e. 'non-sandy arable and waste / disturbed ground', and 'grassland, grassy meadows / pasture', to name two groupings. The habitat groups for Shetland may include species that are not traditionally thought to exhibit this ecology on Mainland Britain. This distinction is important because on Shetland one is dealing with a separate island biota, and the preferred species habitats to some degree reflect a level of opportunism in the growing range of certain plants.

All figures quoted in the tables represent actual counts of macrofossils, and where recorded, actual weights are also given. At Burland, Trondra almost all the 2002 samples were extremely abundant in quantities of carbonised heather stems and peat. Time constraints and efficiency considerations precluded the accurate counting and weighing of all this material. All macrofossils (seeds and cereals) listed represent actual counts recovered from Burland, but numbers of wild material recovered (heather, burnt peat and seaweed) are sometimes given as estimates. These can be distinguished by the presence of a + after the number quoted. In order to estimate these figures the author accurately counted one full petri-dish of remains (usually 10 - 15ml of material, measured by spoon), then as the sample was examined for other remains the author counted how many dishes / spoons of material were needed to complete the sample.

Intra-site comparisons were made by summary table and by the use of histograms, generated using the Excel '97 computer package. Inter-site comparisons discussed in chaper 8.1 also used summary tables and histograms to display the data. This simple data presentation reflects the qualitative nature of the plant macrofossil data; where interpretation is given in the tables it is based upon ecological groupings rather than statistical analysis (e.g. Dincauze 2000, G. E. M. Jones 1991). The environmental material is also discussed and interpreted in context groupings where appropriate in the relevant chapter for each site based upon the stratigraphic data available at the time of writing.

Chapter Three:

3: Marymas Green, Dunnet Bay, Caithness:

3.1: Location of Site and Archaeological Background:

Marymas Green, Dunnet Bay, is located approximately 4.5 kilometres east of Castletown, near Thurso, on the northeastern coast of Caithness, Scotland. The investigated site was located within the extensive sand dune system known as Dunnet Sands, which forms a protected SNH nature reserve. It was positioned at the eastern corner of the dune system, adjacent to the A836, Thurso to John O'Groats road. **Fig. 14** shows the location of the site on the Caithness coast.

The archaeological features visible prior to excavation consisted of a shell midden deposit and an exposed section of dry stone walling. Coastal erosion and the effects of wind blown sand continually alter and often prove a major threat to the preservation of many sites in this area and throughout the Northern Isles. During 1994, Dr. J. H. Barrett took four small assessment samples from the midden, which the author examined prior to the commencement of the 1995 excavation. The results from this assessment are given in **table 4** and **fig. 25** (both presented below). Due to the sensitive nature of the site and the high potential for preservation of Norse remains suggested by Dr. Barrett's assessment, a one-week evaluation excavation was carried out. This was funded by Historic Scotland, and undertaken by GUARD, under the direction of Dr. A. Pollard.

3.2: Archaeological Excavation 1995 Season:

3.2.1: Location of Trenches:

The main aims of the project were to establish the function and period of use of the site as well as the extent and survival of the features (Pollard 1996a). One of the priorities of the excavation strategy was to examine the exposed road facing section, which contained wall C.008 and midden C.007. In addition to this a series of trial trenches to the rear of the dune were opened in an attempt to establish the extent of any surviving structural features. **Fig. 15** shows the location of the eroding section and trial trenches.

The trial trenches were positioned to the rear of the eroding midden and wall. A total of twelve trenches were opened, many of which were in the form of small test pits measuring 2.0 metres by 1.0 metre. Trench 4 was the largest trench opened and this measured approximately 4.0 by 4.0 metres. Trenches 6, 10, 11, and 12, contained only clean sand and no evidence for archaeological deposits.

3.2.2: Stratigraphic Phasing:

A chronology of the various phases described below is provided in **Table 2**.

3.2.2.1: Pre-Norse / Late Iron Age Phases G to F:

Excavation of trenches one and two revealed buried soil horizons pre-dating the accumulation of the Norse midden material (C.007). These cultivation surfaces indicated the existence of manured agricultural fields prior to the Norse activities occurring elsewhere on the site. The road facing section also revealed prehistoric agricultural surfaces below the Norse midden level. This material represented phase G, the earliest material excavated, and potentially dated to the Iron Age. All of the remaining trenches that were excavated produced either midden material or structural features, in many cases both. Within trench four a double-skinned wall feature (C.016) was found, which in many places was several stones thick, and it is possible that this represented a building, although no obvious floor layer was found

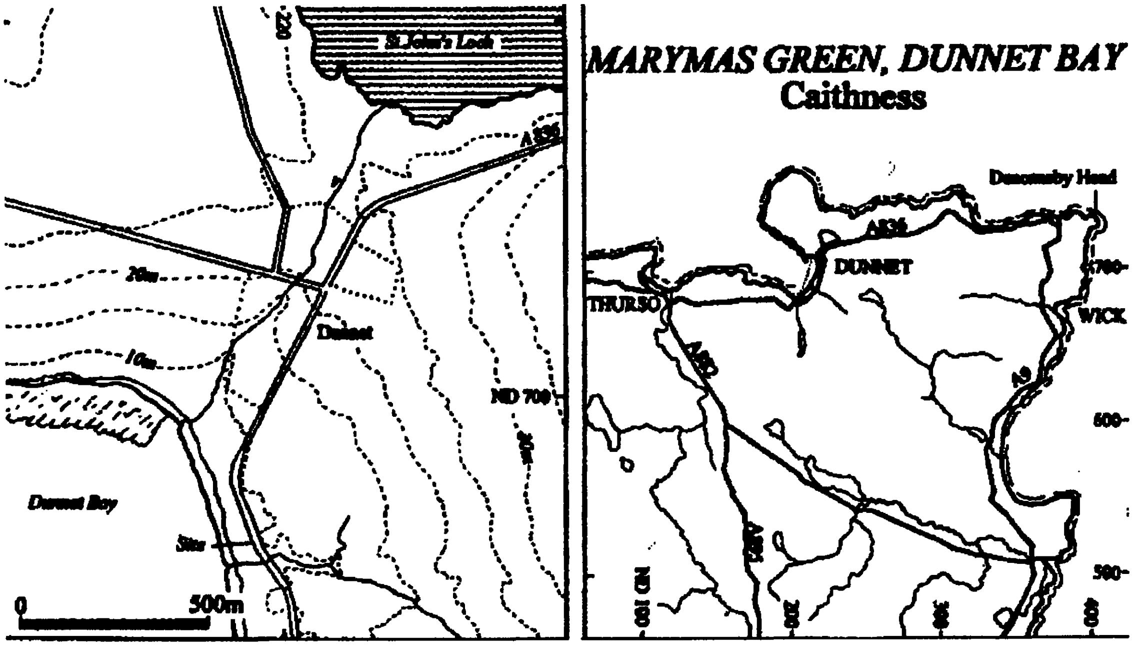


Fig. 14: Location maps of Marymas Green, Dunnet Bay. (Pollard 1996a).

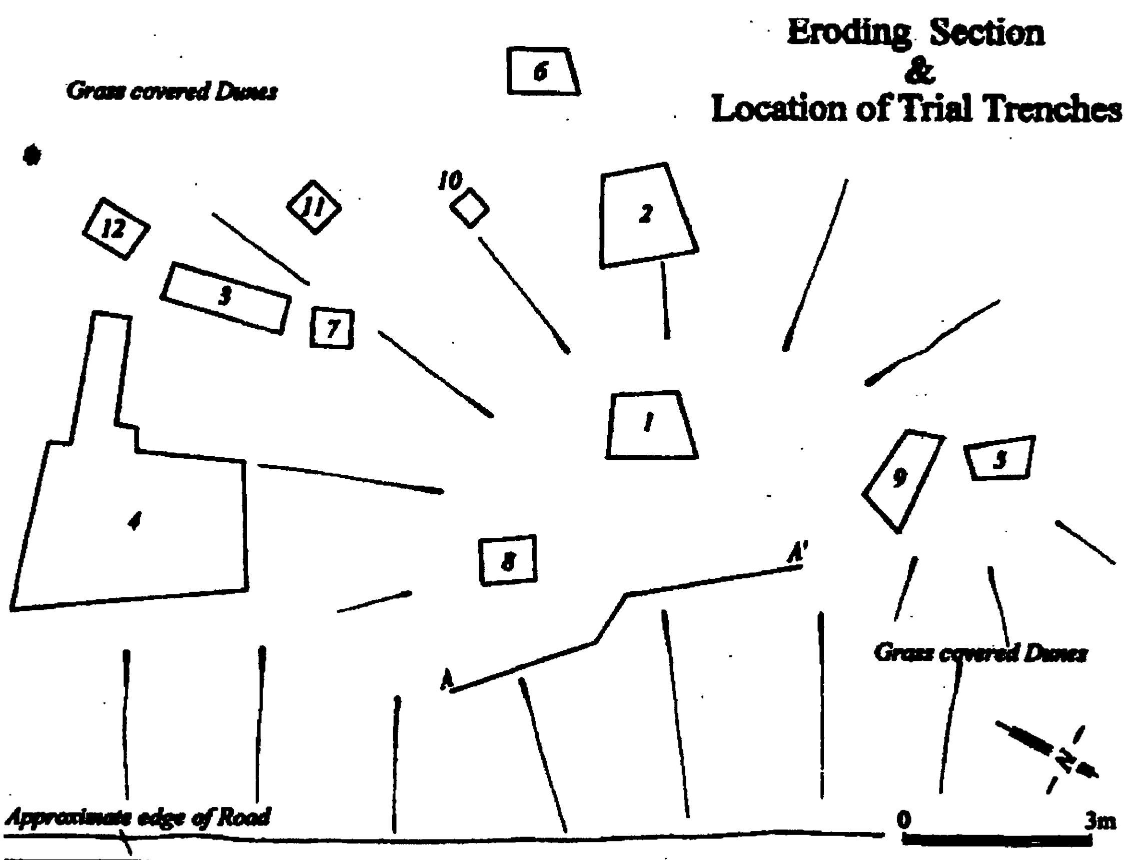


Fig. 15: Site plan of the excavated trenches at Marymas Green, Dunnet Bay. (Pollard 1996a).

Table 2: Marymas Green Phase and Dating Concordances:

Period	Phase	Contexts	Dating
Pre-Norse: Iron Age (?) Agriculture	Phase G	Box Column 1: 013, 014, 033, 035, 036, 043.	None. Prehistoric Agricultural Layers.
Pre-Norse: Late Iron Age / Pictish	Phase F	Trench 4: 016, 018, 019, 027.	Artefactual. 8th Century AD style bone pin.
Norse	Phase E	Midden 007	Artefactual association with 12th - 14th Century AD bone comb.
Norse	Phase D	Midden 007	
Norse	Phase C	Midden 007 + Box Column 2	Found in re-deposited midden material forming a wall core next to midden 007.
Norse	Phase B	Midden 007 + Box Column 2	
Norse	Phase A	Midden 007 + Box Column 2	

(Pollard 1996a). Features in trench four encompass phase F, and are probably Late Iron Age / Pictish.

Midden material consisting of crushed shell and charcoal fragments was found on both sides of the wall and samples were taken from a limpet-rich midden layer (C.019) on the eastern side. No radiometric dating has been carried out at the site due to limited funding, but during the excavation a number of diagnostic artefactual remains were discovered which revealed occupation activities extending over many centuries. A bone pin with a slightly curved shaft suggesting it was carved from a rib bone, was discovered amongst midden material in trench four adjacent to wall C.016. Its relationship to this wall was uncertain but it may have been deposited prior to construction (Pollard 1996a). The pin was identified by Dr. C. Batey as a pre-Viking type, perhaps dating to the 8^{th} century AD. This was an extremely important find as it suggested that the building discovered in trench 4, pre-dated the Norse construction features by several hundred years.

3.2.2.2: Norse Period Phases E to A:

The road facing section produced substantial Norse midden deposits rich in fish bone. This material was spread alongside an area of drystone walling, which had been badly truncated by the construction of the A836, and may have represented the remains of a Norse structure. An impressive antler comb, with many intact surviving teeth was recovered from the midden fill of part of a wall found in trench 5 behind the road-facing wall. Dr. C. Batey dated the comb typologically to the 12^{th} to 14^{th} centuries AD. Pollard (1996a) believed that it was re-deposited along with midden material used in the construction of a wall core. This midden deposit would provide both insulation and packing material for a building and may have been accumulating for some time before being re-used for construction purposes.

3.3: Environmental Sampling and Processing:

3.3.1: Sampling Strategy:

Midden, structural and wind-blown sand deposits were encountered during the excavation. In addition a series of prehistoric agricultural layers sealed by wind-blown sand below the level of midden accumulation were also seen. Sampling strategy involved taking both bulk environmental samples and box column samples through a selection of these deposits. Spot small finds samples were also taken of discrete areas of shell and articulated animal bone found during the course of the excavation. **Table 3** lists the various catagories and number of samples taken as well as weights and volumes where recorded.

A box column sample (column sample 1) was taken through the series of cultivation and wind-blown sand layers below the level of midden C.007, exposed in the road facing section. A second box column (column sample 2) was taken from an area of the midden which appeared to have less stone than other parts. Locations of the sample tins are given in **fig. 16**. The deepest part of the midden was sampled in column form, but excavated following observable stratigraphic divisions, and samples were bagged in bulk fashion. It was aimed to extract between 10-14 litres of sediment from each midden context, but in practice most of these samples came out at c.10 litres due to the thickness of the deposit and presence of stones. The midden contexts formed a continual sequence of deposition, but nothing was known of the time scale of its formation. It was hoped that by taking a number of stratigraphic samples it might be possible to establish changes in the types of remains deposited, with particular interest in the types of cereals and wild resources deposited throughout the sequence. An attempt was also made to sample the 'interfaces' between midden contexts in order to provide some degree of fine-tuning to the samples.

Other bulk samples of 5-20 litres were taken from midden spreads, ashy charred areas and 'loamy' dark brown silty sand deposits around the site.

Table 3: Marymas Green, Dunnet Bay, Excavation 1994/1995: List Of Samples:

Assessment Samples (1994):	**Volume (l)**	**Weight (Kg)**	**Processing**	**Sieve Size**
Midden layer A	10	Unknown	Floated	>300um
Midden layer B	10	" "	Floated	>300um
Midden layer C	10	" "	Floated	>300um
Midden layer D	10	" "	Floated	>300um
Bulk Environmental Samples (1995):				
Midden Samples:				
Midden (007) Section A	10	25	Lab. Sieved	>250um
Midden (007) Interface section A/B	10	15	Lab. Sieved	>250um
Midden (007) Section B	10	15	Lab. Sieved	>250um
Midden (007) Interface section B/C	10	10	Lab. Sieved	>250um
Midden (007) Section C	10	12	Lab. Sieved	>250um
Midden (007) Section D	10	15	Lab. Sieved	>250um
Midden (007) Section E	10	18	Lab. Sieved	>250um
Other Samples:				
Trench 1 (004)	12	20	Lab. Sieved	>250um
Trench 4 (016) Charred corner	8	12	Floated	>300um
Trench 4 (Wall) (019) 1 of 2 / 2 of 2	2x10	20 + 15	Lab. Sieved	>250um
Trench 4 (027)	5	7	Lab. Sieved	>250um
Midden Spread (018)	10	15	Lab. Sieved	>250um
Lower Midden deposit (Pit 7)	10	12	Floated	>300um
Box Column Samples (1995):				
Sample One: Road facing section:	**Volume (ml)**	**Depth (cm)**		
Section 1 (C.043)	800	65-72	Lab. Sieved	>250um
Section 2 (C.033)	500	72-76	Lab. Sieved	>250um
Section 3 (C.035)	1250	76-86	Lab. Sieved	>250um
Section 4 (C.013)	125	86-87	Lab. Sieved	>250um
Section 5 (C.036)	750	87-93	Lab. Sieved	>250um
Section 6 (C.014)	1300	93-104	Lab. Sieved	>250um
Sample Two: Midden column:				
Section A (007) (Top of column)	1875	45-60	Lab. Sieved	>250um
Section B (007) (Middle of column)	1750	60-74	Lab. Sieved	>250um
Section C (007) (Base of column)	1375	74-85	Lab. Sieved	>250um
Spot Samples and Small Finds (1995):	**Type:**	**Notes:**		
Midden (007) (Loose)	S.S.	Fish bone	Lab. Washed	>300um
Trench 1 (004)	S.F.	Bone + Shell	Lab.Washed	>300um
Trench 2 (None)	S.F.	Bone	Unprocessed	
Trench 3 (Loose)	S.F.	Worked Stone	Unprocessed	
Trench 4 (016)	S.F. + S.S.	Bone + Shell	Lab. Washed	>300um
Trench 4 (017)	S.F.	Bone	Unprocessed	
Trench 4 (019)	S.S.	Bone + Fish	Lab. Washed	>300um
Trench 4 (020)	S.S.	Bone + Shell	Lab. Washed	>300um
Trench 4 (021)	S.S.	Bone	Lab. Washed	>300um
Trench 4 (022)	S.S.	Charcoal	Unprocessed	
Trench 4 (026)	S.S.	Bone + Shell	Lab. Washed	>300um
Trench 4 (Extension)	S.S.	Bone + Shell	Unprocessed	
Trench 5 (None)	S.S.	Bone	Lab. Washed	>300um
Trench 5 (Wall)	S.S.	Bone + Shell	Lab. Washed	>300um
Trench 7 (None)	S.F.	Bone + Shell	Unprocessed	
Trench 8 (Possible midden spread)	S.F.	Fish Bone	Lab. Washed	>300um
Road Facing Section (Loose)	S.S. + S.F.	Bone + Fish	Lab. Washed	>300um

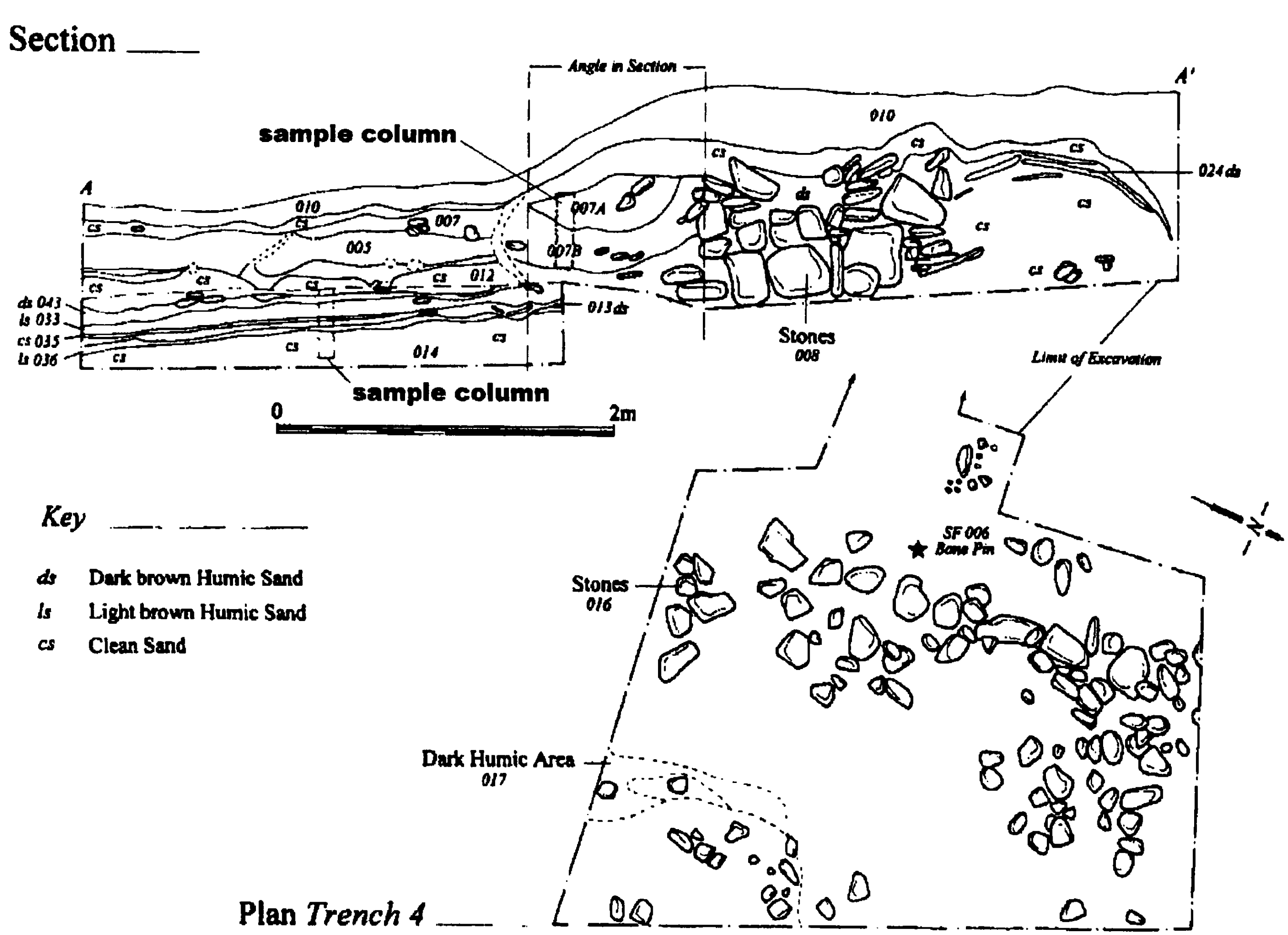


Fig. 16: Road facing section and plan of trench four, Marymas Green, Dunnet Bay. (Pollard 1996a).

3.3.2: Sample Processing:

All the environmental samples taken during the course of the excavation were returned to Glasgow for processing by the author. Bulk and column samples from this site were processed under laboratory conditions – apart from two bulk samples, which were accidentally floated by GUARD staff. Laboratory sieving methods are described in chapter 2.2.3.3. Samples were sieved to >250μm apart from the two floated, the four assessment samples and the spot finds, which were sieved to >300μm.

3.3.3: Sample Analysis:

An abundance of often very delicate plant parts, in particular oat chaff fragments were recovered from these samples, which it could be argued, might not have survived processing by flotation. This has important implications, and so four assessment samples processed by Dr. J. H. Barrett in 1994 using a flotation machine, will be discussed below as they provide comparative data regarding differential recovery patterns.

3.4: Results:

The raw environmental data recovered from the samples taken from Marymas Green are included both in the text and in gatefold form. **Table 4** shows the results obtained from the assessment samples. **Table 5** presents the environmental material recovered from the bulk midden samples. **Table 6** lists the data from other bulk samples. **Tables 7** and **8** show the results from box columns one and two respectively. Raw data recovered from identification of the spot finds / samples are presented in **table 9**.

Raw data **tables 4**, **5**, **6**, **7**, **8** and **9** are presented on the following pages.

Table 4: Marymas Green, Dunnet Bay 1994 Assessment Samples (taken by Dr. J. H. Barrett): (Note: Figures in brackets represent actual counts.)

Marymas Green Caithness: Assessment Samples (1994):	**Midden Layer A**	**Midden Layer B**	**Midden Layer C**	**Midden Layer D**
Carbonised Cereal Grain:				
Avena sp.	2	1	35	
cf. *Avena* sp.		1		
Hordeum vulgare var. *vulgare* (twisted grains)			4	
Hordeum vulgare sl.	1	1	14	
cf. *Hordeum* sp.			2	1
Indeterminate cereal grains (+embryo)			29	9
Indeterminate cereal grains (-embryo)			9	
Carbonised Wild Resources:				
Burnt peat fragments	0.13g (122)	1.7g (188)	2.25g (190)	
Calluna flowers			1	
Calluna stems (roots and twigs)	<0.05g (3)	<0.05g (8)	0.1g (5)	
Carbonised seaweed fragments	<0.05g (2)			
Carbonised Weeds:				
Chenopodium album		1	3	
Stellaria media		1	4	
Spergula arvensis			3	
Rumex sp.		1		
Carex sp.		1		
Poaceae	2			
Poa sp.			1	
Indeterminate weed		1	3	2
Charcoal:				
cf. *Betula*	0.1g (1)			
Alnus			0.4g (2)	
Indeterminate charcoal	0.2g (20)	0.1g (7)	0.3g (14)	
Non-Plant:				
Non-marine mollusc shells		<0.05g (7)		

Table 5: Marymas Green: Bulk Midden Samples

Marymas Green Caithness: Midden Sections:	**C.007**	**C.007**	**C.007**	**C.007**	**C.007**	**C.007**	**C.007**
Environmental Remains:	**A**	**A / B**	**B**	**B / C**	**C**	**D**	**E**
Carbonised Cereal Grain and Chaff:							
Avena sativa florets (with bases)					24	19	
Avena sativa grain in florets (with bases)					4		
Avena cf. *fatua* florets (with bases)					1		
Avena sp. glume fragments (no bases)					103	144	44
Avena sp. grain in glumes (no bases)						4	
cf. *Avena* sp. rachis fragments							
Hordeum vulgare sl. spikelets (+lemma base)						2	
Indeterminate Cerealia / Poaceae stem fragments	4			14	15	4	4
Avena sp.	8	3	5	5	21	215	20
cf. *Avena* sp.	8	5	4	11	27	80	9
Hordeum vulgare var. *vulgare*						10	2
Hordeum vulgare var. *vulgare* (twisted grains)							3
Hordeum vulgare var. *nudum*	6			2	10		
Hordeum vulgare cf. var. *nudum*							1
Hordeum vulgare sl.	16	2	1	5	16	140	4
cf. *Hordeum* sp.			2			25	
Indeterminate cereal grains (+embryo)	29	5			24	240	80
Indeterminate cereal grains (-embryo)					26	63	
Carbonised Wild Resources:							
Burnt Peat fragments	1.7g(16)	2.0g(7)	7.8g(187)	11.5g(486)	4.9g(191)	1.4g(13)	1.5g(81)
Burnt Vesicular (dung or other?)					0.1g(1)		
Corylus avellana nut shell fragments							
Calluna flowers				<0.05g(1)			
Calluna root / twig fragments	0.2g(32)		0.55g(62)	0.6g(211)	0.4g(188)	1.2g(60)	1.0g(75)
Calluna leafy shoot fragments						<0.05g(2)	
Carbonised seaweed fragments	0.4g(87)	0.05g(6)	<0.05g(5)	<0.05g(3)	<0.05g(4)	0.1g(6)	
Cyperaceae rhizome fragments				0.1g(15)	0.05g(8)	0.1g(1)	
Indeterminate rhizome fragment							
Indeterminate bud fragments				1			
Carbonised Weeds:							
Chenopodium album			1	5	2	1	4
Stellaria media				5	1		2
Spergula arvensis			1	1	1		
Rumex sp.							
Empetrum nigrum		1					
Ericaceae							
Aphanes inexspectata							
Euphorbia sp.							
Prunella vulgaris						1	
Galium aparine					1		
Sambucus nigra						1	
Scirpus sp.				5			
Scirpus (Isolepis) setaceus			1				
Carex sp.			1	3			
Poaceae	1						1
cf. *Poa annua*							
Bromus sp.		2		1			
Indeterminate carbonised weed						2	3
Charcoal:							
Betula	0.4g(4)					0.2g(2)	
Alnus						0.1g(1)	
Corylus				0.1g(1)	0.2g(1)		
Indeterminate Charcoal	0.4g(10)		0.05g(1)	<0.05g(4)	0.2g(3)	0.7g(30)	0.5g(35)
Non-Plant: Marine Mollusc Shell:							
Patella vulgata Whole shells	281.9g(91)	325g(133)	188.1g(65)	282.3g(98)	89.5g(36)	477.5g(173)	16.1g(4)
Patella vulgata fragments	137.1g(381)	167.5g(140)	46g(133)	45.4g(164)	31.0g(90)	163.2g(328)	1.1g(6)
Littorina littorea			0.3g(3)	6.4g(2)			3.6g(1)
Nucella lapillus	85.9g(19)	20.6g(6)				15.55g(6)	
Arctica islandica		23.9g(1)			3.1g(1)	7.85g(5)	
Mytilus edulis	0.7g(3)	2.2g(14)	2.3g(4)		0.4g(21)		
Indeterminate marine mollusc	8.8g(40)	2.7g(15)		3.3g(18)	2.5g(14)	11.6g(55)	0.1g(3)
Non-Plant: Bone:							
Fish bone (unburnt)	61g(466)	101.4g(562)	34.1g(179)	34.9g(268)	168.95(381)	26.2g (143)	3.3g (20)
Fish bone (burnt)	5.6g(97)	5.7g(77)	0.5g(1)	3.5g(113)	1.6g (45)	1.2g (17)	0.45g (16)
Mammal bone (unburnt)	0.4g(1)	<0.05g(2)		0.4g (4)			
Mammal bone (burnt)	0.4g(11)	0.25g(18)	1.9g(49)		<0.05g(2)	0.89g(46)	0.1g(4)
Bird bone (unburnt)						0.6g(2)	
Bird / small mammal claw	0.1g(12)	0.2g(22)	<0.05g(10)	<0.05g(11)	0.05g(47)	<0.05g(5)	0.1g(35)
Non-Plant: Other:							
Industrial waste (Slag)	2.0g(11)		0.1g(2)				<0.05g(5)
Mortar remains (concretions)			1.8g(29)				<0.05g(1)
Non-marine mollusc shell	<0.05g(4)	0.8g(8)	0.3g(20)	0.3g(32)	1.05g(15)	0.1g(8)	<0.05 (18)

Table 6: Marymas Green: Other Bulk Samples

Marymas Green Caithness: Other Bulk Samples:	Tr. 1	Tr. 4	Tr. 4	Tr. 4	Tr. 4	Tr.7
Environmental Remains:	**C.004**	**C.016**	**C.019**	**C.027**	**C.018**	**Midden**
Carbonised Cereal Grain and Chaff:						
Avena sativa florets (with bases)						
Avena sativa grain in florets (with bases)		1		2		
Avena cf. *fatua* florets (with bases)						
Avena sp. glume fragments (no bases)						
Avena sp. grain in glumes (no bases)				1		
cf. *Avena* sp. rachis fragments						
Hordeum vulgare sl. spikelets (+lemma base)						
Cerealia / Poaceae stem fragments					1	
Avena sp.	12	2		3	4	2
cf. *Avena* sp.	10	6	2	3	6	1
Hordeum vulgare var. *vulgare*						
Hordeum vulgare var. *vulgare* (twisted grains)						
Hordeum vulgare var. *nudum*						
Hordeum vulgare cf. var. *nudum*		2				
Hordeum vulgare sl.	5	5			1	
cf. *Hordeum* sp.		3	2			1
Indeterminate cereal grains (+embryo)	16	10	3	9	7	
Indeterminate cereal grains (-embryo)						
Carbonised Wild Resources:						
Burnt Peat fragments	1.9g(28)	1.7g(11)	0.6g(27)	2.0g(104)	2.0g(168)	
Burnt Vesicular (dung or other?)				0.2g(2)		
Corylus avellana nut shell fragments					<0.05g(1)	
Calluna flowers						
Calluna stem fragments (roots and twigs)	0.15g(17)	<0.05g(4)		0.3g(52)	0.3g(68)	<0.05g(1)
Calluna leafy shoot fragments					0.05g(1)	
Carbonised seaweed fragments				<0.05g(2)	<0.05g(3)	
Cyperaceae rhizome fragments						
Indeterminate rhizome fragments						
Indeterminate bud fragments						
Carbonised Weeds:						
Chenopodium album						
Stellaria media		1			1	
Spergula arvensis		3				
Rumex sp.					1	
Empetrum nigrum						
Ericaceae						
Aphanes inexspectata			1			
Euphorbia sp.		1				
Prunella vulgaris						
Galium aparine						
Sambucus nigra						
Scirpus sp.						
Scirpus (Isolepis) setaceus						
Carex sp.						
Poaceae		1				
cf. *Poa annua*						
Bromus sp.						
Indeterminate carbonised weed						
Charcoal:						
Betula				0.1g(1)		
Indeterminate Charcoal				0.2g(15)	<0.05g(3)	
Non-Plant: Marine Mollusc Shell:						
Patella vulgata whole shells	3.8g(2)	7.1g(5)	147.9g(103)	0.6g(1)		
Patella vulgata fragments	4.6g(11)	7.1g(25)	165.3g(126)	1.1g(15)	1.6g(10)	
Littorina littorea		129.2g(68)	2.0g(1)	18.9g(6)		
Nucella lapillus						
Arctica islandica						
Mytilus edulis						
Indeterminate marine mollusc		14.3g(126)	<0.05g(2)	0.4g(5)		
Non-Plant: Bone:						
Fish bone (unburnt)	2.0g(6)	0.55g(19)	0.55g(24)	5.45g(36)	0.1g(4)	
Fish bone (burnt)		0.2g(7)				
Mammal bone (unburnt)		17.9g(2)	15.0g(2)		2.5g(32)	0.2g(6)
Mammal bone (burnt)					3.3g(55)	<0.05g(1)
Bird bone (unburnt)						
Bird / small mammal claw	<0.05g(1)			<0.05g(1)	<0.05g(1)	
Non-Plant: Other:						
Industrial waste (Slag)		1.2g(11)	0.1g(6)		0.9g(34)	
Mortar remains (concretions)			0.2g(1)		5.2g(31)	
Non-marine mollusc shell	<0.05g(1)	<0.05g(1)		0.2g(1)		

Marymas Green Caithness: Box Columns:	**Section 1**	**Section 2**	**Section 3**	**Section 4**	**Section 5**	**Section 6**
Box One: Road Facing Section:	**65-72cms**	**72-76cms**	**76-86cms**	**86-87cms**	**87-93cms**	**93-104cms**
Carbonised Cereal Grain:	**C.043**	**C.033**	**C.035**	**C.013**	**C.036**	**C.014**
Avena sp.	1					
Hordeum sp.			1			
Wild Resources:						
Burnt peat fragments		0.1g (1)				
Calluna stem fragments (roots and twigs)	0.1g (7)				<0.05g (1)	
Carbonised seaweed fragments		<0.05g (2)	<0.05g (4)	<0.05g (1)		
Carbonised Weeds:						
Chenopodium album			1			
Indeterminate weed						1
Non-Plant: Marine Mollusc Shell:						
Patella vulgata fragments	1.4g (4)	<0.05g (1)	0.4g (2)		0.1g (3)	
Littorina littorea fragments	23.2g (5)	2.0g (1)				3.1g (1)
Non-Plant: Bone:						
Mammal bone fragments (unburnt)			0.05g (2)		1.1g (1)	<0.05g(2)
Non-Plant: Other:						
Non-marine mollusc shells						<0.05g (1)

Table 7: Marymas Green, Caithness: Box Column Sample One: Road Facing Section.

(Note: Figures in brackets represent actual counts.)

Table 8: Marymas Green Caithness: Box Column Sample Two: Midden Section (C.007): (Note: Figures in brackets represent actual counts).

Marymas Green Caithness: Box Columns:	**Section A**	**Section B**	**Section C**
Box Two: Midden Section C.007:	**45-60cms**	**60-74cms**	**74-85cms**
Carbonised Cereal Grain and Chaff:	**Top Layer**	**Middle Layer**	**Base Layer**
Avena sativa florets (with bases)			9
Avena sp. glumes (no bases)			3
cf. *Avena* sp. rachis fragments		3	
Cerealia / Poaceae stem fragments			19
Avena sp.	2	3	22
cf. *Avena* sp.	3		19
Hordeum vulgare var. *vulgare*		1	
Hordeum vulgare sl.	3	4	10
Indeterminate Cereal Grains (+embryo)		5	36
Wild Resources:			
Burnt Peat fragments	3.1g (20)	1.4g (29)	<0.05g (1)
Calluna stem fragments (roots and twigs)	0.3g (52)	<0.05g (8)	0.15g (19)
Carbonised seaweed fragments	0.2g (85)	<0.05g (16)	<0.05g (2)
Indeterminate rhizome fragments	0.05g (1)		
Indeterminate bud fragments		<0.05g (1)	
Carbonised Weeds:			
Chenopodium album			1
Stellaria media			1
Ericaceae			1
Bromus sp.		4	
Charcoal:			
Betula	1.1g (6)		
Indeterminate charcoal	0.4g (5)		
Non-Plant: Marine Mollusc Shell:			
Patella vulgata whole shells	5.8g (1)	52.1g (29)	37.6g (21)
Patella vulgata fragments	5.9g (32)	42.1g (59)	18.8g (47)
Littorina littorea fragments	21.3g (5)	4.3g (1)	
Arctica islandica fragments		10.1g (1)	
Indeterminate marine mollusc fragments	2.9g (15)		1.4g (4)
Non-Plant: Bone:			
Fish bone (unburnt)	23.5g (213)	17.7g (142)	11.4g (85)
Fish bone (burnt)	2.6g (54)	0.7g (30)	0.4g (15)
Mammal bone (unburnt)	0.05g (7)	0.9g (1)	
Mammal bone (burnt)	1.35g 61)	0.05g (5)	0.2g (5)
Bird / small mammal claw (unburnt)	0.1g (20)	<0.05g (4)	<0.05g (29)
Non-Plant: Other:			
Non-marine mollusc shells		0.2g (11)	
Steatite artefact (possible pot lid)	63.9g (1)		

Marymas Green Caithness:	Midden	Tr. 1	Tr. 2	Tr. 3	Tr. 4	Tr. 4	Tr. 4	Tr. 4	Tr. 4	Tr. 4	Tr. 4	Tr. 4	Tr. 5	Tr. 5	Tr. 7	Tr. 8	Rd. face
Spot Finds / Spot Samples:	**C.007**	**C.004**	**None**	**Loose**	**C.016**	**C.017**	**C.019**	**C.020**	**C.021**	**C.022**	**C.026**	**Ext.**	**None**	**Wall**	**None**	**Midden**	**section**
Wild Resources:																	
Burnt Peat fragments			5.3g(1)				0.1g(4)			0.1g(5)		<0.05g(3)		0.3g(2)			
Calluna stem fragments (roots and twigs)							<0.05g(1)			<0.05g(17)		<0.05g(1)					
Carbonised seaweed fragments							<0.05g(1)			<0.05g(3)							
Non-Plant: Marine Mollusc Shell:																	
Patella vulgata					11.9g(9)					1.3g(11)		66.5g(21)		3.1g(1)			
Littorina littorea		5.0g(1)			366.7g(106)			53.5g(13)				225.9g(61)		2.5g(1)			
Nucella lapillus					25.5g(7)												
Arctica islandica		4.9g(1)			18.5g(3)			63.1g(5)			1.0g(1)	68.2g(6)			2.9g(1)		
Buccinum undatum														40.7g(1)			
Ensis arctuatus															3.7g(1)		
Neptunia antiqua		11.3g(1)															
Non-Plant: Bone:																	
Fish bone (unburnt)	6.8g(8)	15.5g(9)			1.3g(1)		22.1g(53)	6.6g(3)			44.3g(54)	1.3g(2)	3.5g(6)			3.2(7)	9g(7)
Fish bone (burnt)										<0.05g(3)	0.9g(1)						
Mammal bone (unburnt)		8.9g(3)	75.3g(16)		78.1 (3)	83.8g(8)		20.5g(26)	3.4g(2)		16.2g(12)	20.3g(10)			6.5g(4)		4.5g(1)
Mammal bone (burnt)		2.4g(1)					0.8g(1)										
Non-Plant: Other:																	
Industrial Waste (slag)																13.0g(1)	
Mortar remains (concretions)																	
Hammer stone (Old Red Sandstone)					1												
Steatite artefact (possible pot lid)				22.4g(1)													
Indeterminate stone fragment					12.4g(1)												
Non-Plant: 'Modern' Remains:																	
Green bottle glass			57.4g(2)														
Cork piece			6.7g(1)														

Table 9: Marymas Green Caithness: Spot Samples and Small Finds.
(Note: Figures in brackets represent actual counts.)

3.5: Discussion of the Results:

3.5.1: Overview:

A total of 135 litres of bulk sampled sediment were taken from midden and structural contexts from Marymas. A further approximately 50 litres of sediment were collected using box column sampling tins and from the assessment samples. The shell and other material collected as random spot finds was not measured to volume, and for this reason these have been recorded on separate tables rather than incorporating into the main body of data (see **fig. 24**). The material from the bulk samples was analysed together, and divided into Pre-Norse (Pictish) and Norse categories based upon the artefact findings already discussed. Only material from the Norse midden and probably Pictish structures in trench 4 were included in this analysis. Other trenches were not firmly datable. The bulk environmental data are summarized in **table 10** and histograms, **figs. 17**, **18**, **19**, **20**, and **21** (presented in following sections). In these tables / figures the oldest dated phase is always presented first, so the material is listed as pre-Norse (trench 4, phases G, F), followed by Norse midden levels, E, D, C, B, A. During excavation the midden levels were noted to be visibly different from one another, in terms of colour and content, and this enabled division of the layers for interpretation. However it is not known how long these layers took to accumulate, whether single events or long depositional patterns were involved, and this should be remembered when applying interpretation to these data.

Environmental material recovered from the box column and assessment samples are presented separately for analysis in individual histograms based upon the raw data tables already included. The weed habitats utilised have been standardised throughout the different sample types. Box column 1 represents Pre-Norse, possibly Iron Age agricultural activities, but the precise dating of these events is not known. Box column 2 is part of the Norse midden and the pattern of results produced should resemble the Norse bulk midden samples. The assessment samples (see **fig. 25**) taken by Dr. J. H. Barrett should also produce a similar pattern of data, and forms the basis, in section 3.5.7, of a comparison of recovery by different processing techniques. Material from non-bulk samples will be referred to for comparative purposes throughout this chapter. These samples can be found summarized in **figs. 22, 23** and **24**.

3.5.2: Cultivated Plants:

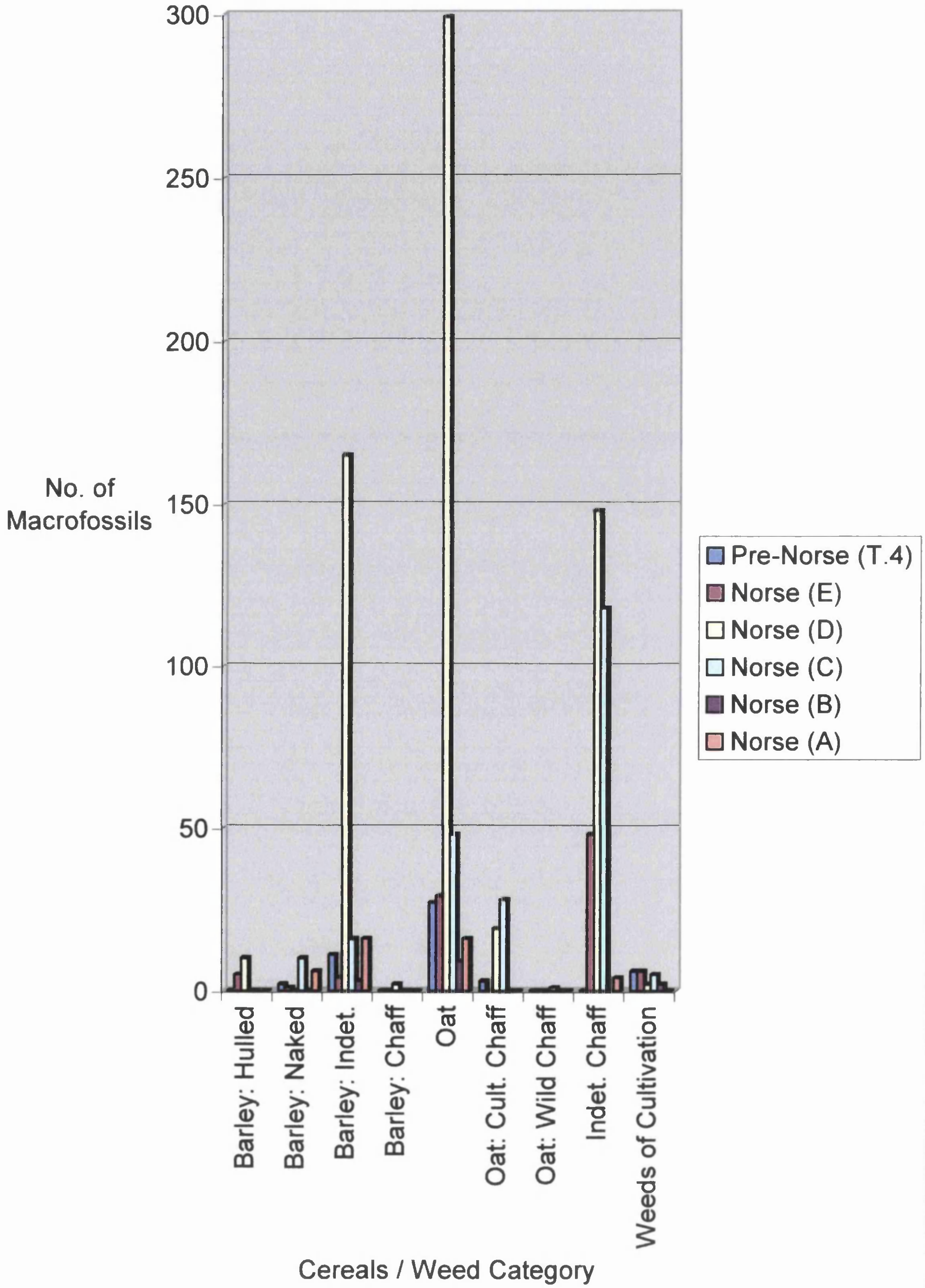
Carbonised cereal grain, chaff and weeds of cultivation are summarized in **table 10** and **fig. 17**. Barley (mainly *Hordeum vulgare* sl.) and oat (*Avena* sp.) grains were recorded from pre-Norse and Norse phases at Marymas Green. Six-row hulled barley (*Hordeum vulgare* var. *vulgare*) was not present in the pre-Norse or the later Norse phases, and was only recovered in small amounts from the earlier Norse midden deposits where twisted grains first appeared in the assemblage. Naked barley (*Hordeum vulgare* var. *nudum*) presented the opposite picture, being recovered in very small trace amounts in the pre-Norse (where it may have been a relict crop) and earlier Norse midden, but increasing later (midden levels C and A). This could indicate an increase in the use of this species (or re-introduction) in the Norse period, although comparative numbers of grain recovered were very small.

Oat grain was the most abundantly recovered carbonised cereal from the deposits. It was present in small amounts in the pre-Norse and earlier Norse midden, and increased dramatically in Norse level D. Subsequently oat continued to be recovered, but the quantities were greatly reduced towards the end of the Norse midden formation. Level D also produced large amounts of chaff, some of which was identified as cultivated oat chaff, suggesting that the grain present was a cultivated, rather than wild species. Indeed, level D produced the greatest quantities of all cereal species recovered from the site, apart from naked barley, which was absent. A similar recovery pattern of cereal was seen in level C, but this

Marymas Green, Caithness: Phasing:	**Pre-Norse**	**Norse**	**Norse**	**Norse**	**Norse**	**Norse**
Bulk Sample Group:	**Trench 4**	**Midden E**	**Midden D**	**Midden C**	**Midden B**	**Midden A**
Total Sample Litres:	43	10	10	10	10	10
Cultivated Plants:						
Barley: Hulled	0	5	10	0	0	0
Barley: Naked	2	1	0	10	0	6
Barley: Indet.	11	4	165	16	3	16
Total Barley Grain Count:	13	10	175	26	3	22
Barley: Chaff	0	0	2	0	0	0
Oat	27	29	299	48	9	16
Oat: Cult. Chaff	3	0	19	28	0	0
Oat: Wild Chaff	0	0	0	1	0	0
Indet. Chaff	0	48	148	118	0	4
Indet. Cereal	29	80	240	24	0	29
Weeds of Cultivation	6 (3 sp.)	6 (2 sp.)	2 (2 sp.)	5 (4 sp.)	2 (2 sp.)	0
Wild Resources:						
Peat	6.3g (310)	1.5g (81)	1.4g (13)	4.9g (191)	7.8g (187)	1.7g (16)
Heather stems	0.65g (124)	1.0g (75)	1.2g (60)	0.4g (188)	0.55g (62)	0.2g (32)
Seaweed	0.1g (5)	0	0.1g (6)	<0.05g (4)	<0.05g (5)	0.4g (87)
Charcoal	0.35g (19)	0.5g (35)	1.0g (33)	0.4g (4)	0.05g (1)	0.8g (14)
Burnt Vesicular (dung or other?)	0.2g (2)	0	0	0.1g (1)	0	0
Other Remains:						
Marine Mollusc Shells	480.80g (360)	20.9g (14)	675.7g (567)	126.5g (162)	234.4g (201)	514.4g (534)
Fish Bone	6.85g (90)	3.75g (36)	27.4g (160)	170.55g (426)	34.6g (180)	66.6g (563)
Other Bone	39.05g (100)	0.2g (39)	1.54g (53)	0.1g (49)	1.95g (59)	0.9g (24)
Slag	2.2g (51)	<0.05g (5)	0	0	0.1g (2)	2.0g (11)

Table 10: Marymas Green, Caithness: Summary Table of Remains Recovered from the Bulk Environmental Samples: (oldest phases first).

Fig. 17: Marymas Green, Caithness: Comparative Chart of Cereal Species and Weeds of Cultivation by Phase:



dropped dramatically in B, before rising slightly again in A, the final midden deposit. Oat may have been cultivated for human consumption, and the straw used for animal fodder. Numbers of weeds of cultivation recovered were very low throughout the samples, so it is difficult to place any firm interpretation on the ecological origins of these species. Indeed, many of the disturbed ground indicators may have been growing in the immediate environs of the site, and be unrelated to cultivation.

The material originally taken for assessment of the midden produced a similar pattern, although covering mainly the later stages of the midden (A-D). The deepest part of the midden (level E) was not apparent until full excavation took place in 1995. In the assessment samples, the largest amounts of grain and weeds of cultivation recovered came from level C (see **fig. 25**) and the grain identified was predominantly oat. Box column 2 (see **fig. 23**) taken by the author from the upper midden deposits also showed this pattern, although hulled barley was recovered from level C, where none was found in the bulk samples of this layer. However, as with the bulk samples, hulled barley was not recovered from the later Norse layers, and weeds of cultivation / disturbed ground disappeared from all sample types in this phase.

The overall lack of weeds of cultivation recorded from the samples may suggest that barley crops were cultivated, or at least partly processed, elsewhere before arriving on-site. This pattern seemed similar from both the pre-Norse and Norse phases. However, the large amounts of oat cereal grain and chaff recovered from the mid-late Norse midden deposits suggested that this cereal underwent an increase at this time, and may have been grown locally for use as grain and / or fodder.

The presence / absence of cereal grain in the Norse midden deposits revealed depositional patterns of great interest, particularly when plotted against the appearance of other remains, such as fish bone, seaweed and marine shell. These patterns are illustrated in **fig. 21**, and will be discussed further in sections 3.5.4 and 3.5.6.

3.5.3: Weed Ecology:

3.5.3.1: Habitat Categories:

The weed flora recovered from the bulk samples from Marymas Green was placed into six habitat catagories, listed below, and presented as **table 11** and **fig. 18**.

1) Sandy arable, damp sand, ditches and dunes:

Spergula arvensis (corn spurrey).

2) Non-sandy arable / waste and disturbed ground:

Chenopodium album (fat hen), *Stellaria media* (chickweed), *Sambucus nigra* (elder), *Aphanes inexpectata* (slender parsley-piert), *Galium aparine* (cleavers), cf. *Poa annua* (annual meadow-grass).

3) Grassland, grassy meadows / pasture:

Prunella vulgaris (selfheal), *Bromus* sp. (bromes).

4) Wetland: Aquatic, waterside, marsh and mire (base rich):

Scirpus (*Isolepus*) *setaceus* (bristle club-rush).

5) Moors, bogs and heath / dry heath:

Empetrum nigrum (crowberry), Ericaceae (heather family).

6) Miscellaneous:

Poaceae (grass family), *Rumex* sp. (docks), *Carex* sp. (sedges), *Scirpus* sp. (wood-rushes), *Euphorbia* sp. (spurges).

3.5.3.2: Summary of Weed Ecology:

Overall weed recovery from the samples was very low and therefore it is difficult to draw any strong conclusions. **Table 11** illustrates the weed categories used and the numbers present by phase. In **fig. 18** these data are presented pictorally. Weeds of sandy arable and non-sandy arable fields were present in small amounts in the pre-Norse phase, with non-sandy arable increasing in the earlier Norse midden phases. Non-sandy arable weeds formed the largest overall category of weeds recorded throughout the phases, although these could also be waste / disturbed ground indicators. A slight increase in recovery in the Norse deposits could suggest the use of less viable agricultural land for the cultivation of oat crops, although this conclusion would be tentative based upon such low recovery.

Grassland and wetland species were recovered from the mid-later part of the Norse midden, and may have arrived with peat or turf. All types of weeds completely disappeared from the uppermost Late Norse deposit.

3.5.4: Wild Resources:

Fig. 19 illustrates the range of wild plant resources recovered from the pre-Norse and Norse phases compared to the presence of cereal grain and slag. In the pre-Norse period peat was a major component of the recovered remains. Heather stems also present in this period probably arrived with peat or drier turf cut for fuel.

Marymas Green, Caithness: Phasing:	Pre-Norse	Norse	Norse	Norse	Norse	Norse
Bulk Sample Group:	**Trench 4**	**Midden E**	**Midden D**	**Midden C**	**Midden B**	**Midden A**
Weed Species Ecology:						
Sandy arable, damp sand, ditches and dunes	3 (1 sp.)	0	0	1 (1 sp.)	1 (1 sp.)	0
Non-sandy arable / waste and disturbed places	3 (2 sp.)	6 (2 sp.)	2 (2 sp.)	4 (3 sp.)	1 (1 sp.)	0
Grassland, grassy meadows / pasture	0	0	1 (1 sp.)	0	0	0
Wetland: Aquatic, waterside, marsh and mire (base rich)	0	0	0	0	1 (1 sp.)	0
Moors, bogs and heath / dry heath	0	0	0	0	0	0

Table 11: Marymas Green, Caithness: Recovered Weed Ecology by Phase, (oldest phases first).

Fig. 18: Marymas Green, Caithness: Recovered Weed Ecology from Pre-Norse Trench and Norse Midden Deposits:

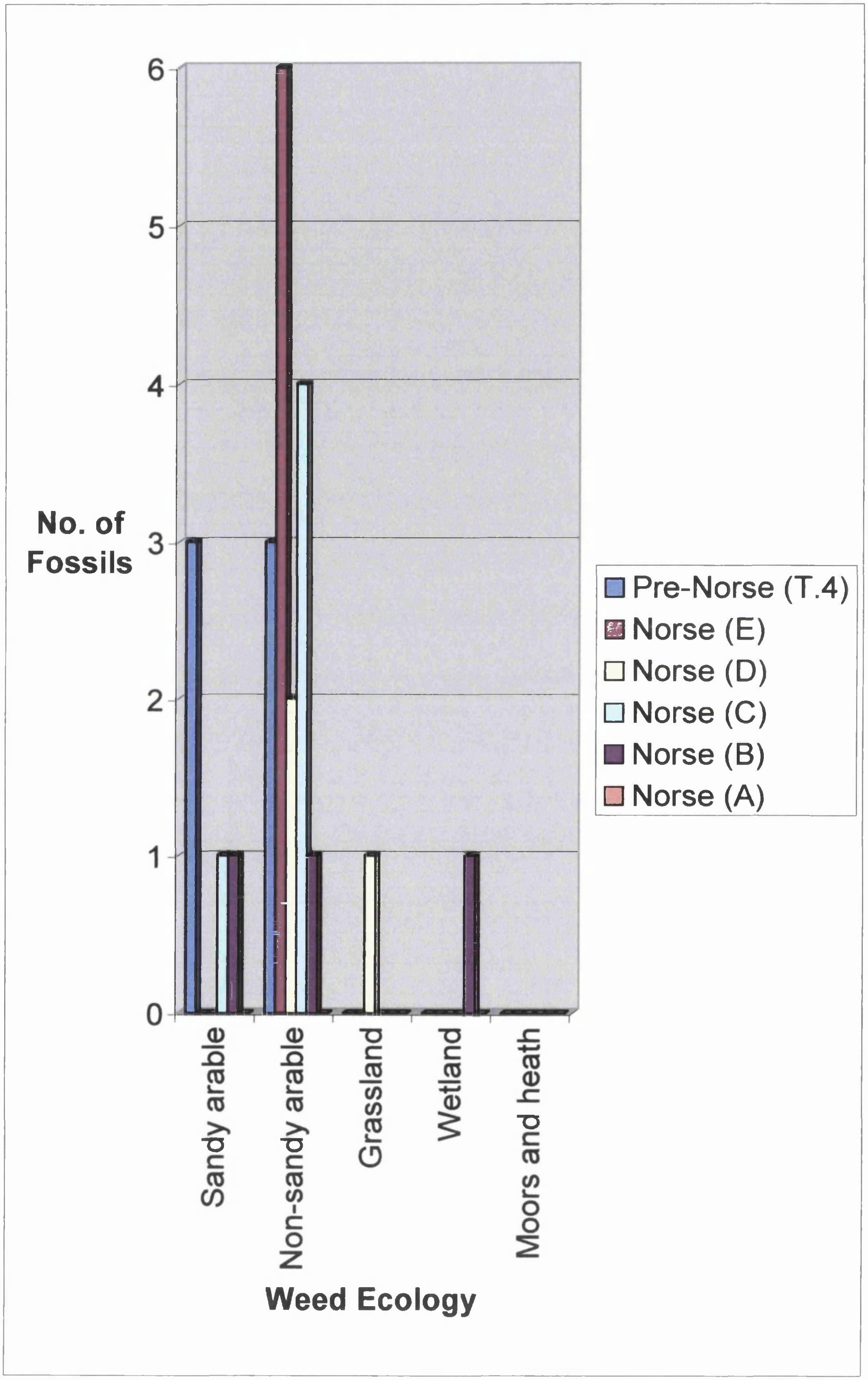
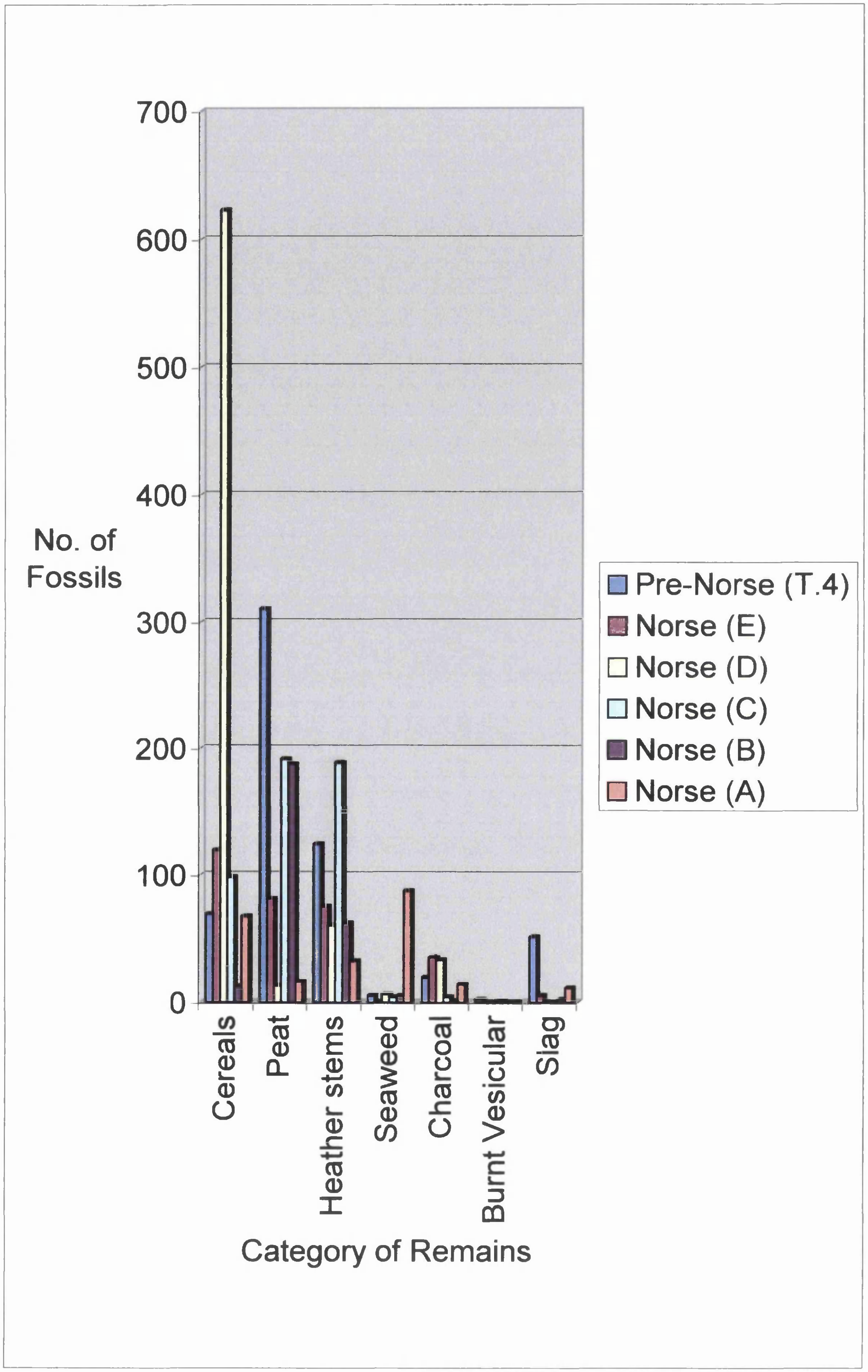


Fig. 19: Marymas Green, Caithness: Comparison of Cereal Grain, Major Fuel and Wild Resources and Slag by Phase:



Peat continued to be a large component of the recovered remains from the Norse period. This was visible in the bulk samples as well as the samples taken for assessment of the midden, but was less obvious from box column 2, although differences in sample size probably account for this.

Seaweed was recovered in small amounts from the pre-Norse samples, it was found in box column 1 throughout the prehistoric agricultural layers, and from the possibly Pictish dated bulk sampled deposits in trench 4. The presence of seaweed within sealed agricultural layers strongly points to its use as an artificial fertiliser at this time. Burnt vesicular remains, which may represent animal dung, were also recovered from the pre-Norse phase, which could suggest the combined use of seaweed and dung on arable fields. In the Norse period seaweed continued to be present in small amounts in the midden, until the final phase when seaweed deposition increased dramatically. A similar increase in seaweed was seen in material processed from box column 2. However bulk floated samples from the assessment failed to show such a rapid increase, and possible reasons for this will be discussed below in 3.5.7.

The increase in seaweed deposition in the later Norse midden may suggest that this material was no longer being spread onto agricultural fields. It has been burnt perhaps as fuel or in lye manufacture (see chapter section 1.5.2.4) and subsequently middened, but has not been applied to arable fields. This could suggest an important economic change occurring at this period, with key indicators being the concurrent rise of seaweed and fish bone in the midden, at the same time as a decrease in the deposition of cereal grain. These factors will be discussed further in 3.5.6.

3.5.5: Charcoal:

Charcoal recovery by phase is summarized in **table 12**, and illustrated in **fig. 20**, and presented together with industrial waste in the form of slag. This is to enable a comparison of slag and charcoal presence to be made, and to facilitate comparative interpretation with the other sites analysed in the thesis where slag was recovered (discussed further in chapter section 8.1.4). The largest category of charcoal recovered from all phases at Marymas Green was 'indeterminate', which, as will be discussed in subsequent chapters, probably reflects upon the recycling on repeated use of such a valuable resource around the site. These charcoal pieces were mostly fragmentary and poorly preserved, which could potentially be seen as a consequence of repeated heating / re-use. Experimental work with charcoal in various types of hearths, e.g. for metalworking, domestic, and corn drying, would be very useful to archaeobotanists analysing the gross morphology of charcoal pieces, and the author would suggest that this would make a very useful study.

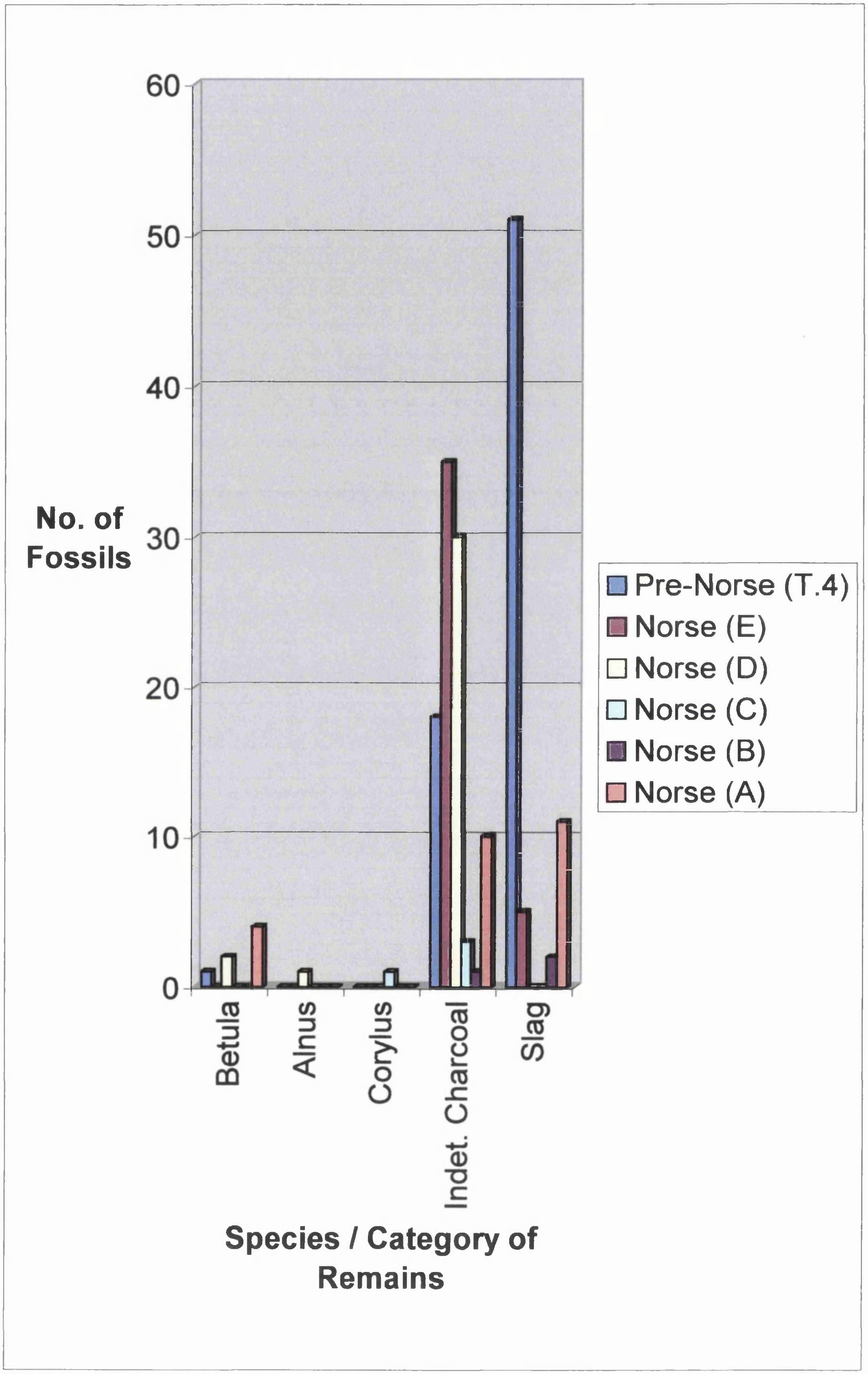
The species recorded from Marymas Green consisted of *Betula* (birch), *Alnus* (alder) and *Corylus* (hazel). All of these may have been growing local to the site, hazel in open scrub areas; alder and birch possibly as scrub forms on bogs and other wetland areas. *Betula* was recovered from the pre-Norse phase, together with a large amount of slag, and indeterminate charcoal. This may suggest the use of birch in metalworking, although the importance of peat charcoal should not be overlooked at this period (for a more thorough discussion of metalworking fuels see chapter 5). As previously discussed (see section 3.5.4 and **fig. 19**) peat was recovered in abundance from the pre-Norse phases and was probably a major fuel in this period.

Norse phases at Marymas Green continued to produce birch charcoal, but also saw the use of alder and hazel wood, which were absent from the pre-Norse samples. Slag presence decreased in the early phases of the Norse midden but saw an increase towards the final stages of deposition, along with a rise in birch

Marymas Green, Caithness: Phasing:	Pre-Norse	Norse	Norse	Norse	Norse	Norse
Bulk Sample Group:	**Trench 4**	**Midden E**	**Midden D**	**Midden C**	**Midden B**	**Midden A**
Charcoal:						
Betula	0.1g (1)	0	0.2g (2)	0	0	0.4g (4)
Alnus	0	0	0.1g (1)	0	0	0
Corylus	0	0	0	0.2g (1)	0	0
Indet. Charcoal	0.25g (18)	0.5g (35)	0.7g (30)	0.2g (3)	0.05g (1)	0.4g (10)
Slag	2.2g (51)	<0.05g (5)	0	0	0.1g (2)	2.0g (11)

Table 12: Marymas Green, Caithness: Summary Table of Charcoal from the Pre-Norse and Norse Phases. (Note: Figures in brackets represent actual counts).

Fig. 20: Marymas Green, Caithness: Summary Chart of Recovered Charcoal and Slag by Phase:



charcoal. However, recovery of charcoal was overall very low, so patterns of change in species use are difficult to interpret.

3.5.6: Other Remains:

Fish bone, mammal and bird bone, and marine mollusc shell were recovered in large amounts from Marymas Green. Mammal and bird bones were grouped together for analysis and are labelled as 'other bone' in the tables and figures. **Fig. 21** compares the presence of marine resources, namely, fish, marine shell, and seaweed with the recovery of cereal grain and 'other bone' from the bulk samples. In the pre-Norse, fish and mammal / bird bone were recovered in almost equal numbers. Dr. J. Richardson identified bones of sheep, pig and cattle, together with occasional large bird bones. Bird bone was not speciated but the presence of large bones suggested that marine species, such as fulmars, gannets and cormorants were probably exploited for their meat, feathers and oil. The recovered mammal bone assemblage indicated the presence of one adult pig, one adult sheep, and four cows, which consisted of two mature animals, one juvenile and one neonatal specimen (Richardson, pers. comm.). This material was all recovered from the pre-Norse deposits, suggesting animal husbandry was occuring at this time, together with the exploitation of local 'wild' resources such as bird and a small amount of fishing. The pre-Norse box column 1 (see **fig. 22**) and bulk samples from trench 4 also pointed to the presence of marine shell in use at this time. This material may have been used for fishing bait or gathered for human consumption.

Recovery of fish bone increased dramatically in the Norse midden deposits, although occasional fluctuations in the amounts present could be seen. **Fig. 21** illustrates the rise in fish bone recovery occuring from midden layer C onwards, with the largest amount present in the most recent (probably Late Norse) layers. This rise is reflected in the results from box column 2, (see **fig. 23**). After the peak in cereal recovery seen in layer D, cereal grain presence gradually decreased as the presence of fish bone increased in the midden deposition. Cereals were still consumed at Marymas, but it would appear that their importance gradually declined as the fishing economy became the major influence on the site. The large rise in middened seaweed in layer A is probably also linked to these events, as this material had not been spread onto arable fields. Agricultural productivity probably declined or shifted elsewhere in the Late Norse period, as the importance of fishing overtook the needs of the subsistence farming economy in coastal areas. Indeed cereal grain may have been imported to this site from elsewhere in this period in exchange for fish products. The midden remains examined certainly suggested a large economic shift in emphasis occuring on the site sometime during the Norse period. The broad based subsistence economy of the Pictish period utilising cattle, sheep, pig and cultivated crops, supplemented with a small amount of fishing, and gathering of marine resources, had been largely replaced by the dominance of the fishing economy by the Late Norse period.

3.5.7: Comparison of Processing Methods:

A total of 40 litres of assessment samples (**table 4** and **fig. 25**), had been processed by flotation methods and the results are broadly quite similar to the material that was laboratory processed (**tables 5** and **6**, and **figs. 17-21**). Differences occurred in the quantity of cereal grain recovered from various levels of the midden, and in the presence of seaweed, between the differently processed samples. Peat recovery was roughly comparable, with peaks in levels C and B, and a decline visible in level A. Processing by flotation tank did not appear to have destroyed vast quantities of this material, as similar amounts were recovered from the laboratory processed samples. Seaweed recovery presented a slightly different picture, as its presence did not increase as much in the floated samples as in the laboratory samples in the latter stages of the midden formation. These differences may simply result from differential deposition - as different areas of the midden were sampled in 1994 and 1995. However, broadly the trends viewed from the recovery of other macrofossils were similar. The lack of seaweed from the floated samples maybe reflects upon the failure of student sorters to recognise all elements of this category of material during residue sorting.

Cereal grain recovery from level C was roughly the same in floated and laboratory samples. However the recovery obtained from level D was quite radically different. The sample volumes processed were the same, so this cannot be attributed to sample size. Level D of the assessment produced very few remains, but in the bulk samples was the most abundant layer. It is difficult to envisage such large disimilarities in recovery being a result of poor processing technique or variations in machine / laboratory recovery, given the experience of the floater (Dr. J.H. Barrett) and the sandy easily disaggregated nature of the soil matrix. It is more likely that this has resulted from sampling different areas of the midden and is a product of formation processes and preservation, rather than accurately reflecting the processing technique used. The overall results of this comparison of processing technique are therefore fairly inconclusive, other than to emphasise the overall importance of using trained staff when residue sorting.

Fig. 21: Marymas Green, Caithness: Presence of Marine Resources Compared to Cereal Grain and Bone by Phase:

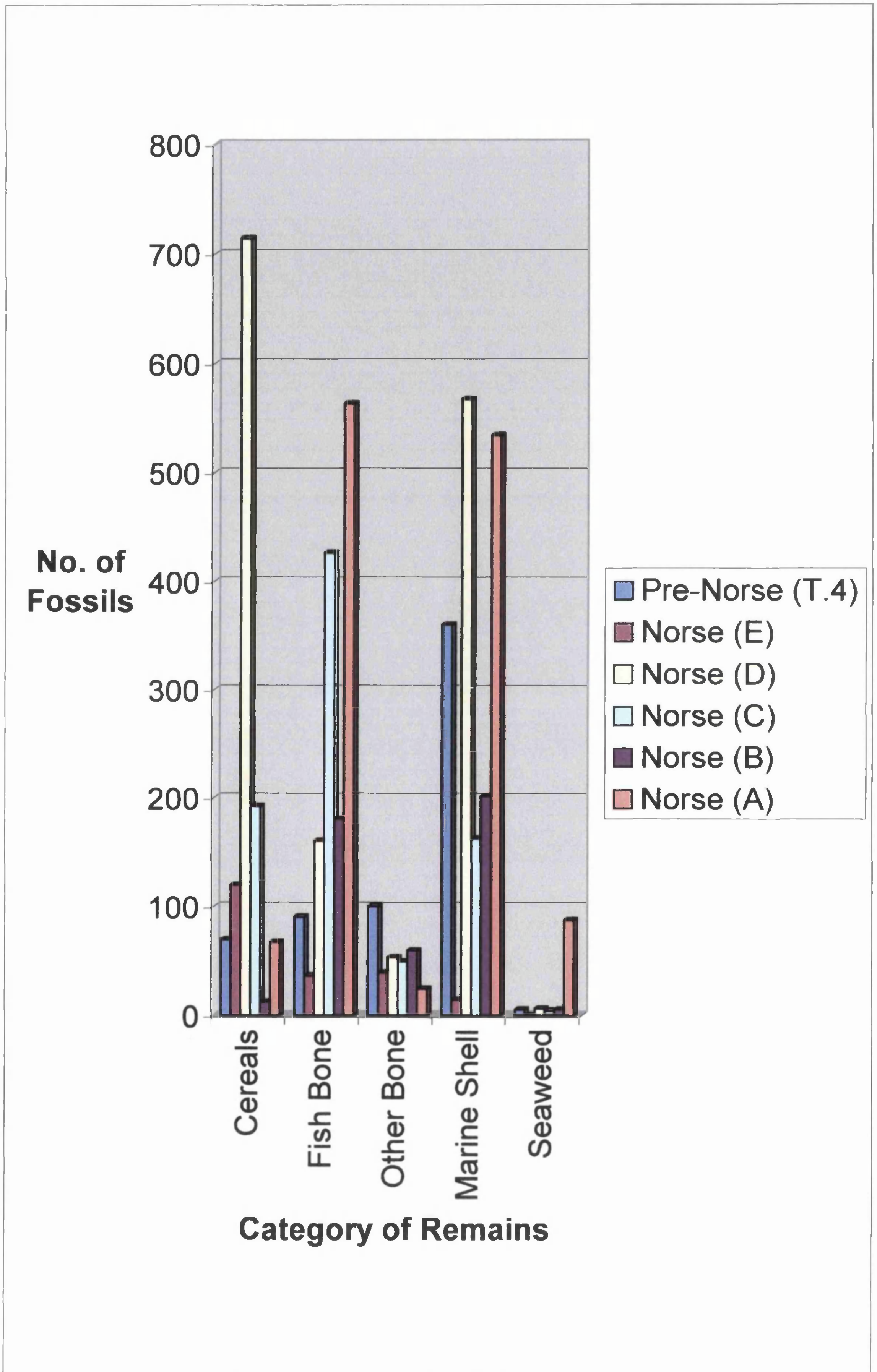


Fig. 22: Marymas Green, Caithness: Summary Chart of Remains from Box Column One: Pre-Norse Phase Undated: (oldest first):

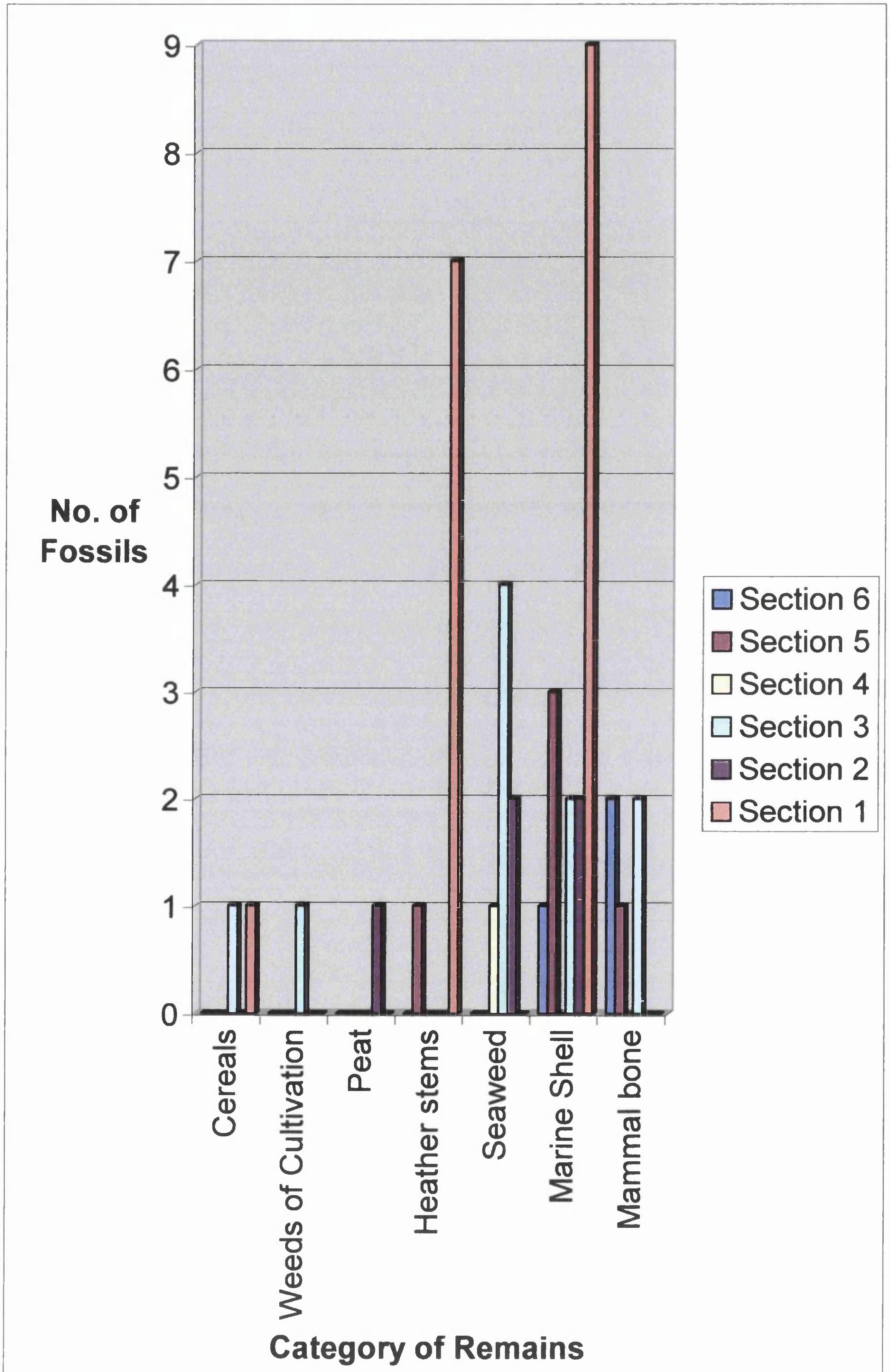


Fig. 23: Marymas Green, Caithness: Box Column Two: Norse Midden Phases: (oldest first):

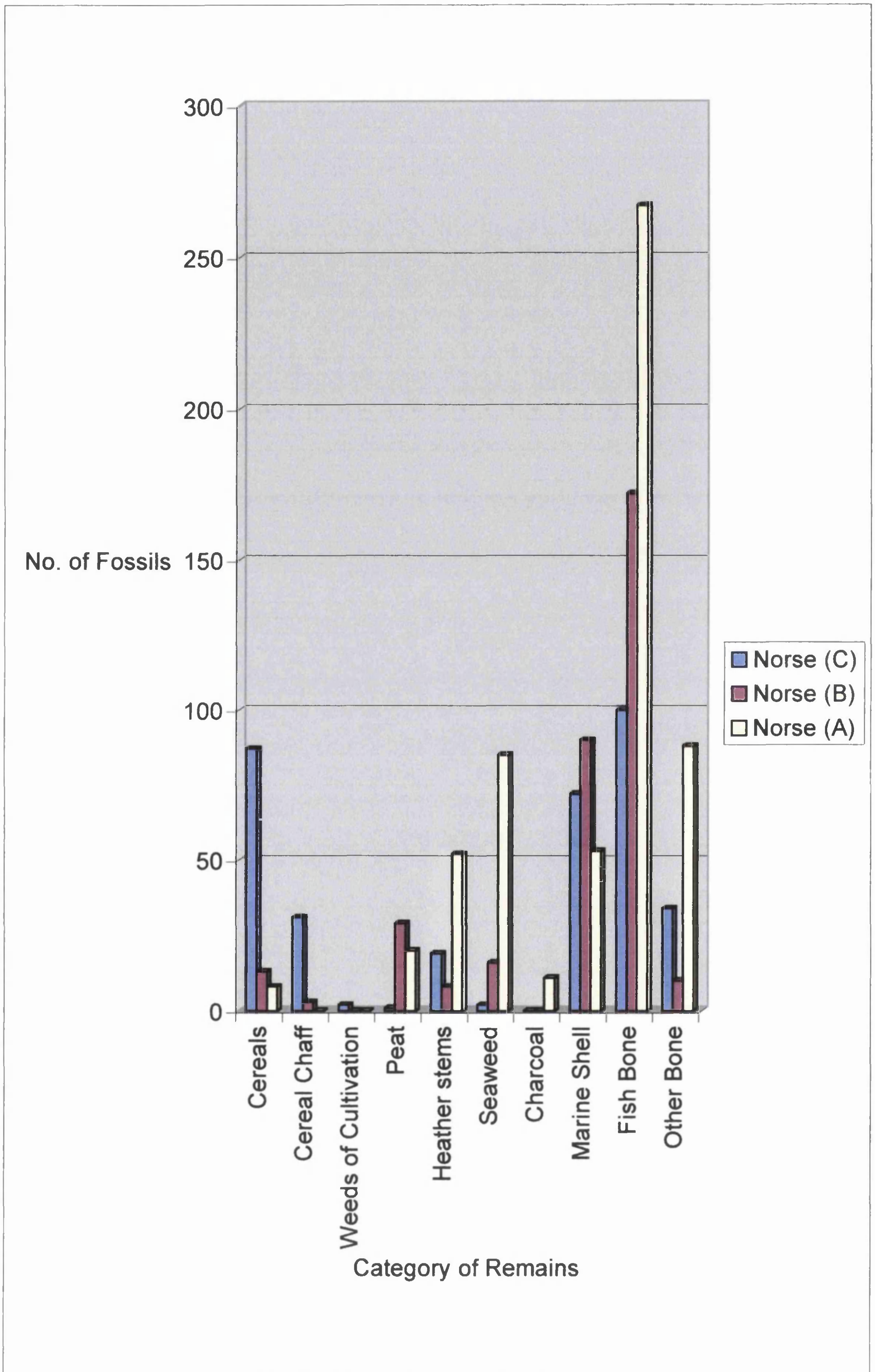


Fig. 24: Marymas Green, Caithness: Summary Chart of Environmental Remains from Spot Finds / Samples:

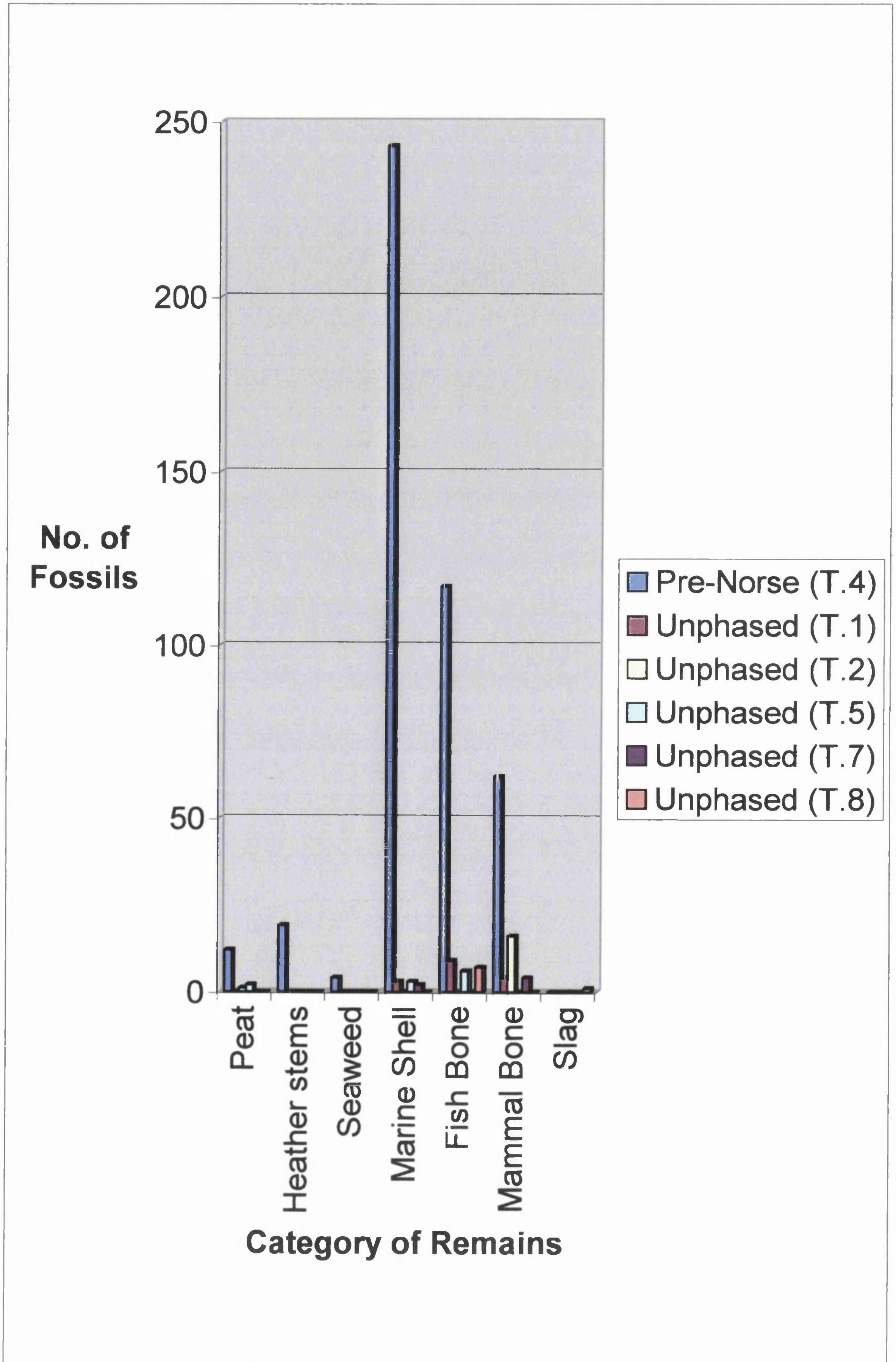
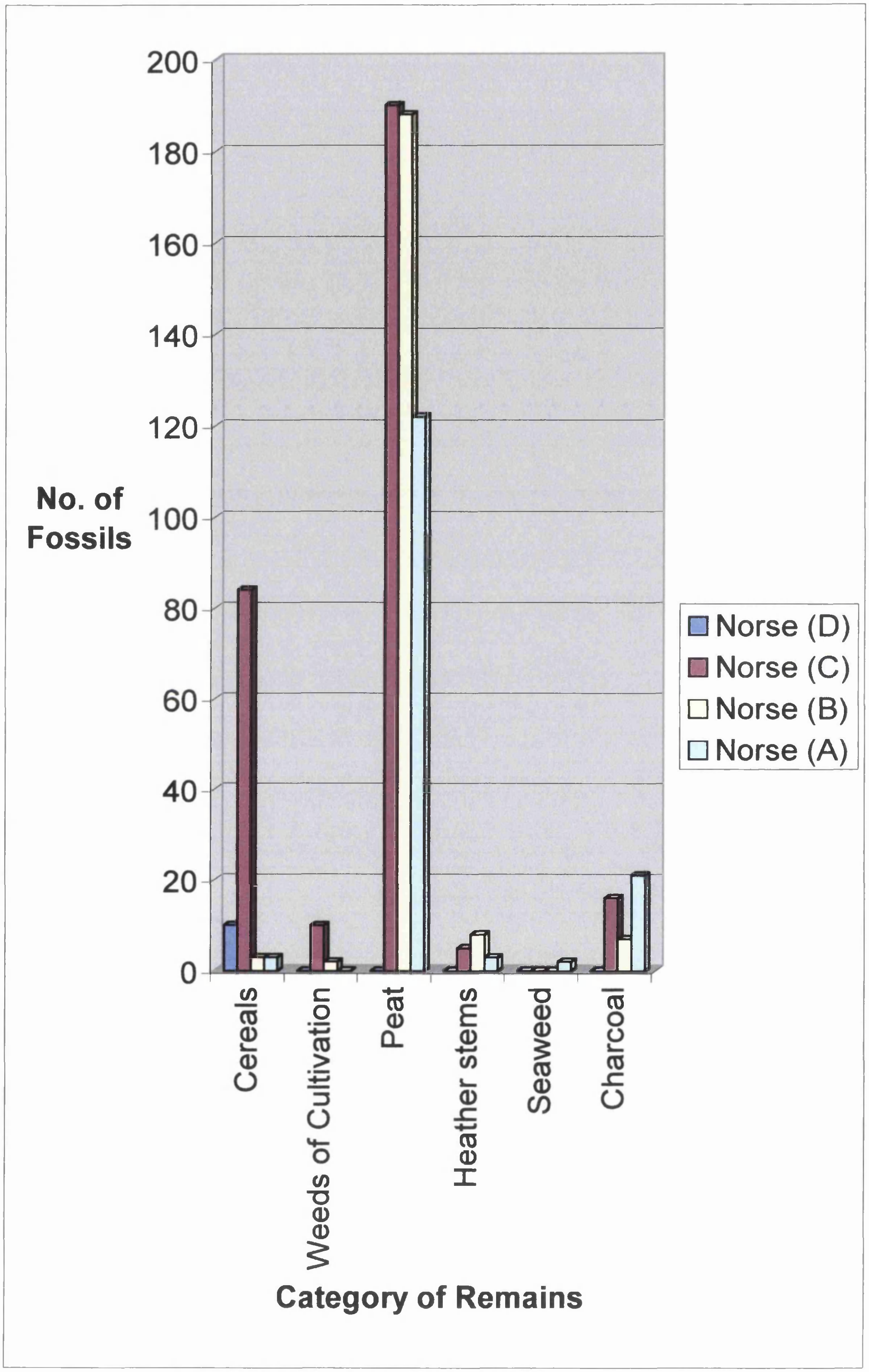


Fig. 25: Marymas Green, Caithness: Summary Chart of Remains from Norse Midden Assesment: (oldest sample first):



Chapter Four:

4: Geodha Smoo, near Durness, Sutherland:

4.1: Location of Site and Archaeological Background:

The Geodha Smoo is a narrow rock cut inlet located on the far northwestern coast of Scotland, near the village of Durness, Sutherland, adjacent to the A838. A series of caves are located within the inlet, including the famous Smoo cave. **Fig. 26** shows the location of the caves on the Sutherland coast. The cave system was created by a combination of successive episodes of high sea level over many hundreds of thousands of years, and a weak fault line in the Cambrian Limestone geology of the local area. The soft limestone eroded at a faster rate than the surrounding geology of mainly Lewisian gneiss. As the cavern deepened the cave roof progressively collapsed resulting in the formation of an inlet some 600 metres in length (Gleed-Owen 1992). The inlet culminates in a main cavern (shown in **plate 7**) measuring an impressive 35 metres wide by 50 metres deep approximately (Pollard 1996b).

Outwith of the main cave, and approximately 80 metres to the north, several smaller caverns have been eroded into the wall of the inlet. Two of these caves were investigated and named respectively Glassknapper's cave and Antler cave in order to avoid confusion with the main Smoo cave. The name 'Smoo' derives from the Old Norse *smuga*, meaning 'rift' or 'cleft', whilst the Gaelic word geodha, is also derived from ON *gja*, meaning cleft (Fraser 1995: 94). The inlet probably acted as a safe harbour for local fishing boats and visiting Norse traders, whilst the caves themselves formed a convenient processing station for the gutting of large amounts of fish, and probably a regional stopover point for travellers on longer journeys. **Plate 8** was taken looking north along the inlet and illustrates the sheltered position of this location. This area of north-western Sutherland would have been an extremely important settlement location during the Norse period, particularly for travellers preparing to sail the dangerous waters around Cape Wrath, on the trade route to the Western Isles. Nearby areas of coastal machair such as at Balnakeil could have provided a prime location for agricultural settlement. Indeed, the excavations at Sangobeg have revealed pre-Norse and Norse occupation in this area, although the results from this site await further analysis and publication.

4.2: Archaeological Excavation 1992 and 1995 Seasons:

4.2.1: Location of Trenches:

Glasgow University Archaeological Research Division carried out two seasons of excavation in the Geodha Smoo. The first, in 1992, lasted only four days and was funded by Caithness and Sutherland Enterprise, concentrating on the recording and sampling of a midden section within Smoo cave itself, prior to the construction of a protective wall to prevent further erosion of the midden (Pollard 1992). In 1995 a more extensive four-week programme of work, funded by Historic Scotland, was carried out in Glassknapper's cave and Antler cave. Entrances to both caves were partially blocked by extensive midden deposits, often up to 2 metres deep. These deposits were subject to continuing erosion at high tide, and excavation was necessary before all were lost to the sea. For the purposes of this thesis the remains from the 1995 excavation were examined. **Fig. 27** shows the relative positions of the two caves and the location of the excavated trenches. **Fig. 28** shows a section drawing of the midden deposits sampled in Glassknapper's cave.

4.2.2: Stratigraphic Phasing:

The midden material from Glassknappers cave was radiocarbon dated. The choice of contexts to date was made by Dr. A. Pollard, who selected samples from spits

Plate 7: Smoo Cave, Durness, Sutherland 1996. (Photo: D. Alldritt).

Plate 8: Smoo inlet looking north, Durness, Sutherland 1996.
(Photo: D. Alldritt).

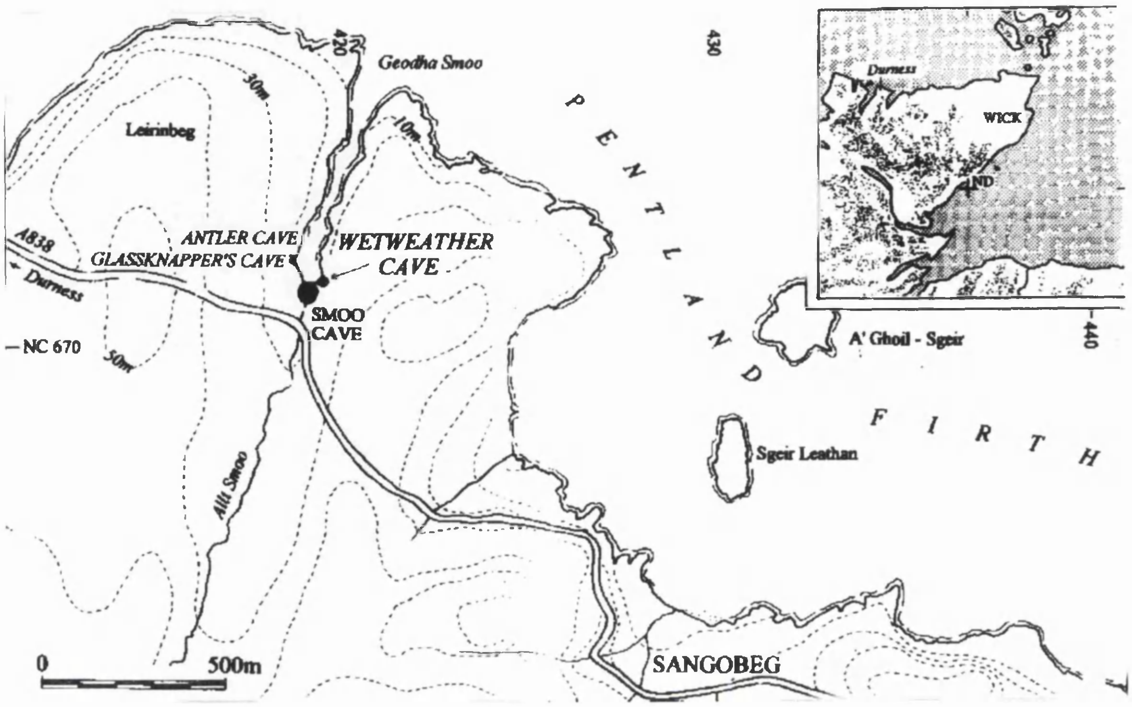


Fig. 26: Location map of Geodha Smoo, Durness, Sutherland. (Pollard 1996b).

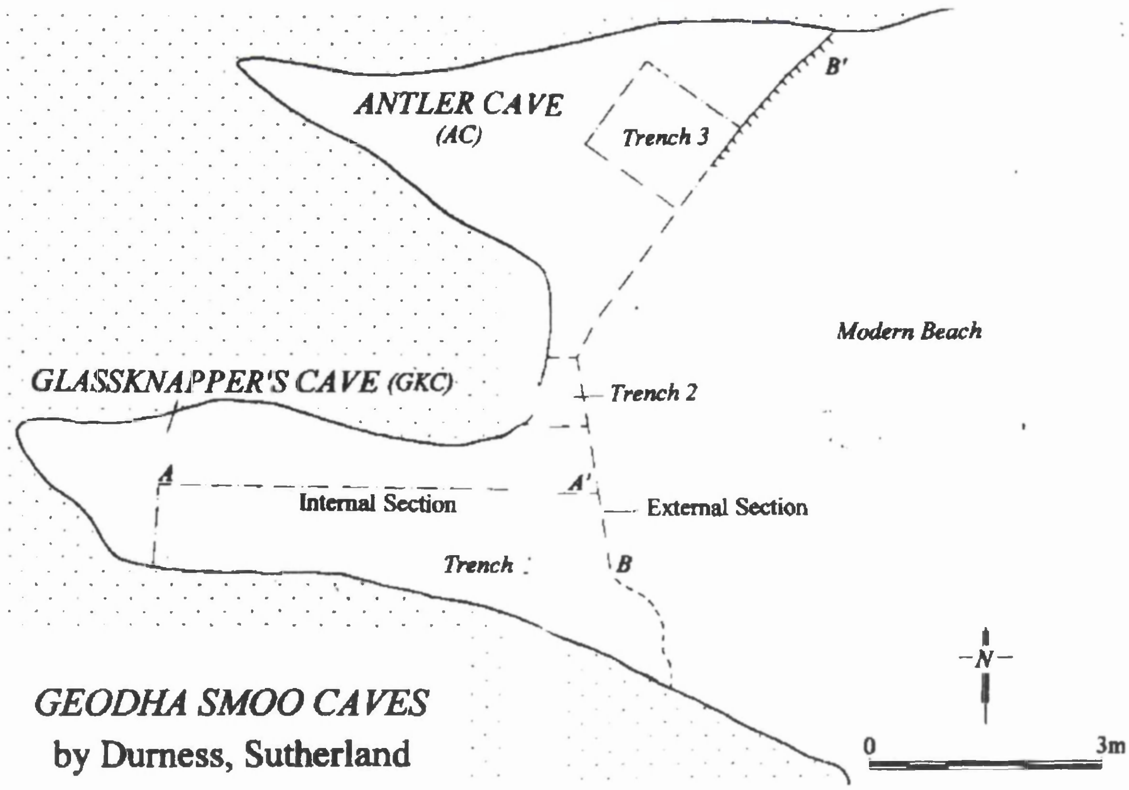


Fig. 27: Location of excavated trenches in Geodha Smoo. (Pollard 1996b).

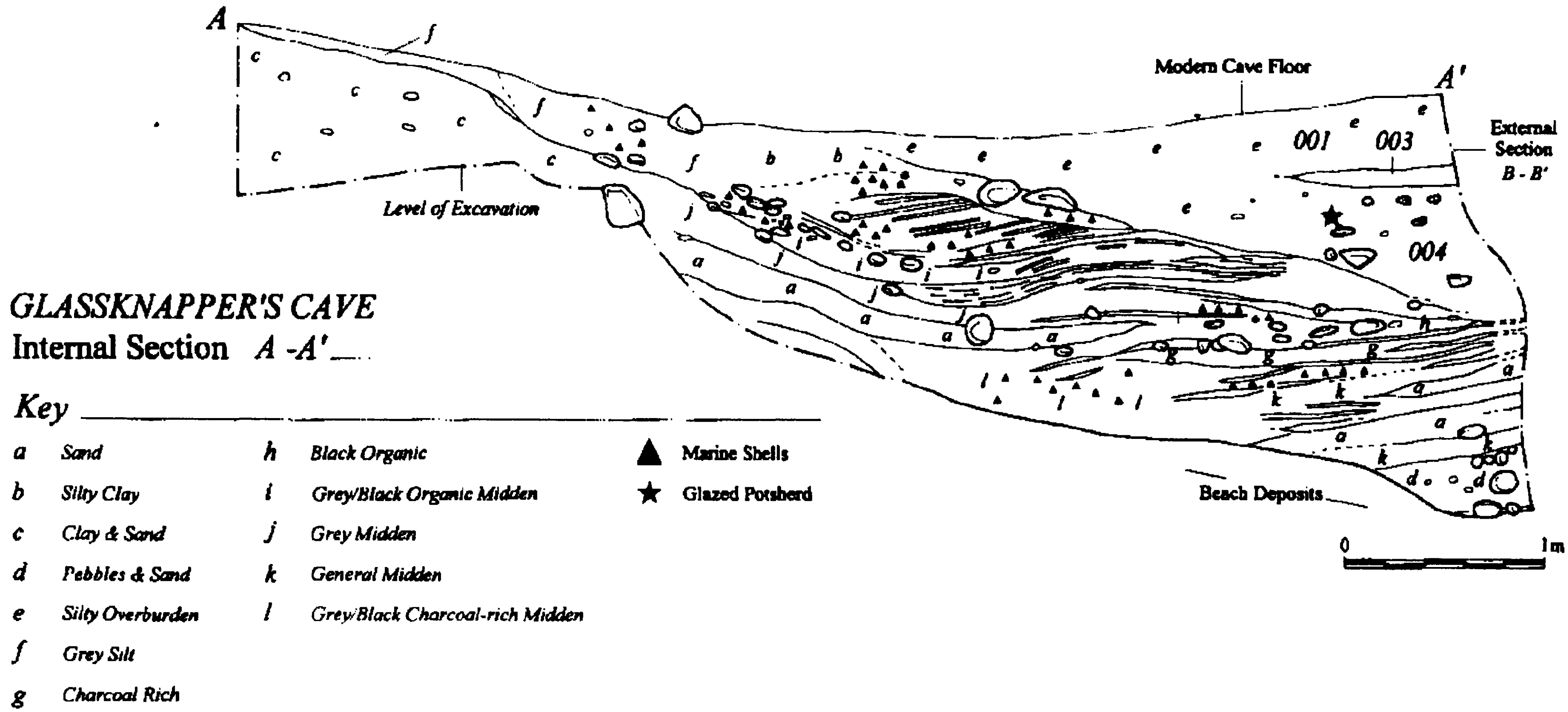


Fig. 28: Section drawing of midden deposits in Glassknapper's Cave, Geodha Smoo. (Pollard 1996b).

taken at different levels of the midden. These dates were based upon charcoal examined by the author and were taken, starting at the base of the midden, from spit 33, spit 15 and spit 2 respectively. The dates were returned (Bronk-Ramsay *et al* 1999) and calibrated to the two sigma level, producing the following results:

Spit 33: AD 820 – 1000 (OxA-8212) (Indeterminate charcoal).
Spit 15: AD 770 – 980 (OxA-8211) (Indeterminate charcoal).
Spit 2: AD 890 – 1160 (OxA-8210) (*Betula* and *Salix* charcoal).

This information placed the midden accumulation firmly in the Norse period, and interpretation of the use of the cave could possibly be extended into the very Early Norse period. Site chronology and phasing are described in **Table 13**.

4.3: Environmental Sampling and Processing:

4.3.1: Sampling Strategy:

The excavation of the midden deposits revealed the dumping of large quantities of domestic waste, including fish bone, mammal bone, marine mollusc shells and carbonised plant remains. Inside Glassknapper's cave excavation revealed an extremely complex sequence of deposits. The stratigraphy consisted of many layers and lenses of organic deposits, clays and silts, ash, charcoal, shell, bone, and sand (Pollard 1996b). These deposits were often impossible to excavate as individual contexts, and so the archaeologists decided to excavate and sample these features as a continuous column sample. The column sample was taken at the deepest portion of the deposits and measured approximately 0.75m by 0.75m, with samples bagged in 0.02m spits (Pollard 1996b). In Antler cave the deposits consisted of looser, less compacted lenses than in Glassknapper's cave. These were excavated by means of a small trench beginning at the external section and extending for just over a metre into the cave, and were sampled in bulk. **Table 14**

Table 13: Geodha Smoo Phase and Dating Concordances:

Period	Phase	Contexts	Dating
Pre-Norse / Unknown	Antler Cave Unphased	028, 029, 035, 036, 040	None
Norse?	Glassknapper's Cave Unphased	013, 019, 021, 030, 037	None
Norse?	Glassknapper's Cave Unphased	Context 008: Spits 1-6	None
Early Norse	Glassknapper's Cave Post AD820-1000	Column Spits 16-33	C14 Indeterminate Charcoal
Early Norse	Glassknapper's Cave Post AD770-980	Column Spits 3-15	C14 Indeterminate Charcoal
Late Norse	Glassknapper's Cave	Column Spits 1-2	C14 Birch / Willow Charcoal

Table 14: Smoo Cave, Sutherland, Excavation 1995: List of Samples:

Bulk Environmental Samples (1995):	Volume (l)	Processing	Sieve Size
GKC Column Sample Spit 1	3	Floated on site	>250um
GKC Column Sample Spit 2	5	Floated on site	>250um
GKC Column Sample Spit 3	5	Floated on site	>250um
GKC Column Sample Spit 4	5	Floated on site	>250um
GKC Column Sample Spit 5	2.5	Floated on site	>250um
GKC Column Sample Spit 6	3	Floated on site	>250um
GKC Column Sample Spit 7	3	Floated on site	>250um
GKC Column Sample Spit 9	3	Floated Glasgow	>500um
GKC Column Sample Spit 10	5	Floated Glasgow	>500um
GKC Column Sample Spit 11	5	Floated Glasgow	>500um
GKC Column Sample Spit 12	2	Floated Glasgow	>500um
GKC Column Sample Spit 13	3	Floated Glasgow	>500um
GKC Column Sample Spit 14	2.5	Floated Glasgow	>500um
GKC Column Sample Spit 15	3	Floated Glasgow	>500um
GKC Column Sample Spit 16	3	Floated Glasgow	>500um
GKC Column Sample Spit 17	3	Floated Glasgow	>500um
GKC Column Sample Spit 18	3	Floated Glasgow	>500um
GKC Column Sample Spit 19	3	Floated Glasgow	>500um
GKC Column Sample Spit 20	3	Floated Glasgow	>500um
GKC Column Sample Spit 21	2	Floated Glasgow	>500um
GKC Column Sample Spit 23	3	Floated Glasgow	>500um
GKC Column Sample Spit 24	3	Floated Glasgow	>500um
GKC Column Sample Spit 25	5	Floated Glasgow	>500um
GKC Column Sample Spit 26	2	Floated Glasgow	>500um
GKC Column Sample Spit 27	3	Floated Glasgow	>500um
GKC Column Sample Spit 28	3	Floated Glasgow	>500um
GKC Column Sample Spit 29	3	Floated Glasgow	>500um
GKC Column Sample Spit 31	3	Floated Glasgow	>500um
GKC Column Sample Spit 32	2	Floated Glasgow	>500um
GKC Column Sample Spit 33	3	Floated Glasgow	>500um
GKC (008) Spit 1	10	Floated on site	>500um
GKC (008) Spit 2	10	Floated on site	>250um
GKC (008) Spit 3	14	Floated on site	>500um
GKC (008) Spit 4	10	Floated on site	>250um
GKC (008) Spit 5	12	Floated on site	>250um
GKC (008) Spit 6	10	Floated on site	>250um
GKC (008) Slot 1, Trans 1	14	Floated on site	>500um
GKC (008) Slot 1, Trans 1 Ext. (Loose)	14	Floated on site	>250um
GKC (008) Slot 2, Spit 3	12	Floated Glasgow	>500um
GKC (008/013) Slot 2, Spit 1	10	Floated Glasgow	>500um
GKC (008/013) Slot 2, Spit 5	10	Floated Glasgow	>500um
GKC (012) Slot 2, Spit 2	10	Floated Glasgow	>500um
GKC (013) Slot 2, Spit 1	10	Floated on site	>500um
GKC (013) Tumble	14	Floated on site	>500um
GKC (019)	N/A	Spot charcoal	N/A
GKC (021) N.+S. Spit, Trans 1	12	Floated on site	>500um
GKC (030)	N/A	Spot charcoal	>500um
GKC (037) Slot 2	N/A	Spot charcoal	N/A
AC (028)	10	Floated Glasgow	>500um
AC (029)	10	Floated Glasgow	>500um
AC (035)	10	Floated Glasgow	>500um
AC (036)	10	Floated Glasgow	>500um
AC (040)	10	Floated Glasgow	>500um

lists the samples taken from both caves and provides volume information – weights are not available for this site.

4.3.2: Sample Processing:

A total of eighteen of the environmental samples were processed on site using a water flotation machine as described in chapter 2.2.3.4. The main source of water for this process was the sea, which did not appear to have damaged any of the plant material recovered. However, the author would prefer to use a 'mains' water supply when processing environmental samples, both to prevent contamination and because seawater forms salt crystals when dry which could cause damage to carbonised plant remains. The electric pump used for this process broke down during the excavation and so the remaining samples were returned to Glasgow for bulk flotation by a University technician. Samples were sieved to >500μm and >250μm.

4.3.3: Sample Analysis:

All samples were received by the author in a fully processed condition. Therefore it was not possible to sieve any samples under laboratory conditions in order to provide comparative material to the floated remains. Residues from this site were sorted by GUARD staff and environmental remains forwarded as appropriate.

4.4: Results:

The results from Smoo are presented in gatefold form in **tables 15**, **16** and **17**. The following samples produced no environmental data and were not included in the tables: column spits: 12, 14, 26, 31 and 33; C.008 (spit 1); bulk samples: C.012 (SI.2, sp.2); C.037 (SI.2). Antler cave samples: C.028; C.029; C.035; C.036; C.040. Raw data **tables 15**, **16** and **17** are presented on the following pages.

Table 15: Geodha Smoo: Midden Column Spits 1-13

Small Poaceae	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
Poa sp.											
Bromus sp.	1		1								
Danthonia decumbens				1		2					
Charcoal:											
Picea											
Pinus sylvestris	0.15g(3)		0.25g(2)	0.95g(2)							
Indeterminate Coniferous type											
Ulmus											
Quercus											
Betula	1.45g(8)	2.0g(10)	0.55g(5)	1.4g(10)		1.1g(7)	0.4g(3)		0.2g(2)		
Alnus	0.45g(4)					0.5g(3)	0.1g(2)				
cf. *Alnus*											
Corylus			0.1g(1)	0.5g(4)		0.1g(1)	0.25g(4)		0.25g(2)		
cf. *Corylus*							0.15g(1)				
Salix		0.1g(1)		0.5g(4)		0.15g(2)			0.5g(2)		
Malus / Crataegus type											
Prunus spinosa											
cf. Pomoideae	0.15g(1)										
Indeterminate charcoal		0.5g(7)	0.2g(2)	0.5g(7)	0.15g(2)	0.15g(2)	0.05g(1)	0.1g(5)			0.05g(2)
Sorted indeterminate charcoal		8.7g		1.0g		14.4g	1.0g		5.3g		6.3g
Non-Plant: Marine Mollusc Shell:											
Patella vulgata: Whole shells	25.0g(7)										
Patella vulgata: Fragments	19.2g(44)										
Littorina littorea	10.0g(4)										
Littorina saxatilis	0.05g(2)	0.05g(2)									
Nucella lapillus											
Mytilus edulis	1.2g(3)	0.2g(1)									
Indeterminate fragments							<0.05g(1)		<0.05g(1)		
Non-Plant: Bone:											
Fish bone (unburnt)	19.55g(430)	0.65g(4)	0.35g(10)	0.15g(6)		0.35g(26)	0.2g(4)				
Fish bone (burnt)	2.15g(40)	0.3g(26)		0.05g(3)		12.8g(302)			0.2g(7)		
Mammal bone (unburnt)	5.5g(4)							0.05g(2)			
Mammal bone (burnt)											
Bird bone (unburnt)							0.1g(1)				
Bird / small mammal claw						<0.05g(1)	<0.05g(4)				
Non-Plant: Other:											
Industrial residue (slag)											
Non-marine mollusc shells		<0.05g(1)	<0.05g(2)	<0.05g(3)	0.05g(6)	0.1g(6)	0.1g(19)	0.35g(26)		<0.05g(5)	0.1g(22)

Geodha Smoo: Environmental Remains:	**C.S.**	**C.S.**	**C.S.**	**C.S.**	**C.S.**	**C.S.**	**C.S.**	**C.S.**	**C.S.**	**C.S.**	**C.S.**
Carbonised Cereal Grain and Chaff:	**Sp. 1**	**Sp. 2**	**Sp. 3**	**Sp. 4**	**Sp. 5**	**Sp. 6**	**Sp. 7**	**Sp. 9**	**Sp. 10**	**Sp. 11**	**Sp. 13**
Avena sativa florets (with bases)		1									
Avena sativa grain in florets (with bases)											
Hordeum sp. rachis internode										1	
Indeterminate Cerealia / Poaceae stem fragments	1		7		1					2	
Avena sp.	4	6	5	2	7						1
Avena sp. (rolled flat ?)					1						
cf. *Avena* sp.		1		1							
Hordeum vulgare var. *vulgare*		2		2				1			
Hordeum vulgare var. *vulgare* (twisted grain)					1						
Hordeum vulgare var. *nudum*	1		1							1	
Hordeum vulgare sl.	1	6	2	3			2	2	1	3	
cf. *Hordeum* sp.						1				1	
cf. *Triticum dicoccum*						1					
cf. *Triticum* sp.											
Indeterminate Poaceae / Cerealia											
Indeterminate cereal grain (+embryo)	2		4			2	4			3	
Carbonised Wild Resources:											
Burnt Peat fragments	1.4g(5)	1.4g(74)				0.6g(16)			0.6g(50)		1.2g(154)
Corylus avellana nut shell fragments						<0.05g(2)					0.1g(2)
Calluna stems (roots / twigs)	0.15g(7)	0.8g(58)	0.1g(4)	0.75(9)	0.1g(2)	5.7g(340)	0.2g(2)		1.2g(86)		0.2g(31)
Calluna vulgaris (seed)						2	5	2			
Calluna flowers											
Calluna leafy shoots	13	6	31	15	32	57	40				2
Calluna capsules	4	6	44	170	32	40	39				7
Carbonised Seaweed fragments	<0.05g(2)										<0.05g(1)
Indeterminate Rhizome fragments											
Cyperaceae Rhizome fragments											
Carbonised Bud											
Indeterminate twig fragments	<0.05g(2)			0.25g(1)							
Carbonised Weeds:											
Ranunculus repens	1	3	1	8	1		7				
Ranunculus scleratus	1	1	1		2		1				
Ranunculus flammula		2		2							
Ranunculus sp.	2	3	3			2	2				
Chenopodium album			2								
Stellaria media	12	1	5	7	9	6	9	1		3	2
Spergula arvensis	7	3	10	2		2	1				
Silene cf. *vulgaris*											
Silene dioica	2					1					
Polygonum aviculare sl.		1									
Rumex sp.	20	8	19		8		1				
Empetrum nigrum		2	1	1	3						
Erica tetralix											
Erica cinerea											
Potentilla sp.					1	1	1				
Alchemilla alpina											
Rosa canina sl.	2	3		4							
Sorbus aucuparia		1		4							
Fabaceae					1		2				
Myosotis arvensis								2			
Galeopsis tetrahit		1									
Prunella vulgaris					1						
Plantago lanceolata			1		1	1					
Galium aparine				1		1	1	1			
Luzula sp.		2		1			1			1	
Scirpus (Isolepis) setaceus	1	1				1					
Scirpus sp.	3	2	1		3			1			1
Carex flacca	2			1						1	
Carex viridula ssp. *oedocarpa*											
Carex cf. *hostiana*											
Carex sp.		6	4					4			1
Large Poaceae		1		1							
Small Poaceae	45	4	33	19	17	18	3	3			
Poa sp.											
Bromus sp.	1		1								
Danthonia decumbens				1		2					
Charcoal:											
Picea											
Pinus sylvestris	0.15g(3)		0.25g(2)	0.95g(2)							
Indeterminate Coniferous type											
Ulmus											
Quercus											
Betula	1.45g(8)	2.0g(10)	0.55g(5)	1.4g(10)		1.1g(7)	0.4g(3)		0.2g(2)		
Alnus	0.45g(4)					0.5g(3)	0.1g(2)				
cf. *Alnus*											
Corylus			0.1g(1)	0.5g(4)		0.1g(1)	0.25g(4)		0.25g(2)		
cf. *Corylus*							0.15g(1)				
Salix		0.1g(1)		0.5g(4)		0.15g(2)			0.5g(2)		
Malus / Crataegus type											
Prunus spinosa											
cf. Pomoideae	0.15g(1)										
Indeterminate charcoal		0.5g(7)	0.2g(2)	0.5g(7)	0.15g(2)	0.15g(2)	0.05g(1)	0.1g(5)			0.05g(2)
Sorted indeterminate charcoal		8.7g		1.0g		14.4g	1.0g		5.3g		6.3g
Non-Plant: Marine Mollusc Shell:											
Patella vulgata : Whole shells	25.0g(7)										
Patella vulgata : Fragments	19.2g(44)										
Littorina littorea	10.0g(4)										
Littorina saxatilis	0.05g(2)	0.05g(2)									
Nucella lapillus											
Mytilus edulis	1.2g(3)	0.2g(1)									
Indeterminate fragments							<0.05g(1)		<0.05g(1)		
Non-Plant: Bone:											
Fish bone (unburnt)	19.55g(430)	0.65g(4)	0.35g(10)	0.15g(6)		0.35g(26)	0.2g(4)				
Fish bone (burnt)	2.15g(40)	0.3g(26)		0.05g(3)		12.8g(302)			0.2g(7)		
Mammal bone (unburnt)	5.5g(4)							0.05g(2)			
Mammal bone (burnt)											
Bird bone (unburnt)							0.1g(1)				
Bird / small mammal claw						<0.05g(1)	<0.05g(4)				
Non-Plant: Other:											
Industrial residue (slag)											
Non-marine mollusc shells		<0.05g(1)	<0.05g(2)	<0.05g(3)	0.05g(6)	0.1g(6)	0.1g(19)	0.35g(26)		<0.05g(5)	0.1g(22)

Table 16: Geodha Smoo: Midden Column Spits 15-32

Charcoal:														
Picea														
Pinus sylvestris														
Indeterminate Coniferous type										0.2g(1)				
Ulmus	0.1g(1)													
Quercus													0.6g(1)	
Betula	1.8g(12)	0.9g(5)	0.2g(1)		1.15g(9)	1.0g(7)	0.7g(4)	0.9g(1)	0.4g(4)		0.6g(6)	0.05g(1)	0.4g(1)	
Alnus	0.95g(9)	4.0g(15)	0.45g(1)		0.15g(2)			0.05g(1)						
cf. *Alnus*														
Corylus	0.8g(4)	0.8g(4)	0.4g(3)		0.1g(1)	0.6g(5)			0.9g(4)	2.0g(7)	0.6g(2)	0.05g(1)	0.2g(1)	
cf. *Corylus*														
Salix	0.3g(3)				0.1g(1)								0.2g(1)	
Malus / Crataegus type														
Prunus spinosa						0.1g(1)								
cf. Pomoideae														
Indeterminate charcoal	0.3g(3)	1.1g(10)	0.1g(1)	0.05g(4)	0.2g(9)	0.1g(1)	0.15g(10)					<0.05g(4)	0.8g(4)	0.05g(3)
Sorted indeterminate charcoal	8.4g	20.2g	11.3g		9.6g	16.9g	18.7g		12.7g	13.0g	11.0g			2.0g
Non-Plant: Marine Mollusc Shell:														
Patella vulgata: Whole shells														
Patella vulgata: Fragments														
Littorina littorea														
Littorina saxatilis														
Nucella lapillus														
Mytilus edulis														
Indeterminate fragments	0.1g(10)		<0.05g(2)				<0.05g(3)							
Non-Plant: Bone:														
Fish bone (unburnt)	1.35g(41)		0.3g(3)				<0.05g(2)							
Fish bone (burnt)		0.1g(10)									0.1g(12)			
Mammal bone (unburnt)		0.3g(3)	0.5g(2)	0.1g(1)	0.05g(1)									
Mammal bone (burnt)			3.9g(64)		0.6g(5)	1.2g(42)	1.4g(58)		0.05g(7)	1.3g(42)	0.45g(2)			
Bird bone (unburnt)	1.1g(5)													
Bird / small mammal claw														
Non-Plant: Other:														
Industrial residue (slag)						0.4g(15)	0.7g(40)		0.7g(4)	0.6g(7)				
Non-marine mollusc shells	<0.05g(1)	0.1g(12)				<0.05g(1)	<0.05g(3)	<0.05g(1)	0.05g(7)	<0.05g(1)	<0.05g(3)	0.15g(8)	<0.05g(2)	0.15g(12)

Geodha Smoo: Environmental Remains:	C.S.	C.S.	C.S.	C.S.	C.S.	C.S.	C.S.	C.S.	C.S.	C.S.	C.S.	C.S.	C.S.	C.S.
Carbonised Cereal Grain and Chaff:	**Sp. 15**	**Sp. 16**	**Sp. 17**	**Sp. 18**	**Sp. 19**	**Sp. 20**	**Sp. 21**	**Sp. 23**	**Sp. 24**	**Sp. 25**	**Sp. 27**	**Sp. 28**	**Sp. 29**	**Sp. 32**
Avena sativa florets (with bases)														
Avena sativa grain in florets (with bases)														
Hordeum sp. rachis internode														
Indeterminate Cerealia / Poaceae stem fragments														
Avena sp.				1										
Avena sp. (rolled flat ?)														
cf. *Avena* sp.		1							1					
Hordeum vulgare var. *vulgare*														
Hordeum vulgare var. *vulgare* (twisted grain)					1									
Hordeum vulgare var. *nudum*														
Hordeum vulgare sl.	1			1		1								
cf. *Hordeum* sp.														
cf. *Triticum dicoccum*														
cf. *Triticum* sp.														
Indeterminate Poaceae / Cerealia														
Indeterminate cereal grain (+embryo)														
Carbonised Wild Resources:														
Burnt Peat fragments		1.35g(46)	3.1g(97)	0.05g(2)	0.9g(13)	1.0g(49)	2.1g(55)		1.9g(68)	0.4g(25)	3.4g(33)			
Corylus avellana nut shell fragments					<0.05g(1)		0.1g(2)							
Calluna stems (roots / twigs)	<0.05g(1)	1.55g(107)	2.2g(117)		1.25g(38)	1.45g(84)	2.15g(132)	<0.05g(1)	1.3g(63)	1.6g(70)	1.8g(104)			0.6g(17)
Calluna vulgaris (seed)														
Calluna flowers						2								
Calluna leafy shoots								2					4	
Calluna capsules	4		1	6	4	3	2	5						1
Carbonised Seaweed fragments	<0.05g(1)												<0.05g(1)	
Indeterminate Rhizome fragments														
Cyperaceae Rhizome fragments					<0.05g(1)	<0.05g(1)								
Carbonised Bud			1											
Indeterminate twig fragments			<0.05g(2)											
Carbonised Weeds:														
Ranunculus repens														
Ranunculus scleratus														
Ranunculus flammula														
Ranunculus sp.														
Chenopodium album						1								
Stellaria media	1		1		2							1	5	
Spergula arvensis														
Silene cf. *vulgaris*														
Silene dioica														
Polygonum aviculare sl.														
Rumex sp.						1								
Empetrum nigrum														
Erica tetralix							1							
Erica cinerea									1					
Potentilla sp.														
Alchemilla alpina														
Rosa canina sl.		1												
Sorbus aucuparia														
Fabaceae														
Myosotis arvensis														
Galeopsis tetrahit														
Prunella vulgaris														
Plantago lanceolata														
Galium aparine		1							1					
Luzula sp.														
Scirpus (Isolepis) setaceus														
Scirpus sp.														
Carex flacca					1									
Carex viridula ssp. *oedocarpa*														
Carex cf. *hostiana*														
Carex sp.	2	1												
Large Poaceae								1						
Small Poaceae			1		1							1		
Poa sp.														
Bromus sp.														
Danthonia decumbens														
Charcoal:														
Picea														
Pinus sylvestris														
Indeterminate Coniferous type										0.2g(1)				
Ulmus	0.1g(1)													
Quercus													0.6g(1)	
Betula	1.8g(12)	0.9g(5)	0.2g(1)		1.15g(9)	1.0g(7)	0.7g(4)	0.9g(1)	0.4g(4)		0.6g(6)	0.05g(1)	0.4g(1)	
Alnus	0.95g(9)	4.0g(15)	0.45g(1)		0.15g(2)			0.05g(1)						
cf. *Alnus*														
Corylus	0.8g(4)	0.8g(4)	0.4g(3)		0.1g(1)	0.6g(5)			0.9g(4)	2.0g(7)	0.6g(2)	0.05g(1)	0.2g(1)	
cf. *Corylus*														
Salix	0.3g(3)				0.1g(1)								0.2g(1)	
Malus / Crataegus type														
Prunus spinosa						0.1g(1)								
cf. Pomoideae														
Indeterminate charcoal	0.3g(3)	1.1g(10)	0.1g(1)	0.05g(4)	0.2g(9)	0.1g(1)	0.15g(10)					<0.05g(4)	0.8g(4)	0.05g(3)
Sorted indeterminate charcoal	8.4g	20.2g	11.3g		9.6g	16.9g	18.7g		12.7g	13.0g	11.0g			2.0g
Non-Plant: Marine Mollusc Shell:														
Patella vulgata: Whole shells														
Patella vulgata: Fragments														
Littorina littorea														
Littorina saxatilis														
Nucella lapillus														
Mytilus edulis														
Indeterminate fragments	0.1g(10)		<0.05g(2)				<0.05g(3)							
Non-Plant: Bone:														
Fish bone (unburnt)	1.35g(41)		0.3g(3)				<0.05g(2)							
Fish bone (burnt)		0.1g(10)									0.1g(12)			
Mammal bone (unburnt)		0.3g(3)	0.5g(2)	0.1g(1)	0.05g(1)									
Mammal bone (burnt)			3.9g(64)		0.6g(5)	1.2g(42)	1.4g(58)		0.05g(7)	1.3g(42)	0.45g(2)			
Bird bone (unburnt)	1.1g(5)													
Bird / small mammal claw														
Non-Plant: Other:														
Industrial residue (slag)						0.4g(15)	0.7g(40)		0.7g(4)	0.6g(7)				
Non-marine mollusc shells	<0.05g(1)	0.1g(12)				<0.05g(1)	<0.05g(3)	<0.05g(1)	0.05g(7)	<0.05g(1)	<0.05g(3)	0.15g(8)	<0.05g(2)	0.15g(12)

Table 17: Geodha Smoo: Other Bulk Samples

Poa sp.							1							
Bromus sp.														
Danthonia decumbens														
Charcoal:														
Picea						0.3g(1)								
Pinus sylvestris						0.05g(1)					1.7g(5)			
Indeterminate Coniferous type														
Ulmus						0.25g(1)								
Quercus											0.4g(1)			
Betula					0.1g(1)	2.15g(17)			5.8g(17)		1.55g(7)		0.05g(1)	
Alnus				1.4g(3)		1.85g(12)			1.4g(5)		0.35g(6)	4.9g(2)		
cf. *Alnus*														
Corylus					0.1g(1)	0.7g(8)		0.1g(2)	4.3g(8)		0.65g(10)	3.4g(2)	0.65g(2)	
cf. *Corylus*														
Salix						0.95g(6)			0.15g(2)		0.1g(2)			
Malus / Crataegus type						0.05g(1)								
Prunus spinosa														
cf. Pomoideae														
Indeterminate charcoal		0.1g(4)	0.1g(3)	0.25g(9)	0.8g(5)	2.65g(48)	<0.05g(1)	0.15g(6)	0.1g(1)		0.2g(3)			
Sorted indeterminate charcoal								1.1g	21.9g					
Non-Plant: Marine Mollusc Shell:														
Patella vulgata: Whole shells		4.7g(1)		6.0g(2)	10.4g(3)	6.1g(5)								
Patella vulgata: Fragments	0.1g(1)	1.4g(3)	2.9g(6)	9.4g(17)	3.2g(11)	9.2g(16)							1.5g(3)	
Littorina littorea		18.8g(7)		93.9g(33)	35.6g(13)	12.2g(5)								
Littorina saxatilis			0.05g(1)			0.05g(4)								
Nucella lapillus			6.4g(3)		9.7g((6)									
Mytilus edulis		11.2g(27)	9.0g(27)	0.55g(7)	11.85g(5)	8.9g(26)							7.4g(16)	
Indeterminate fragments				64.1g(112)	43.7g(96)			1.2g(1)	0.25g(5)		1.7g(7)		0.3g(8)	
Non-Plant: Bone:														
Fish bone (unburnt)	0.05g(1)	0.45g(9)		2.2g(30)	43.35g(215)	34.1g(526)	0.1g(1)	0.05g(4)	0.4g(14)		2.4g(47)		1.2g(39)	
Fish bone (burnt)						0.35g(3)			<0.05g(1)				0.9g(10)	
Mammal bone (unburnt)		69.9g(3)		12.5g(5)	7.7g(9)	2.3g(6)		0.05g(4)						
Mammal bone (burnt)				0.05g(1)	0.1g(1)	0.1g(5)			1.8g(46)				<0.05g(1)	
Bird bone (unburnt)						0.9g(1)								
Bird / small mammal claw						0.15g(5)		<0.05g(1)						
Non-Plant: Other:														
Industrial residue (slag)											26.0g(1)		0.05g(1)	
Non-marine mollusc shells	0.05g(1)						0.45g(59)	1.0g(526)	0.2g(139)	0.25g(75)	0.2g(18)		0.55g(8)	1.85g(218)

Geodha Smoo: Environmental Remains:	C.008	C.008	C.008	C.008	C.008	C.008	C.008	C.008/013	C.008/013	C.013	C.013	C.019	C.021	C.030
Carbonised Cereal Grain and Chaff:	Sp. 2	Sp. 3	Sp. 4	Sp. 5	Sp. 6	Sl.1,Tr.1	Sl.2,Sp.3	Sl.2,Sp.1	Sl.2,Sp.5	Sl.2,Sp.1	Tumble	GKC	Sp.N+S	GKC
Avena sativa florets (with bases)														
Avena sativa grain in florets (with bases)								3						
Hordeum sp. rachis internode														
Indeterminate Cerealia / Poaceae stem fragments								1						
Avena sp.		2		3	3	6		3						
Avena sp. (rolled flat ?)														
cf. *Avena* sp.					1									
Hordeum vulgare var. *vulgare*														
Hordeum vulgare var. *vulgare* (twisted grain)		4												1
Hordeum vulgare var. *nudum*				1										
Hordeum vulgare sl.	2	4	1	4	4	3	2		1	1				1
cf. *Hordeum* sp.					1			1	1					1
cf. *Triticum dicoccum*														
cf. *Triticum* sp.		1	1											
Indeterminate Poaceae / Cerealia														
Indeterminate cereal grain (+embryo)		1		2	1		3	2						1
Carbonised Wild Resources:														
Burnt Peat fragments				3.2g(5)				0.3g(2)	0.05g(1)					
Corylus avellana nut shell fragments			<0.05g(1)	<0.05g(1)		0.5g(5)			0.05g(1)		0.05g(2)		<0.05g(1)	
Calluna stems (roots / twigs)			0.01g(2)	0.1g(12)	0.15g(6)	0.35g(12)		0.5g(8)	1.8g(109)		0.5g(1)			
Calluna vulgaris (seed)						1								
Calluna flowers														
Calluna leafy shoots				1		8	1		3				1	
Calluna capsules						7	13	1	13					1
Carbonised Seaweed fragments				<0.05g(3)	0.05g(3)	0.05g(2)	<0.05g(2)			<0.05g(1)	0.15g(8)			
Indeterminate Rhizome fragments			<0.05g(1)											
Cyperaceae Rhizome fragments														
Carbonised Bud														
Indeterminate twig fragments					0.15g(2)	0.25g(7)								
Carbonised Weeds:														
Ranunculus repens						2								
Ranunculus scleratus														
Ranunculus flammula														
Ranunculus sp.														
Chenopodium album						2								
Stellaria media					3	8							1	
Spergula arvensis														
Silene cf. *vulgaris*	1													
Silene dioica		2	1					1						
Polygonum aviculare sl.														
Rumex sp.							35							
Empetrum nigrum						2								4
Erica tetralix									1					
Erica cinerea														
Potentilla sp.														
Alchemilla alpina					1									
Rosa canina sl.								1						
Sorbus aucuparia														
Fabaceae						1								
Myosotis arvensis														
Galeopsis tetrahit							1							
Prunella vulgaris														
Plantago lanceolata						1								
Galium aparine														
Luzula sp.						2	3							
Scirpus (Isolepis) setaceus														
Scirpus sp.														
Carex flacca							1							
Carex viridula ssp. *oedocarpa*														
Carex cf. *hostiana*								1						
Carex sp.					1	3	4		6					
Large Poaceae														
Small Poaceae						3								
Poa sp.							1							
Bromus sp.														
Danthonia decumbens														
Charcoal:														
Picea						0.3g(1)								
Pinus sylvestris						0.05g(1)					1.7g(5)			
Indeterminate Coniferous type														
Ulmus						0.25g(1)								
Quercus											0.4g(1)			
Betula					0.1g(1)	2.15g(17)			5.8g(17)		1.55g(7)		0.05g(1)	
Alnus				1.4g(3)		1.85g(12)			1.4g(5)		0.35g(6)	4.9g(2)		
cf. *Alnus*														
Corylus					0.1g(1)	0.7g(8)		0.1g(2)	4.3g(8)		0.65g(10)	3.4g(2)	0.65g(2)	
cf. *Corylus*														
Salix						0.95g(6)			0.15g(2)		0.1g(2)			
Malus / Crataegus type						0.05g(1)								
Prunus spinosa														
cf. Pomoideae														
Indeterminate charcoal		0.1g(4)	0.1g(3)	0.25g(9)	0.8g(5)	2.65g(48)	<0.05g(1)	0.15g(6)	0.1g(1)		0.2g(3)			
Sorted indeterminate charcoal								1.1g	21.9g					
Non-Plant: Marine Mollusc Shell:														
Patella vulgata: Whole shells		4.7g(1)		6.0g(2)	10.4g(3)	6.1g(5)								
Patella vulgata: Fragments	0.1g(1)	1.4g(3)	2.9g(6)	9.4g(17)	3.2g(11)	9.2g(16)							1.5g(3)	
Littorina littorea		18.8g(7)		93.9g(33)	35.6g(13)	12.2g(5)								
Littorina saxatilis			0.05g(1)			0.05g(4)								
Nucella lapillus			6.4g(3)		9.7g((6)									
Mytilus edulis		11.2g(27)	9.0g(27)	0.55g(7)	11.85g(5)	8.9g(26)							7.4g(16)	
Indeterminate fragments				64.1g(112)	43.7g(96)			1.2g(1)	0.25g(5)		1.7g(7)		0.3g(8)	
Non-Plant: Bone:														
Fish bone (unburnt)	0.05g(1)	0.45g(9)		2.2g(30)	43.35g(215)	34.1g(526)	0.1g(1)	0.05g(4)	0.4g(14)		2.4g(47)		1.2g(39)	
Fish bone (burnt)						0.35g(3)			<0.05g(1)				0.9g(10)	
Mammal bone (unburnt)		69.9g(3)		12.5g(5)	7.7g(9)	2.3g(6)		0.05g(4)						
Mammal bone (burnt)				0.05g(1)	0.1g(1)	0.1g(5)			1.8g(46)				<0.05g(1)	
Bird bone (unburnt)						0.9g(1)								
Bird / small mammal claw						0.15g(5)		<0.05g(1)						
Non-Plant: Other:														
Industrial residue (slag)											26.0g(1)		0.05g(1)	
Non-marine mollusc shells	0.05g(1)						0.45g(59)	1.0g(526)	0.2g(139)	0.25g(75)	0.2g(18)		0.55g(8)	1.85g(218)

4.5: Discussion of the Results:

4.5.1: Overview:

A total of 319 litres of sediment were processed from Geodha Smoo. The samples taken from Antler cave produced no environmental remains, and evidence for the nature of human activity in this area was extremely difficult to excavate and interpret (Pollard 1996b). This cave will not be discussed any further in the text. Samples from Glassknapper's cave were more enlightening, and produced abundant quantities of marine mollusc shell, fish bone and animal bone, and evidence for cereal agriculture in the form of carbonised grain and chaff remains. The radiocarbon dating evidence generated from the Glassknapper's cave midden, has been used to divide the recovered data into chronological groups. **Table 18** summarizes the identified environmental material utilising the available dates. Undated bulk samples have been split into two groups for interpretation based upon context information. These are listed as GKC 008, and GKC Other, and are included in **table 18** for comparative purposes.

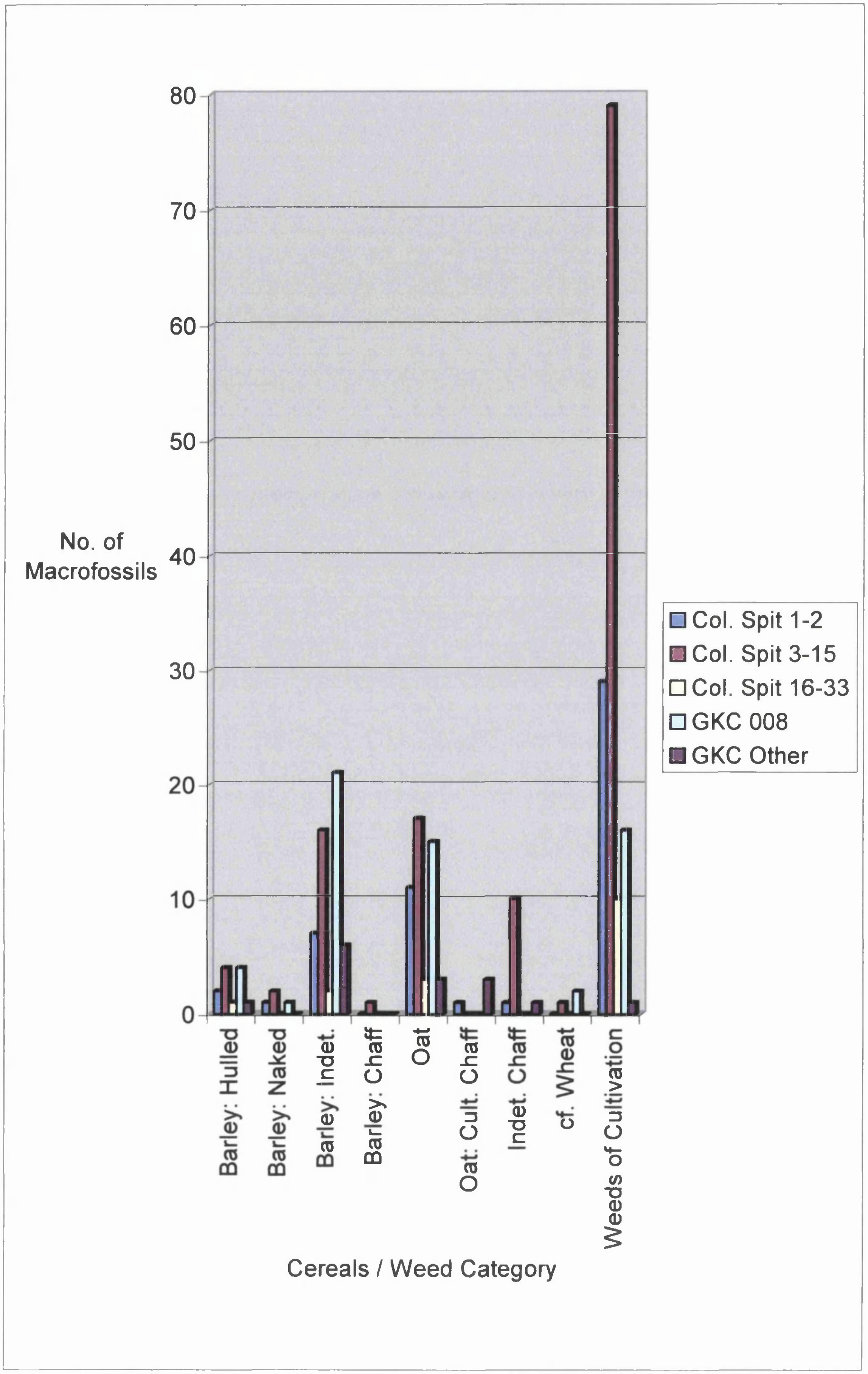
4.5.2: Cultivated Plants:

Carbonised cereal grain and occasional chaff were recovered from the Glassknapper's cave midden remains. This material is presented in summary form in **table 18**. Barley (mainly *Hordeum vulgare* sl.) was the most commonly recovered cereal grain from the column samples, with some twisted grain identified as *Hordeum vulgare* var. *vulgare* (six-row hulled barley). Naked barley (*Hordeum vulgare* var. *nudum*) was present in small amounts in the more recent midden deposits only and may have been re-introduced as a cereal crop by the Norse. **Fig. 29** clearly shows that the presence of oat as a cultivated cereal – whether for human consumption or animal fodder – should not be underestimated. The peaks in oat grain presence reflect the peaks in barley, with most cereal grain recovered

Geodha Smoo, Sutherland: Phasing:	**Post 890-1160 AD**	**Post 770-980 AD**	**Post 820-1000 AD**	**Undated Bulk**	**Undated Bulk**
Sample Group:	**Col. Spit 1-2**	**Col. Spit 3-15**	**Col. Spit 16-33**	**GKC 008**	**GKC Other**
Total Sample Litres:	8	42	47	106	76
Cultivated Plants:					
Barley: Hulled	2	4	1	4	1
Barley: Naked	1	2	0	1	0
Barley: Indet.	7	16	2	21	6
Barley: Total Grain	10	22	3	26	7
Barley: Chaff	0	1	0	0	0
Oat	11	17	3	15	3
Oat: Cult. Chaff	1	0	0	0	3
Indet. Chaff	1	10	0	0	1
Wheat (cf.)	0	1	0	2	0
Indet. Cereal	2	13	0	7	3
Weeds of Cultivation	29 (5 sp.)	79 (5 sp.)	10 (2 sp.)	16 (4 sp.)	1 (1 sp.)
Wild Resources:					
Peat	2.8g (79)	2.4g (220)	14.2g (388)	3.2g (5)	0.35g (3)
Heather stems	0.95g (65)	8.3g (475)	13.95g (733)	0.61g (32)	2.8g (118)
Seaweed	<0.05g (2)	0.1g (2)	<0.05g (1)	0.2g (10)	0.2g (9)
Charcoal (not including 'sorted indet.')	4.8g (34)	4.3g (110)	20.4g (137)	11.85g (122)	25.95g (82)
Other Remains:					
Marine Mollusc Shell	55.7g (63)	0.2g (12)	0.1g (5)	379.4g (413)	12.35g (40)
Fish Bone	22.65g (500)	15.45g (399)	0.55g (27)	80.6g (785)	5g (115)
Other Bone	5.5g (4)	1.25g (8)	9.95g (239)	93.7g (36)	1.95g (52)
Slag	0	0	2.4g (66)	0	26.05g (2)

Table 18: Geodha Smoo: Summary Table of Remains Recovered from the Environmental Samples.

Fig. 29: Geodha Smoo, Sutherland: Comparative Chart of Cereal Species and Weeds of Cultivation by Sample Group:



from the central portion of the midden deposits (dated to AD 770-980). Cultivation of oat cereal, for grain and straw, was probably equally as important as barley during this period. Weeds of cultivation also reached a peak during the central part of the midden, although their presence in all parts of the midden outweighs that of cereals. This strongly suggested that a large constituent of the midden consisted of dumped cereal processing waste.

A trace amount of wheat was also recovered from the central part of the midden and from context 008. These grains may represent material imported from more fertile agricultural areas. Ethnographic records from the 18th century revealed that north-west Sutherland imported grain from Caithness, although some agriculture was carried out locally (Bangor-Jones 2000: 66). This practice may have been common in the past during times of poor harvest, or to supplement locally grown produce. The peaks in cereal presence in the midden stratigraphy follow a similar pattern to the deposition of fish bone (see **fig. 33**), which will be discussed further below. Trade and exchange in fish and cereal grain, mainly by sea routes, is likely to have formed an important part of the Early Norse economy, and this is reflected in the dated material from Smoo.

4.5.3: Weed Ecology:

4.5.3.1: Habitat Categories:

The weed seeds recovered from Glassknappers' cave were divided into nine ecological groupings, as listed below with the species these incorporated. The number of weeds recovered per phase divided into appropriate ecological groupings is presented in **table 19**. These data are then presented in histogram form in **fig. 30**. The following groupings were applied to the raw data from Smoo:

1) Sandy arable land, damp sand, ditches and dunes:

Myosotis arvensis (field forget-me-not), *Spergula arvensis* (corn spurrey), *Ranunculus repens* (creeping buttercup).

2) Non-sandy arable / waste and disturbed ground:

Chenopodium album (fat hen), *Stellaria media* (chickweed), *Polygonum aviculare* sl. (knotgrass), *Galeopsis tetrahit* (common hemp-nettle).

3) Grassland, grassy meadows / pasture:

Prunella vulgaris (selfheal), *Plantago lanceolata* (ribwort plantain), *Carex flacca* (glaucous sedge), *Bromus* sp. (bromes), *Silene* cf. *vulgaris* (cf. bladder campion).

4) Mountain pastures / rock crevices:

Alchemilla alpina (alpine lady's-mantle).

5) Wetland: Aquatic, waterside and mire (base rich):

Ranunculus flammula (lesser spearwort), *Ranunculus scleratus* (celery-leaved buttercup), *Scirpus* (*Isolepis*) *setaceus* (bristle club-rush), *Carex viridula* ssp. *oedocarpa* (yellow-sedge), *Carex* cf. *hostiana* (cf. tawny sedge).

6) Moors, bogs and heath / dry heath:

Empetrum nigrum (crowberry), *Danthonia decumbens* (heathgrass), *Erica tetralix* (cross-leaved heath), *Erica cinerea* (bell heather).

7) Sea cliffs, banks and woodland scrub:

Silene dioica (red campion), *Sorbus aucuparia* (rowen), *Rosa canina* sl. (dog-rose).

8) Shingle beaches and shores:

Galium aparine (cleavers).

9) Miscellaneous:

Poaceae (grass family), Fabaceae (pea family), *Carex* sp. (sedges), *Luzula* sp. (wood rush), *Scirpus* sp. (wood club-rushes), *Ranunculus* sp. (buttercups), *Rumex* sp. (docks), *Potentilla* sp. (cinquefoils), *Poa* sp. (meadow grasses).

4.5.3.2: Summary of Weed Ecology:

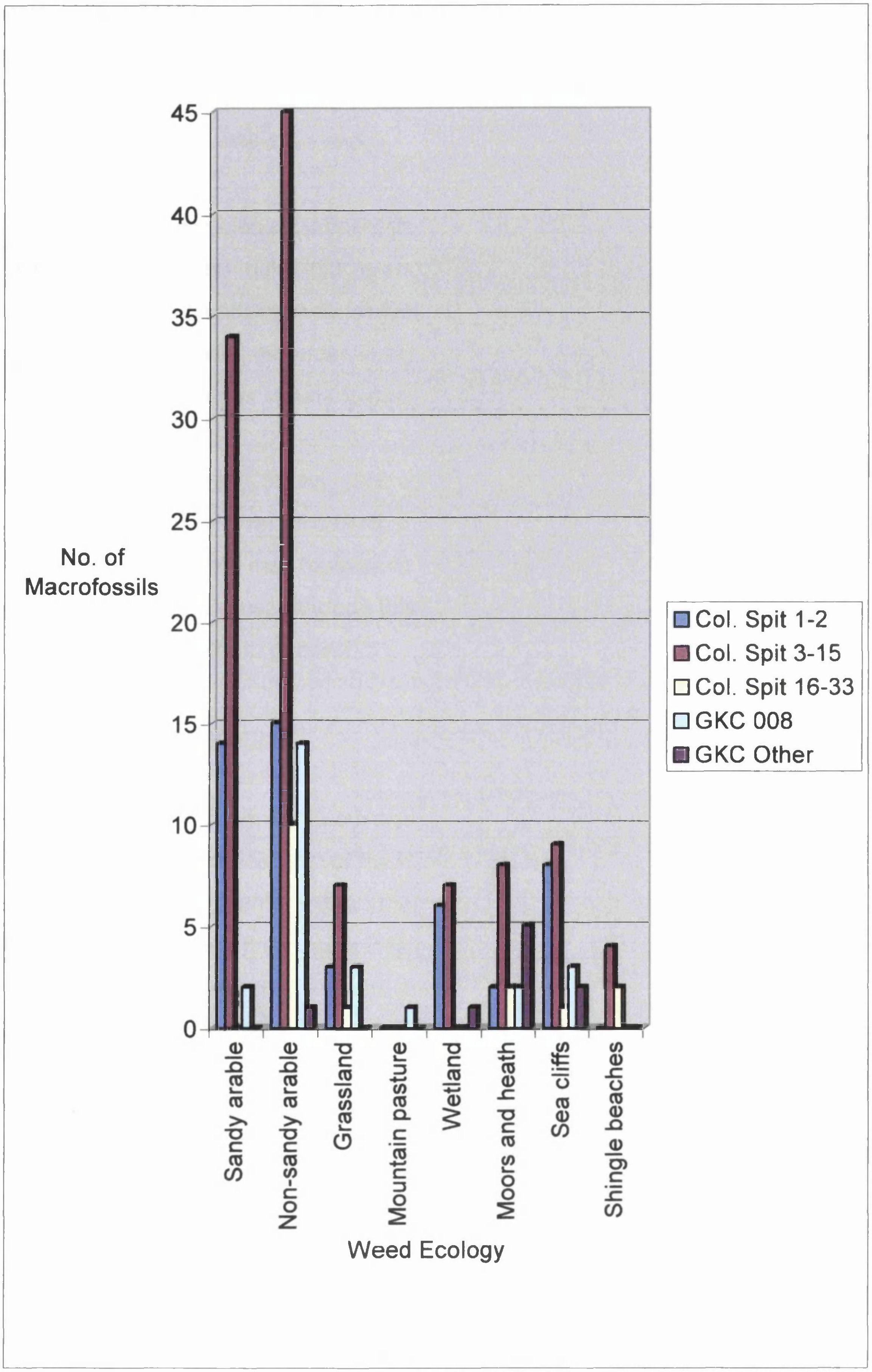
Most of the weeds recorded from Geodha Smoo were agricultural or waste / disturbed ground species. **Fig. 30** illustrates that a large number of the weeds present in the GKC midden consisted of non-sandy arable species, and that these were present throughout the dated column deposits. Sandy arable weeds only appeared in the middle portion (AD 770-980) and later. This is concurrent with the rise in cereal grain presence already discussed in section 4.5.2. It is possible that early local agriculture was occurring (and indeed continued) on less productive arable land – perhaps the only land available in the immediate area (the sandy machair at Balnakeil is some 2.5km distance from the caves). However, by AD 770-980 this was supplemented by grain grown on good quality sandy agricultural soils – which may suggest that this grain was imported from elsewhere.

Wetland plants and species prefering moors and drier heaths were recovered in small numbers from Glassknappers' cave, with a total of nine different species recorded for these habitats. These plants occur most abundantly in the mid-later

Geodha Smoo, Sutherland: Phasing:	Post AD 890-1160	Post AD 770-980	Post AD 820-1000	Undated Bulk	Undated Bulk
Sample Group:	Col. Spit 1-2	Col. Spit 3-15	Col. Spit 16-33	GKC 008	GKC Other
Weed Species Ecology:					
Sandy arable, damp sand, ditches and dunes	14 (2 sp.)	34 (3 sp.)	0	2 (1 sp.)	0
Non-sandy arable / waste and disturbed ground	15 (3 sp.)	45 (2 sp.)	10 (2 sp.)	14 (3 sp.)	1 (1 sp.)
Grassland, grassy meadows / pasture	3 (2 sp.)	7 (4 sp.)	1 (1 sp.)	3 (3 sp.)	0
Mountain pastures / rock crevices	0	0	0	1 (1 sp.)	0
Wetland: Aquatic, waterside, marsh and mire (base rich)	6 (3 sp.)	7 (3 sp.)	0	0	1 (1 sp.)
Moors, bogs and heath / dry heath	2 (1 sp.)	8 (1 sp.)	2 (1 sp.)	2 (1 sp.)	5 (2 sp.)
Sea cliffs, banks and woodland	8 (3 sp.)	9 (3 sp.)	1 (1 sp.)	3 (1 sp.)	2 (2 sp.)
Shingle beaches and shores	0	4 (1 sp.)	2 (1 sp.)	0	0

Table 19: Geodha Smoo, Sutherland: Recovered Weed Ecology by Phase.

Fig. 30: Geodha Smoo, Sutherland: Recovered Weed Ecology by Sample Group:



parts of the midden and were probably accidently gathered as a result of peat cutting operations, and collection of wetter fen material for fuel and building purposes. Indeed, drier heath species are present in the early midden, peak in the middle and decline toward the end.

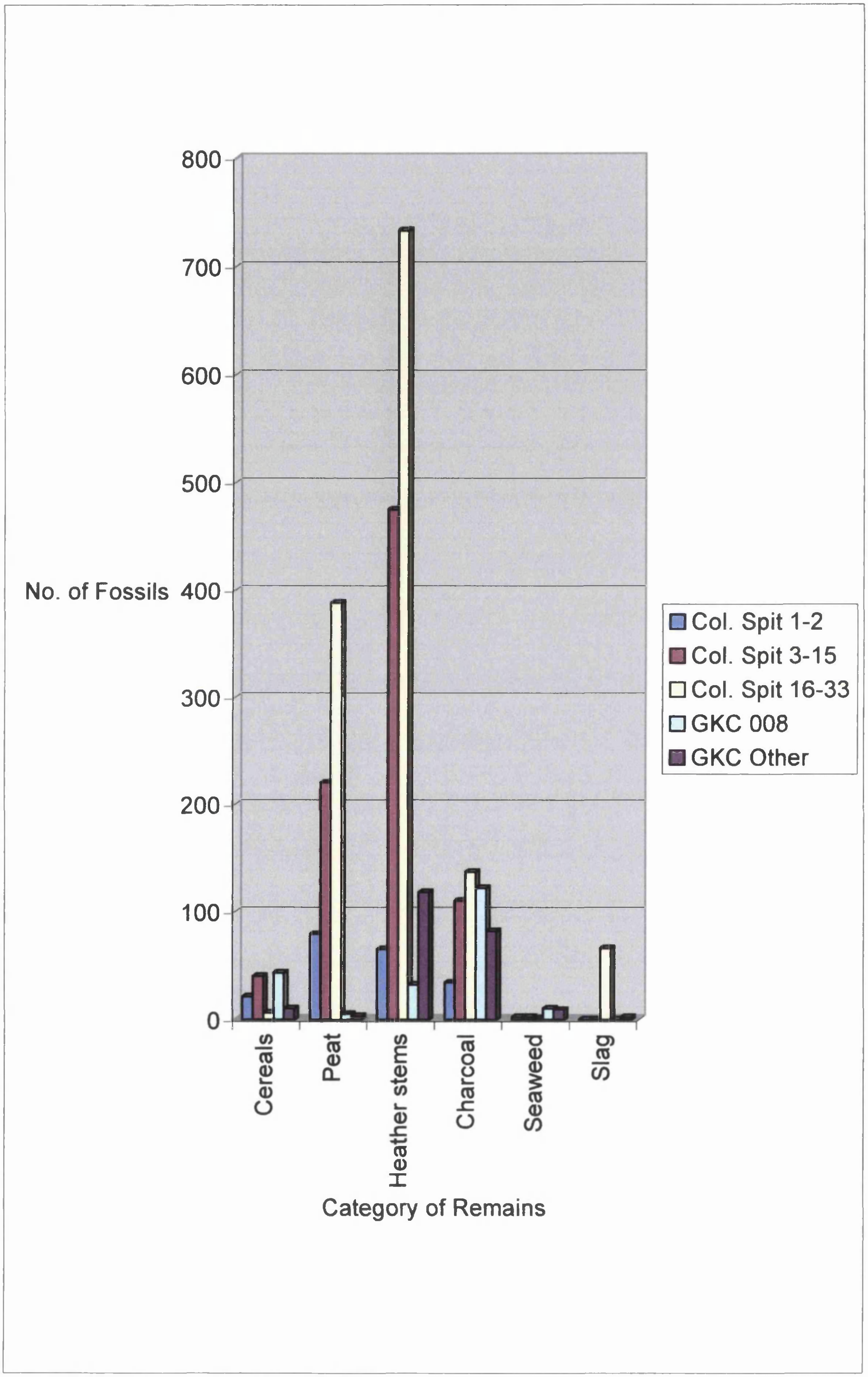
Wet fen and bog species are absent from the early deposits and are present in almost equal numbers in the middle and end. This probably suggests the increased use of fen-like and wetter turves for fuel in the later period deposits. When compared with the wild resources in **fig. 31** (discussed below) the use of plant material from drier areas seems to decline throughout the lifespan of the midden.

Species of sea cliffs and banks, such as *Sorbus aucuparia* and *Rosa canina* s.l. were probably growing very locally to the caves in sheltered crevices and on ledges. *Galium aparine* may have been growing on the shingle beach deposits around the cave environs, although this weed is fairly ubiquitous to waste and barren ground habitats in general.

4.5.4: Wild Resources:

Gathered resources from dry heath and peatland were recovered in most abundant quantities from the earliest part of the midden. The identification of the 'gross' elements of peat fragments and heather stems presented in **fig. 31** reinforces the data collected from the finer macrofossil evidence already discussed in 4.5.3.2. **Fig. 31** compares these data with the occurrence of cereal grain, charcoal, seaweed and slag throughout the samples. This draws out an interesting pattern, as cereal grains are almost absent from the early midden (AD 820-1000), and yet fuel resources are present in abundance. It has been suggested by Pollard (1996b) that early Norse activities in the caves may have involved brief stopovers, for boat repair and supply gathering, as part of longer journeys, and that this use was probably seasonal. The abundance of fuel for domestic fires, the presence of

Fig. 31: Geodha Smoo, Sutherland: Comparison of Cereal Grain, Major Fuel and Wild Resources and Slag by Sample Group:



charcoal and most importantly slag from metalworking, lends weight to Pollard's argument that the caves were initially used as brief resting-places for seafarers.

Carbonised seaweed was recovered from all the sample groups in small numbers, and was probably present as middened material throughout the dumping activities in the caves. Unfortunately it was recovered in greatest amounts from the undated samples, so it is impossible to asign its use to any specific period other than Norse.

4.5.5: Charcoal:

Geodha Smoo produced a large amount of wood charcoal, covering species from a range of habitats including, scrub and open woodland, mountainous areas and sheltered valleys and straths. **Fig. 32** presents this material in histogram form using the actual number of fossils recovered, whilst **table 20** provides comparative weight as well as number information for each species. Slag presence is also recorded, as its presence was considered important enough to be included across a range of figures for comparative interpretation.

Coniferous wood charcoal was found in small amounts in Glassknappers' cave. This included *Picea* sp. (spruce) which was probably driftwood gathered from the local shore, and *Pinus sylvestris* (Scots pine) which may have been driftwood or imported from further south on the Scottish mainland. Other imports may have included the deciduous woods, *Ulmus* (elm) and *Quercus* (oak), present in small quantities, with oak only found in the early dated part of the midden sequence. These species could have been transported from further south, or may have been growing in the region of the caves. Both species are found in the north and west of Britain, where oak can survive on shallow acid soils, sometimes over 300m, whilst elm (particularly wych elm – *Ulmus glabra*) inhabits limestone areas in these regions (Stace 1997: 112, 123). These trees were probably extremely rare and found amongst scrub in sheltered areas. Other deciduous woods included species tolerant of bog and other wet conditions, such as *Alnus* (alder), and *Betula* (birch), and open woodland and scrub species such as *Corylus* (hazel) and *Salix* (willow). Birch was recovered from all the sample groups and dominated the assemblage of identified charcoal species. Large amounts of birch, hazel and alder were present in the earliest midden deposits, together with a peak in slag, and these remains may represent waste from smithing hearths. These species continued to dominate during the middle of the midden, with a rise in recovered willow charcoal. By the end of the midden formation the range of species recovered and the number of fossils present greatly decreased, with birch remaining as the main species recorded.

4.5.6: Other Remains:

Fig. 33 illustrates the recovery of fish bone, other bone (bird, mammal, indeterminate), and marine mollusc shell, and compares this to the presence of cereal grain collected from the sample groups. The majority of fish bone and marine shell recorded came from the Glassknapper's cave deposits, which were unfortunately not dated (GKC 008 and GKC other). However, the GKC column sample groups, which were dated have produced some interesting results. In the early part of the midden very few cereal grains were present, a small quantity of fish bones were recovered, and a large number of other bones were found. Many of these bones were burnt (see raw data **table 16**), and may represent meals cooked and consumed in the caves by early travellers or fishermen. Mammal and bird bone decreases significantly in the middle of the midden, whilst cereals increase slightly and fish bones increase dramatically. Fish bone presence continued to rise towards the end of the midden formation, and cereal occurrence dropped slightly. Marine shellfish also increased in the most recent part of the midden, and these were probably used as fishing bait. These events probably represented a firmer presence, perhaps involving settlement rather than seasonal visits, marked out by the Norse during AD 770-980. The results from the midden analysis reveal an increase in Norse activities by AD 890-1160 in this area, with the processing of fish for trade a key factor in these developments.

Geodha Smoo, Sutherland: Phasing:	Post 890-1160 AD	Post 770-980 AD	Post 820-1000 AD	Undated Bulk	Undated Bulk
Sample Group:	**Col. Spit 1-2**	**Col. Spit 3-15**	**Col. Spit 16-33**	**GKC 008**	**GKC Other**
Charcoal Species:					
Picea	0	0	0	0.3g (1)	0
Pinus sylvestris	0.15g (3)	1.2g (4)	0	0.05g (1)	1.7g (5)
Coniferous Type	0	0	0.2g (1)	0	0
Ulmus	0	0.1g (1)	0	0.25g (1)	0
Quercus	0	0	0.6g (1)	0	0.4g (1)
Betula	3.45g (18)	5.45g (39)	6.3g (39)	2.25g (18)	7.4g (25)
Alnus	0.45g (4)	1.55g (14)	4.65g (19)	3.15g (15)	6.65g (13)
Corylus	0	2.15g (17)	5.65g (28)	0.8g (9)	9.1g (24)
Salix	0.1g (1)	1.45g (11)	0.3g (2)	0.95g (6)	0.25g (4)
Malus / Crataegus	0	0	0	0.05g (1)	0
Prunus spinosa	0	0	0.1g (1)	0	0
cf. Pomoideae	0.15g (1)	0	0	0	0
Indeterminate charcoal	0.5g (7)	2.6g (34)	2.6g (46)	3.95g (70)	0.45g (10)
Industrial waste (slag)	0	0	2.4g (66)	0	26.05g (2)

Table 20: Geodha Smoo: Summary of Recovered Charcoal Species by Phase. (Note: Figures in brackets represent actual counts).

Fig. 32: Geodha Smoo, Sutherland: Summary Chart of Recovered Charcoal and Slag by Sample Group.

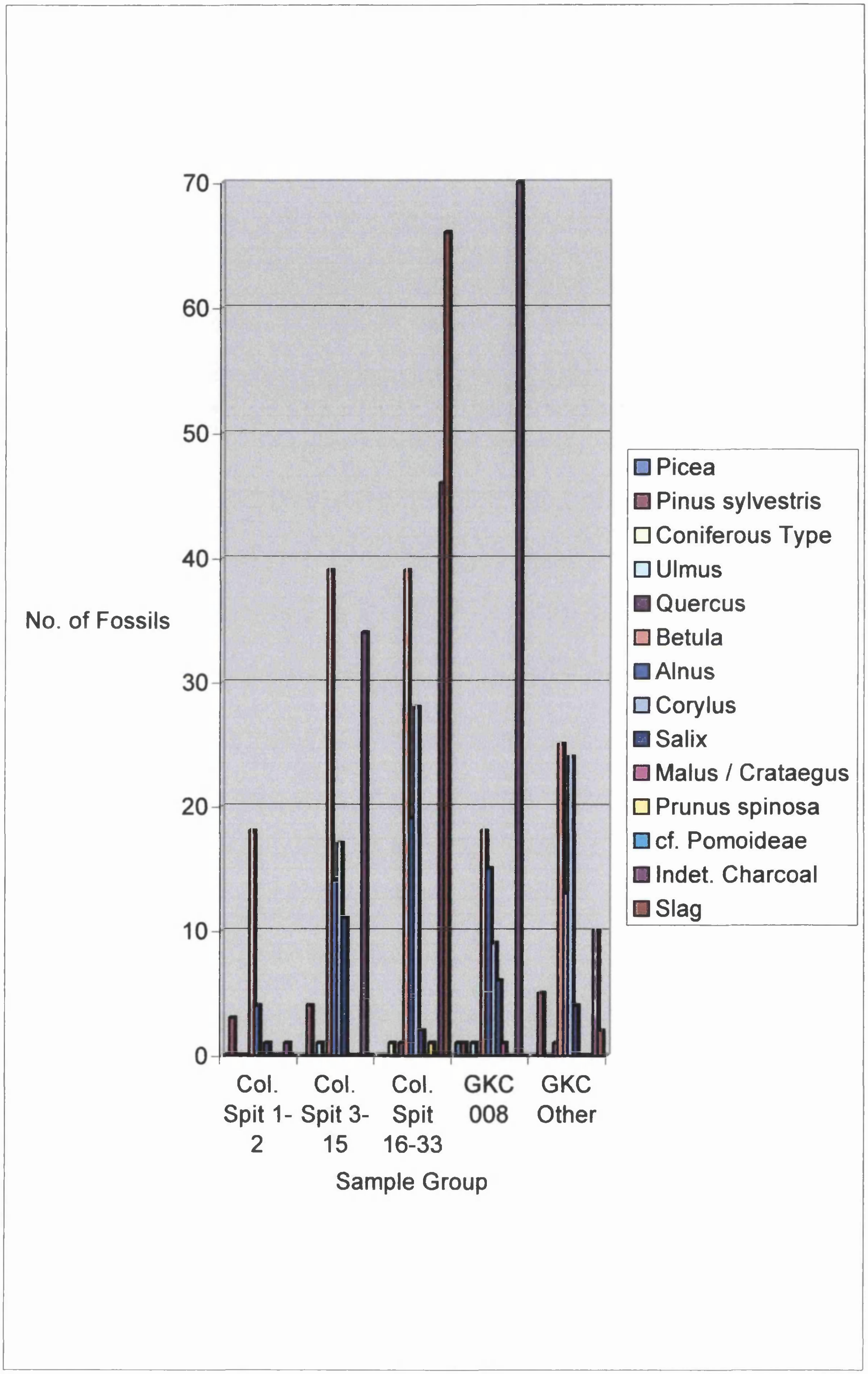
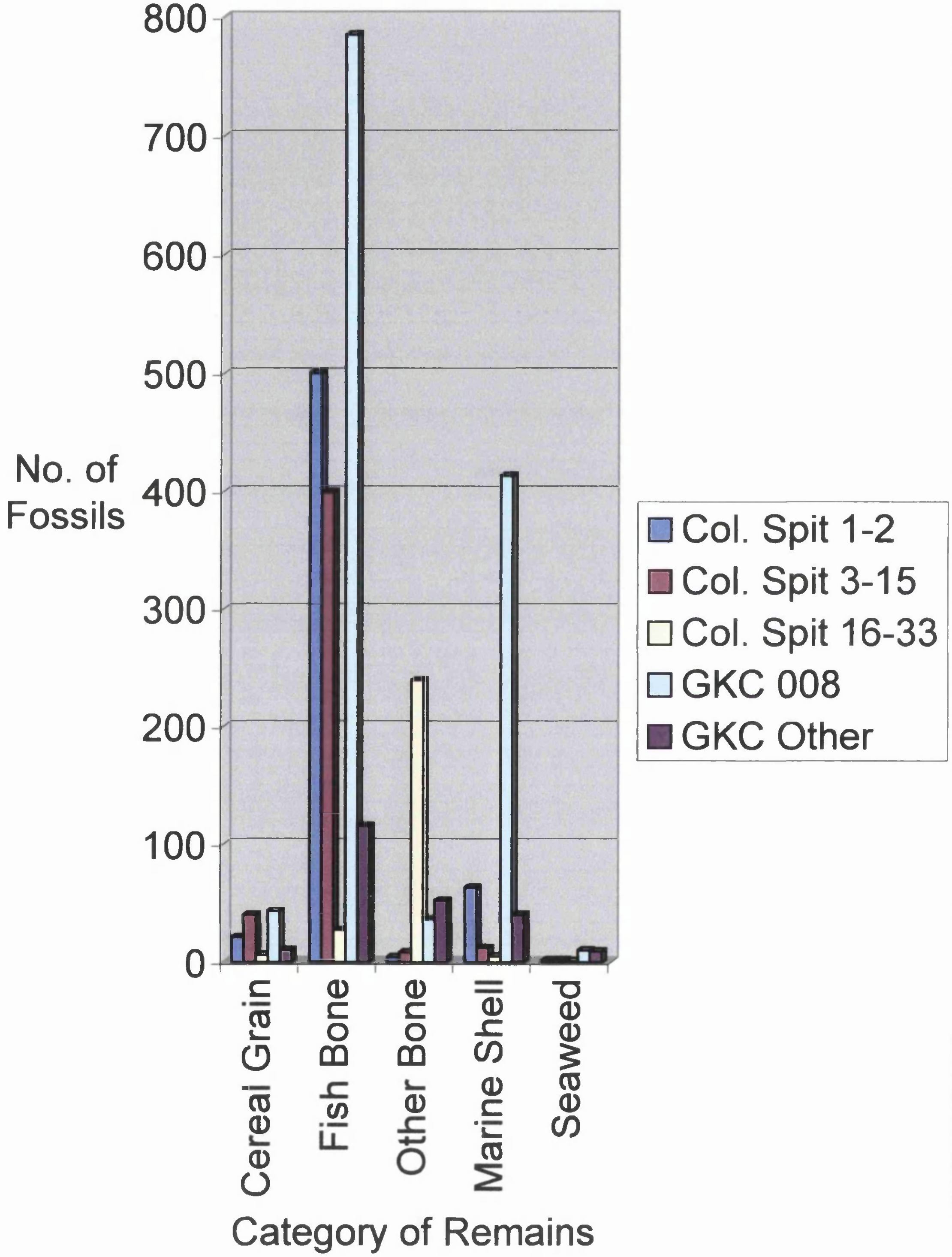


Fig. 33: Geodha Smoo, Sutherland: Presence of Marine Resources, Compared with Cereal Grain and Other Bone by Sample Group:



Chapter Five:

5: Burland, Trondra, Shetland:

5.1: Location of Site and Archaeological Background:

The excavations at Burland, Trondra were commissioned and funded by Historic Scotland and Shetland Amenity Trust, and fieldwork, supervised by Ms. Hazel Moore and Mr. Graeme Wilson of Ease Archaeology, was carried out over two seasons, between June – July 2000 and July – August 2002. The island of Trondra is located off the west coast of the mainland of Shetland to the south of Scalloway. **Fig. 34** shows the location of Trondra and the position of the site. Since the early 1970s Trondra has been connected by road-bridge to the mainland and to the adjacent island of West Burra. The island itself consists of gently undulating and low-lying hills (highest point 50m OD). In modern times the largely poorly drained peaty podzols of the island have been used primarily as rough grazing for sheep, with only a small amount of arable agriculture occurring on improved areas of land.

The archaeological excavations were located midway along the west-coast of Trondra to the north-west of Burland croft, a traditional Shetland croft run by Mr. and Mrs. Isbister and open to the public. The site is located on the edge of low-lying soft sediments less than 5m OD, and is subject to coastal erosion especially during stormy winters. To the west of the site a shallow stony causeway extends part way across the rocky beach towards a small islet, where the remains of a broch (burgh), from which the placename 'Burland' was thought to derive, was located (Moore and Wilson, forthcoming). It was believed that part of the broch had been dismantled and the stone taken away by boat to build a new pier at Scalloway during the 19th century (pers. comm. T. Isbister in Moore and Wilson, forthcoming). The potential for an archaeological site in this area was first proposed to Shetland Amenity Trust by Mr. and Mrs. Isbister, when they noted pottery and shell eroding from the coastline. In 1995 Ease Archaeology carried out a coastal survey on Trondra, and although little was seen of the suspected broch, they recorded a low mound with peat ash and charcoal deposits further to the south (Moore and Wilson 1995, 2001).

Based upon the results of the 1995 survey, Ease Archaeology proposed a series of excavations with the aim of determining the nature, extent and date of the archaeological remains eroding from the coastal section, to be undertaken by trial trenching and open area excavation (Moore and Wilson, forthcoming).

5.2: Archaeological Excavation 2000 and 2002 Seasons:

5.2.1: Location of Trenches:

The excavation trenches were located with reference to the position of the mound and the eroding coastal section. A ruinous shed at the edge of the mound was avoided as it would have been difficult to remove. Trench 1, measuring 9m by 9m and covering the entire area of the mound, was placed immediately to the north side of the shed and adjacent to the coastal edge, although it was set back from the edge by 1m to prevent any further erosion. Trench 2, measuring 3m by 2m, was opened to the north-east corner of trench 1, after the discovery of a secondary structure during excavations in trench 1 (Moore and Wilson 2001). **Fig. 35** shows the location of the excavated trenches opened during the 2000 season. During this season the main concentration of archaeological remains were seen to be concentrated within a structure to the centre and western side of trench 1, and this area became the main focus of work for this season. Excavation work carried out during 2002 also focused attention on trench 1 with the aim of interpreting the sequence of structures in this area, and removing the archaeological remains down to bedrock.

Fig. 34: Location map of Burland, Trondra, Shetland (Moore and Wilson 2001).

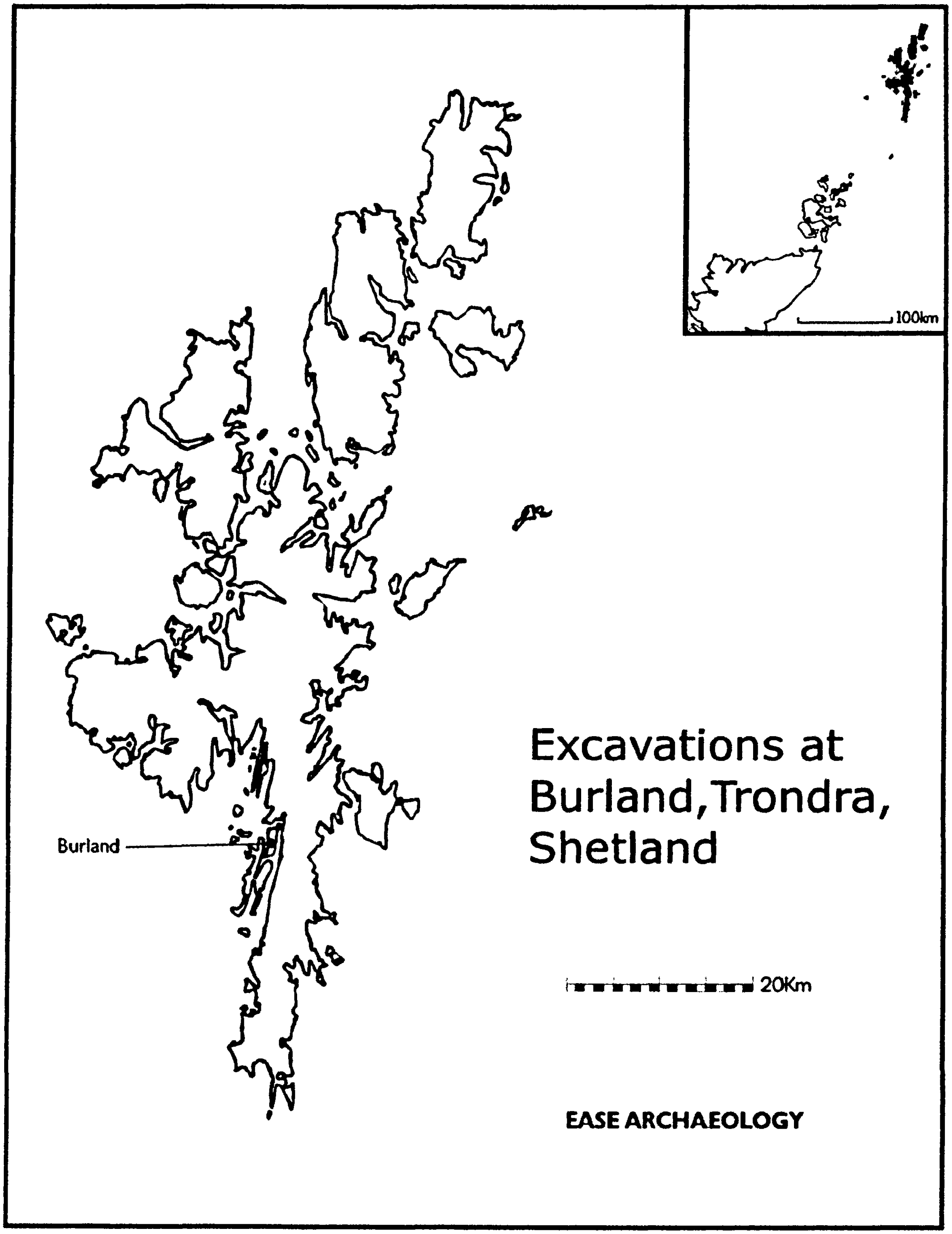
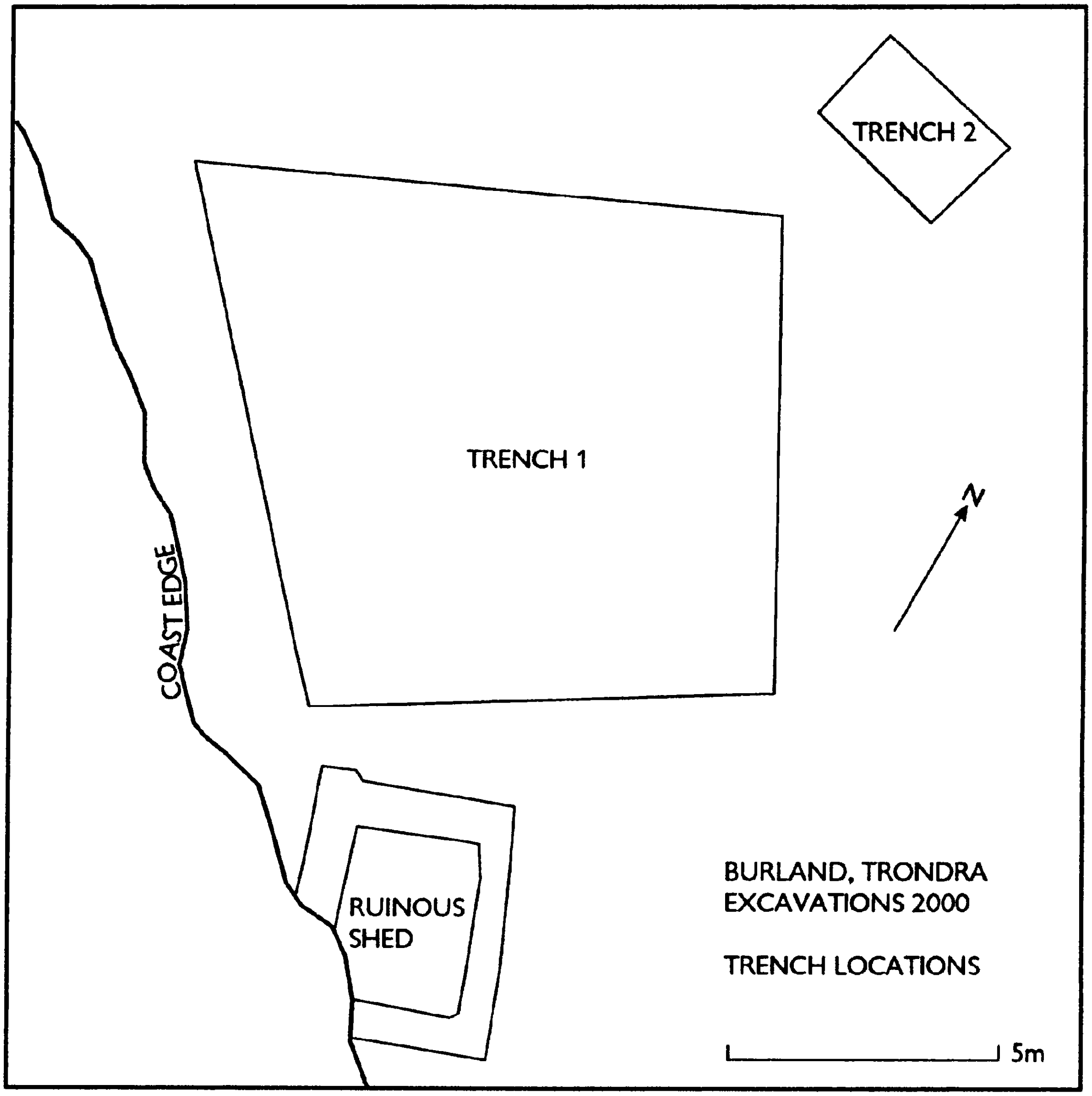


Fig. 35: Location of excavation trenches at Burland, Trondra, Shetland (Moore and Wilson 2001).



At least three separate structures were discovered during the excavations at Burland. Structure 2 was the most complete building excavated and was interpreted as a Mid-Late Iron Age ('Pictish') smithy. Beneath this structure traces of an earlier, perhaps Mid-Late Iron Age building, associated with metalworking were also glimpsed. A rectilinear building of possibly Viking or Norse date was discovered to the north east of structure 2, and only partly excavated. During 2002 the offshore islet was also examined and the remains of a probable broch and stone causeway were discovered. **Fig. 36** shows the orientation of structures 1, 2 and 3.

The excavated remains were divided into seven different phases by Moore and Wilson (2001 and forthcoming) with the earliest phase labelled first. These are discussed below in order to aid the interpretation of the environmental remains in subsequent sections. All dating assignments follow this phasing, which is summarised in **table 21**.

5.2.2: Stratigraphic Phasing:

5.2.2.1: Phase 1: Early Cultivation Remains: Pre / Early Iron Age:

Traces of early cultivation in the form of ard marks were discovered cut into the underlying natural 'C' horizon, after the removal of all structural remains in trench 1. Several episodes of cultivation were suggested by the alignment of the ard marks in different directions. Dating of these features was difficult but they probably represented agricultural activity pre-dating the occupation of the site by many years.

5.2.2.2: Phase 2: Early Activity: Mid-Late Iron Age:

These features consisted of a series of anthropogenic soils and cut features in the north and western sides of trench 1. They were discovered in association with a wall and were interpreted as evidence of the earliest occupation of the site. Two features (629 and 630) were thought to be the remains of early metalworking activity pre-dating the construction of structure 2. A drain covered by capstones (590, 602, 603, 610, 611) was found cut into the 'C' horizon at the western edge of the trench. This feature was extensively sampled. The features in this phase extended beyond the trench edges and so were not fully excavated. Deep peat ash and charcoal rich soil layers characterised the matrix of this phase, in particular context 544 which contained abundant peat ash and was up to 0.3m deep.

5.2.2.3: Phase 3: Structure 2, the Pictish smithy: Mid-Late Iron Age / Pictish:

Fig. 37 shows a composite plan of structure 2. This building was defined by three lengths of walling, and was thought to have been primarily constructed for metalworking puposes, based upon the discovery of large ammounts of hammerscale and large lumps of metalworking debris in the interior of the building. The building was lobate or cellular in design and at least 5.4m wide and 8m long, with the long axis following an approximately north-south alignment. Several hearths containing large quantities of metal waste and hammerscale were discovered. Two ingot moulds and some possible casting waste were also recovered. Extensive evidence for occupation deposits and hearth places were excavated. This building is thought to have been in use during the Mid - Late Iron Age, but post-dates phase two.

A complex succession of soil deposits and hearth and pit features were interpreted as contemporary with the occupation of structure 2. Early features consisted of a stone lined box or tank (161 / 508, 512), and a deep pit (595) filled with metalworking debris. The pit also contained part of a rotary quern stone. Later features consisted of a series of hearths (151, 159, 180 / 514, 565) and pits (176,

Table 21: Burland, Trondra, Dating and Phasing Concordances:

Period	Phase	Contexts	Dating
Pre / Early Iron Age	Phase 1	Data not available No Samples	Stratigraphic: agricultural layers pre-dating all Mid-Late Iron Age structures on site.
Mid-Late Iron Age	Phase 2	528, 544, 569, 570, 571, 579, 587, 589, 596, 599, 601, 602, 604, 606, 608, 610, 612, 614, 615, 616, 618, 620, 622, 625, 631, 632, 633, 634.	Artefactual and structural: Metalworking waste, structural features, peat ash (all pre-date structure 2 / phase 3).
Mid-Late Iron Age / Pictish	Phase 3	Structure 2: 106, 107, 119, 122, 128, 129, 132, 135, 138, 146, 150, 151, 154, 155, 156, 157, 159, 160, 161, 163, 164, 165, 166, 167, 174, 176, 177, 178, 180, 181, 182, 508, 509, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 525, 529, 530, 532, 533, 535, 536, 537, 538, 541, 543, 545, 546, 551, 553, 555, 556, 557, 558, 559, 560, 562, 563, 565, 566, 567, 568, 574, 576, 578, 580, 581, 583, 584, 591, 592, 593, 594, 595, 598, 624.	Artefactual and structural: Metalworking hearths, Rotary quernstones, Pictish diagnostic artefacts, Figure of eight style amorphous cellular building.
Pictish (?) / Unknown	Phase 4	117, 118, 148, 149, 505, 510, 523, 526, 527, 534, 539.	Uncertain: Partially excavated cellular building, truncated by coastal erosion.
Viking / Early Norse	Phase 5	108, 109, 112, 113, 115, 127, 133, 136, 137, 139, 140, 144, 145, 168, 170, 173.	Artefactual and structural: Sub-rectangular / oval structure. Central drain. Pottery.
Abandonment: Late / Post Norse	Phase 6	102, 104, 105, 501, 503, 505, 507.	Stratigraphic: Abandonment, loose rubble collapse and soil, hillwash containing worked flints.
Peat Stack	Phase 7	103, 502. No Samples.	Ethnographic: Possibly 19thC.

Fig. 36: Orientation of Structures, Burland, Trondra, Shetland (Moore and Wilson 2001).

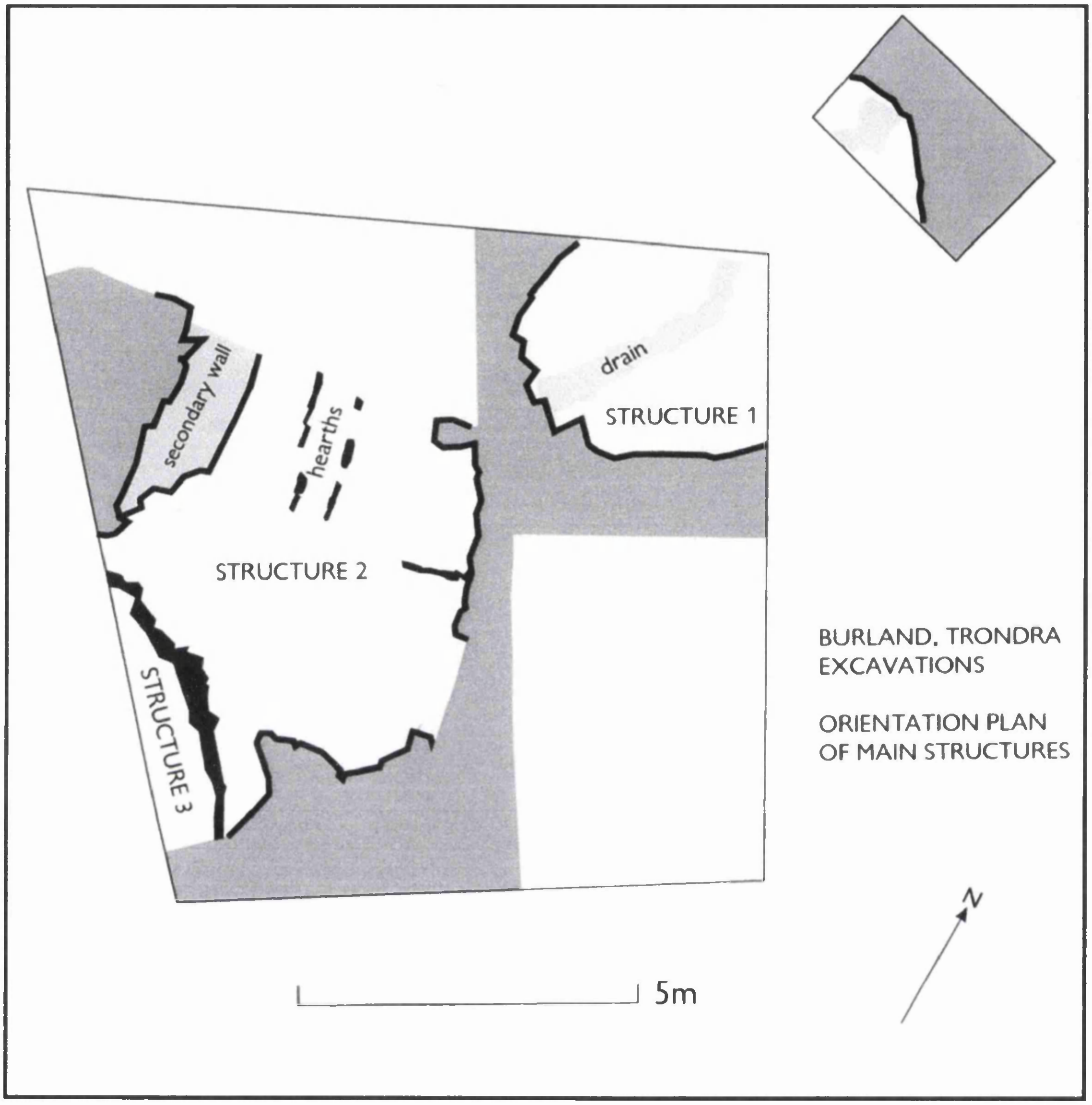
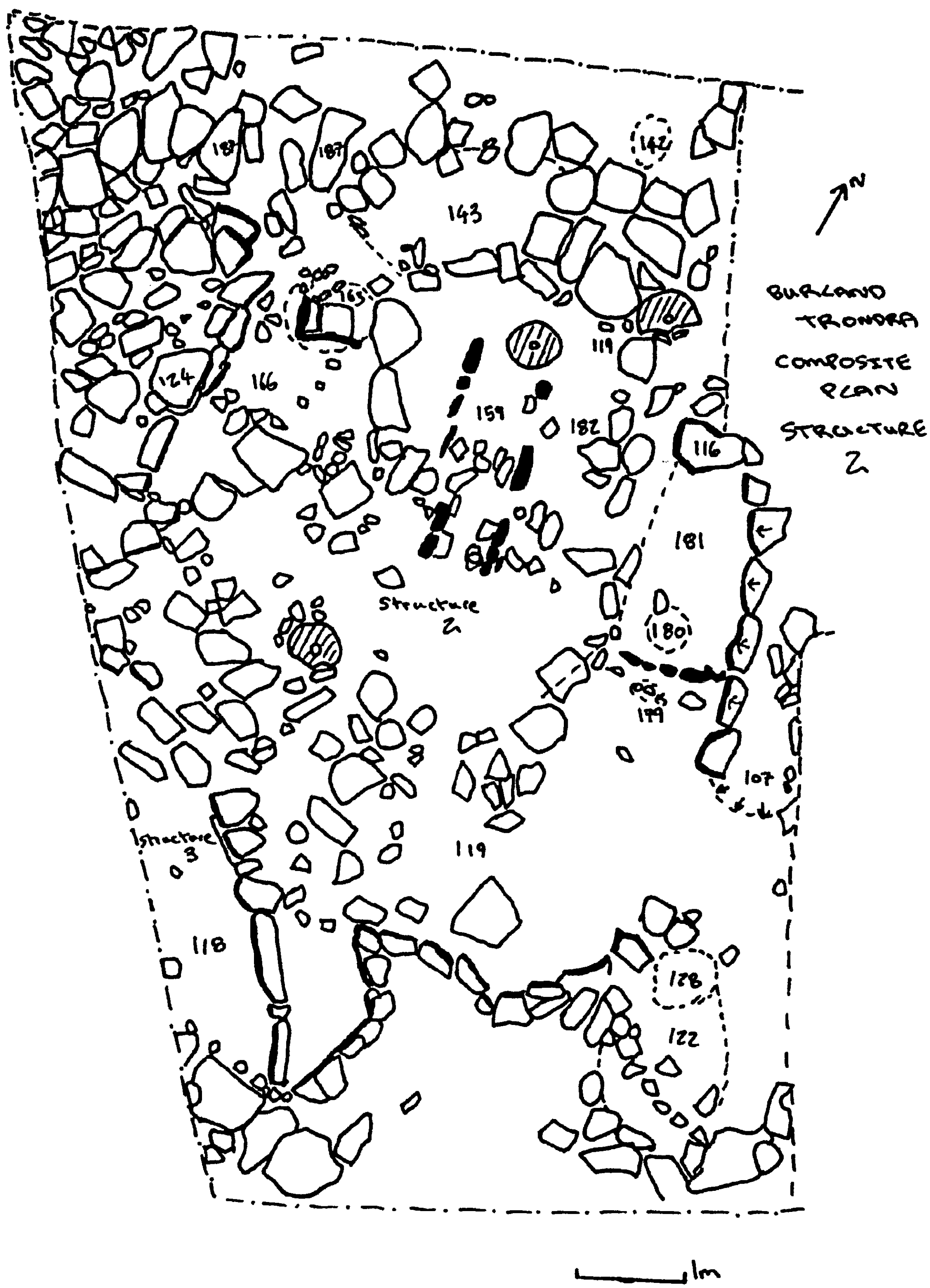


Fig. 37: Composite Plan of Structure 2: Burland, Trondra, Shetland (after Moore and Wilson 2001).



177, 566, 567, 591, 592) associated with dumps of peat ash and metalwork, and possible crushed metal ore. Paving and a series of occupation deposits containing pottery, charcoal, peat ash, burnt bone and metal debris were also visible, together with rotary quernstones. The presence of quernstones suggested that some of the hearth features could have been used for domestic purposes as well as metalworking.

5.2.2.4: Phase 4: Structure 3: Pictish? / Unknown:

Structure 3 extended beyond trench 1 to the west and was only partly excavated. An arc of revetted walling (117 / 526) and a stone built drain (148 / 527) were uncovered. Its survival was believed to be limited as it extended out toward the eroding coastline.

5.2.2.5: Phase 5: Structure 1: Viking / Early Norse:

This building was located in the northwest corner of trench 1 where a curving arc of walling (114) suggested a probable sub-rectangular or oval building. Part of a curving wall was also present in trench 2, maybe representing an internal dividing wall, or a continuation of that found in trench 1. The interior of structure 1 was dominated by a large central stone-capped drain, containing silty fills with pottery and charcoal. These were extensively sampled (115, 136, 137, 139, 168). Four separate occupation deposits (112, 113, 140, 173) contemporary with the drain and consisting of silty clay with pottery, peat ash and charcoal, were also sampled.

5.2.2.6: Phase 6: Abandonment: Late / Post Norse:

A deposit of soil and loose rubble covered the whole site and marked the abandonment of structures 1 and 3. This material probably derived from the collapse of these structures. No evidence for any occupation after the abandonment of these buildings was suggested. The entire site was covered with a grey silty soil deposit to a depth of 0.25m containing glazed pottery and fragments of struck quartz. This deposit was probably an old ground surface derived from hillwash, and the quartz remains probably derived from an earlier settlement uphill, possibly disturbed by later farming activities.

5.2.2.7: Phase 7: Peat stack: 19th Century (?):

A large mound of peat (103 / 502) covered the central and south-western part of trench 1, to a depth of 0.45m. It was firmly compacted and lacked any structure, and probably represented re-deposited material. It was interpreted as the remains of a peat stack, possibly 19th century in date.

5.3: Environmental Sampling and Processing:

5.3.1: Sampling Strategy:

Bulk environmental samples were taken from all deposits considered archaeological in nature during the course of the excavations (Moore and Wilson 2001). Samples were not available from phase 1 or phase 7 contexts. A routine sampling policy of a minimum of 14 litres per context had been adopted by EASE during the 2000 excavation, although this varied dependent upon the size of the feature sampled. In the case of smaller features a total sample (100% of the context) was taken. With larger extensive contexts, bulk samples of up to 60 litres were taken, primarily for the recovery of bone and non-biological remains, such as slag and pottery. In particular - with the author's presence on site during 2002 - hearth contexts rich in visible heather remains were systematically sampled to between 28 to 56 litres to maximise the potential recovery of carbonised plant remains. **Table 22** lists the samples from 2000, and **table 23** from 2002, both providing volume data for all samples. Occassionally small additional samples of

Table 22: Burland, Trondra: Bulk Environmental Samples 2000 Excavation:

Bulk Environmental Samples (2000)	Phase	Volume (l)	Processing	Sieve Size
F.102	6	20	Floated	>300um
F.104	6	18	Floated	>300um
F.105	6	20	Floated	>300um
F.106	3	5	Floated	>300um
F.107	3	2	Floated	>300um
F.108	5	15	Floated	>300um
F.109	5	18	Floated	>300um
F.112	5	14	Floated	>300um
F.113	5	14	Floated	>300um
F.115	5	14	Floated	>300um
F.118	4	18	Floated	>300um
F.119	3	39	Floated	>300um
F.122	3	6	Floated	>300um
F.127	5	16	Floated	>300um
F.128	3	14	Floated	>300um
F.129	3	10	Floated	>300um
F.132	3	4	Floated	>300um
F.133	5	16	Floated	>300um
F.135	3	4	Floated	>300um
F.136	5	14	Floated	>300um
F.137	5	2	Floated	>300um
F.138	3	17	Floated	>300um
F.139	5	8	Floated	>300um
F.140	5	10	Floated	>300um
F.144	5	14	Floated	>300um
F.145	5	14	Floated	>300um
F.146	3	16	Floated	>300um
F.149	4	16	Floated	>300um
F.150	3	16	Floated	>300um
F.154	3	16	Floated	>300um
F.155	3	2	Floated	>300um
F.156	3	2	Floated	>300um
F.157	3	8	Floated	>300um
F.160	3	6	Floated	>300um
F.163	3	5	Floated	>300um
F.164	3	16	Floated	>300um
F.165	3	14	Floated	>300um
F.166	3	14	Floated	>300um
F.167	3	4	Floated	>300um
F.168	5	16	Floated	>300um
F.170	5	16	Floated	>300um
F.173	5	14	Floated	>300um
F.174	3	10	Floated	>300um
F.177	3	1	Floated	>300um
F.178	3	8	Floated	>300um
F.181	3	17	Floated	>300um
F.182	3	7	Floated	>300um

Table 23: Burland, Trondra: Bulk Environmental Samples 2002 Excavation:

Bulk Environmental Samples 2002	Phase	Volume (l)	Processing	Sieve Size
F.501	6	56	Floated	>300um
F.503	6	56	Floated	>300um
F.505	4	14	Floated	>300um
F.506	6	14	Floated	>300um
F.507	6	56	Floated	>300um
F.509	3	56	Floated	>300um
F.510	4	14	Floated	>300um
F.511	3	14	Floated	>300um
F.513	3	14	Floated	>300um
F.514	3	28	Floated	>300um
F.515	3	56	Floated	>300um
F.516	3	56	Floated	>300um
F.517	3	56	Floated	>300um
F.518	3	14	Floated	>300um
F.519	3	42	Floated	>300um
F.520	3	28	Floated	>300um
F.521	3	28	Floated	>300um
F.522	3	56	Floated	>300um
F.523	4	14	Floated	>300um
F.525	3	14	Floated	>300um
F.526	4	14	Floated	>300um
F.528	2	14	Floated	>300um
F.529	3	56	Floated	>300um
F.530	3	28	Floated	>300um
F.532	3	14	Floated	>300um
F.533	3	14	Floated	>300um
F.534	4	14	Floated	>300um
F.535	3	14	Floated	>300um
F.536	3	14	Floated	>300um
F.537	3	56	Floated	>300um
F.538	3	28	Floated	>300um
F.539	4	14	Floated	>300um
F.541	3	14	Floated	>300um
F.543	3	14	Floated	>300um
F.544	2	14	Floated	>300um
F.545	3	14	Floated	>300um
F.546	3	14	Floated	>300um
F.551	3	56	Floated	>300um
F.553	3	14	Floated	>300um
F.555	3	14	Floated	>300um
F.556	3	56	Floated	>300um
F.557	3	14	Floated	>300um
F.558	3	14	Floated	>300um
F.559	3	14	Floated	>300um
F.560	3	28	Floated	>300um
F.562	3	14	Floated	>300um
F.563	3	56	Floated	>300um
F.566	3	56	Floated	>300um
F.568	3	182	Floated	>300um
F.569	2	14	Floated	>300um
F.570	2	56	Floated	>300um
F.571	2	14	Floated	>300um
F.574	3	56	Floated	>300um
F.576	3	56	Floated	>300um
F.578	3	14	Floated	>300um

Table 23: cont.../

Bulk Environmental Samples 2002	Phase	Volume (l)	Processing	Sieve Size
F.579	2	56	Floated	>300um
F.580	3	14	Floated	>300um
F.581	3	14	Floated	>300um
F.583	3	14	Floated	>300um
F.584	3	14	Floated	>300um
F.587	2	14	Floated	>300um
F.589	2	126	Floated	>300um
F.592	3	14	Floated	>300um
F.593	3	14	Floated	>300um
F.594	3	14	Floated	>300um
F.596	2	28	Floated	>300um
F.598	3	14	Floated	>300um
F.599	2	56	Floated	>300um
F.601	2	14	Floated	>300um
F.602	2	14	Floated	>300um
F.604	2	14	Floated	>300um
F.606	2	14	Floated	>300um
F.608	2	14	Floated	>300um
F.610	2	14	Floated	>300um
F.612	2	14	Floated	>300um
F.614	2	14	Floated	>300um
F.615	2	14	Floated	>300um
F.616	2	14	Floated	>300um
F.618	2	14	Floated	>300um
F.620	2	14	Floated	>300um
F.622	2	14	Floated	>300um
F.624	3	14	Floated	>300um
F.625	2	28	Floated	>300um
F.631	2	14	Floated	>300um
F.632	2	14	Floated	>300um
F.633	2	14	Floated	>300um
F.634	2	14	Floated	>300um

approximately 1 litre were taken to test for the presence of hammerscale, but these are still to be analysed by an appropriate metalworking specialist, and are not included here.

A total of 47 bulk samples were taken during 2000 and a further 87 during the 2002 season. The sampling strategy encompassed a thorough investigation of the various hearths, pits and metalworking activity areas around the site. By studying the deposition of carbonised deposits within these features it may be possible to shed new light on the exact activities occurring within these buildings, be they domestic or industrial, which may not be attainable by excavation alone. The composition of individual samples, containing peat, charcoal, cereal grain, metalwaste, and so forth, and their variation across the site, reflects the agricultural and industrial activities important to people during the Pictish / Norse periods. As such it will enable a wider understanding of the social and political influences affecting Trondra at this time.

5.3.2: Sample Processing:

All bulk environmental samples were processed on site utilising a water flotation machine with a fresh water supply, using the techniques described in chapter 2.2.3.2. Prior to processing, a small 0.5 to 1 litre subsample was removed from each bulk sample and retained for potential use by other specialists. The author was not present during the 2000 excavation, where all samples were floated and the residues sorted by Ease staff. However during the 2002 season the author was present on site for the full season and supervised the sampling, processing and sorting of all bulk samples. Ms. Mairhi-Clair Semple floated all the bulk samples for 2002 on site. Bulk samples were floated to >300μm, subsamples laboratory processed to >250μm. The residues for 2002 were sorted by the author and Mr. Brian Hession whilst on Shetland. The flots for 2000 and 2002 were forwarded, with the kind permission of Ms. Hazel Moore and Mr. Graeme Wilson, to Glasgow University for analysis by the author.

5.3.3: Sample Analysis:

The floted samples were sorted and identified following the proceedures described in chapter 2.2.3.2. The subsamples from 2002 were also sent to Glasgow for analysis. These were processed following the methods in chapter 2.2.3.3. A total of 16 subsamples - representing almost 20% of the total number of samples taken in 2002 – were selected for laboratory sieving in order to test for any possible loss or differential recovery occurring during flotation. These were selected after a consideration of the quantities of material extracted from each sample by standard flotation techniques. The author chose samples of proven abundance levels of cereals and chaff where possible, mainly to be certain that some material would be present from both types of method, which could then be used to make comparisons on quantity and quality of grain, chaff, weeds etc recovered. Volumes of subsamples processed are listed in **table 29**.

5.4: Results:

For the purposes of interpretation the 2000 and 2002 excavation season samples have been combined and presented by phase. The following samples produced no carbonised plant material or other environmental remains and were not included in the tables: 102, 106, 145, 167, 170, 503, 601, 614 and 620. Subsample 526 also produced no data and is not included in the tables. The samples were grouped into phases 2, 3, 4, 5 and 6 respectively. Phases 2 and 3 are presented in gatefold form as **tables 24** and **25**. Phases 4, 5 and 6 are presented in the text in **tables 26**, **27** and **28**. Raw results from the subsamples are presented in the text in **table 29**. Identifications of wood charcoal from both the bulk and subsamples are presented together in **table 30**.

Raw data tables **24**, **25**, **26**, **27**, **28**, **29** and **30** are presented on the following pages.

Table 24: Burland, Trondra: Phase Two

Burland, Trondra: Phase Two Contexts (F.no.):	528	544	569	570	571	579	587	589	596	599	602	604	606	608	610	612
Carbonised Cereal Grain and Chaff:																
Avena sp.				6												
cf. *Avena* sp.																
Hordeum vulgare var. *vulgare*		1		919	5	15		8	14	7	1		1			
Hordeum vulgare var. *vulgare* (twisted)		4		36		2		1		2						
Hordeum vulgare var. *nudum*				7				1		11						5
Hordeum vulgare cf. var. *nudum*																
Hordeum vulgare sl.				622	19	7		15	12	23		1	2			1
cf. *Hordeum* sp.				194		5			5						2	
Hordeum vulgare sl. spikelet				1												
cf. *Triticum aestivum* sl.				4												
Cerealia / Poaceae stem fragment																
Indeterminate cereal chaff																
Indeterminate cereal grain (+ embryo)	2	2		93	8	7		1		10			3			
Indeterminate cereal grain (- embryo)				616	15	6	1			3					1	
Carbonised Wild Resources:																
Burnt peat fragments	1	7	8	13		9										
Burnt Vesicular (dung or other?)									1							
Carbonised seaweed																
Calluna vulgaris (seeds)																
Calluna stems (roots and twigs)	1	1		1	150+	5		1200+	10+	150+	25+	50+				
Calluna leafy shoots				1					1							
Calluna flower capsules																
Cyperaceae type rhizomes				7												
Indeterminate rhizomes																
Carbonised Weeds:																
Ranunculus sp.																
Ranunculus repens																1
Ranunculus bulbosus																
Chenopodium album																
Montia fontana ssp. *fontana*						1										
Stellaria media		20	1	19	10	44	2		43		2		1	1		
Spergula arvensis		1	1	10		1										
Silene dioica								1								
Polygonum sp.																
Polygonum aviculare s.l.																
Polygonum arenastrum																
Rumex sp.						2			6							
Rumex acetosa																
cf. *Rumex* sp.																
Capsella bursa-pastoris																
Brassica sp.				6			1									
Empetrum nigrum						1										
Linum usitatissimum																
cf. *Linum* sp.																
Galeopsis tetrahit				2	1				3							
Prunella vulgaris				3												
Plantago lanceolata																
Galium aparine																
Sambucus nigra																
cf. *Potamogeton* sp.																
Eleocharis sp.		1														
Scirpus sp.						2										
Scirpus setaceus				2												
cf. *Scirpus* sp.																
Carex sp.				4		5			1							
Small Poaceae	1			2			1		1					1		1
Poa annua		2														
Bromus sp.																
Danthonia decumbens		3										1				
Other Remains:																
Burnt indeterminate bone																
Fish bone (unburnt)																
Small mammal bone									1							
Slag bubbles		2		1		4										

Burland, Trondra: Phase Three Contexts (F.No):	107	119	122	128	129	132	135	138	146	150	154	155	156	157	160	163	164	165	166	174	177	178	181	182	509	511	513	514	515	516	517	518	519	520	521	522	525	529	530	532	533	535	536	537	538	541	543	545	546	551	553	555	556	557	558	559	560	562	563	566	568	574	576	578	580	581	583	584	592	593	594	598	624
Carbonised Cereal Grain and Chaff:																																																																									
Avena sp.																																																	5	1						2	2												1				
cf. *Avena* sp.																																																								2																	
Hordeum vulgare var. *vulgare*									2	1		4		2	5		1									3		1		3	1	6	2												3			2	79	547			83	1	16	4	65		4	5	2		2		3	1	8	6					3
Hordeum vulgare var. *vulgare* (twisted)									2					1	1		2		1												1		2		1										3		3		3	83			5		3	3	11			2	2						1			2			3
Hordeum vulgare var. *nudum*													1						2				1	3												2														112			9																				
Hordeum vulgare cf. var. *nudum*																																																1																									
Hordeum vulgare sl.			1		4				3							1	1		3	3				4			5			2	7	4	7		1	4	1		1		1		1	1	9				50	1136			56	1	13	7	27		5	8		3	5		3		6	11			1		
cf. *Hordeum* sp.																														2		7			3														33				35	2		4				4								3					
Hordeum vulgare sl. spikelets																														1																										1																	
cf. *Triticum aestivum* sl.																																																																									
Cerealia / Poaceae stem fragment					1																													1															6						6								1										
Indeterminate Cereal chaff																																																																									
Indeterminate Cereal (+ embryo)									1		1								2	1		1					2			1				1			2	3					1		5		1	4	84	520		1	61	3	24	8	61			5					4		11	6	2				
Indeterminate Cereal (- embryo)													1						2																													1	54	16			4			3	10			6					3		4	4				2	
Carbonised Wild Resources:																																																																									
Burnt Peat fragments	10+	5					20+	5+			5		5	5+	50+											3	6	5			13	17			12	22			13				3	10						26	3		1		25	1			6	11	61	20	1					23	11				
Burnt Vesicular (dung or other?)																										1										1			1									1																	1			1					
Carbonised Seaweed		2										1					25	12		4		1			9		3		3	22				128													1		1				1		1			100+	30	3	1	1		1									
Calluna vulgaris (seeds)																																1																																									
Calluna stems (roots and twigs)	25+	250+		2000+	5		20+	10+		10+	10+			5+			3			1	1		100+	25+	15	10+	500+	100+	2	10+	200+	200+	5		2	550+			10+				4	10	50+			200+		15+			5					5		2	100+	300+	6		20+	50+	100+	1	5	50+	6	2	
Calluna leafy shoots																														1		3																																									
Calluna flower capsules																																										1																															
Cyperaceae type rhizomes	16																																																																1							
Indeterminate rhizomes					1																															1																							1		1												
Carbonised Weeds:																																																																									
Ranunculus sp.																																													1																												
Ranunculus repens																																																											1				1										
Ranunculus bulbosus																																		1																																							
Chenopodium album						1																																				2																															
Montia fontana ssp. *fontana*																														2				8													2								2					1													
Stellaria media	1	1	4			16			23		1						4	1	3	7		3	2		1	1	32			307		9	2	495	2	1	3	3				5	9		3	1	65	6	27	8			1	20	34	4	5		429	10	119	17	189	1	18	1	6	10	8			1	14
Spergula arvensis	1																															3		2															1						2					2													
Silene dioica																																																																									
Polygonum sp.																																																																			1	3					
Polygonum aviculare s.l.																														1																																											
Polygonum arenastrum																																																																									
Rumex sp.									1																					2		1											1	1			1		4						3				6		1		5		1								1
Rumex acetosa																																																									11																
cf. *Rumex* sp.																			1																																																						
Capsella bursa-pastoris																																															4		2							1																	
Brassica sp.																																													2				1	1																							
Empetrum nigrum																																								1									1						1					1			1		1								
Linum usitatissimum									1																																																		1														
cf. *Linum* sp.																																																	1						4								1										
Galeopsis tetrahit																																																1												1													
Prunella vulgaris																																1																												1													
Plantago lanceolata																														1				2																								1															
Galium aparine																																																																									
Sambucus nigra																			1								1																																														
cf. *Potamogeton* sp.																																													1																												
Eleocharis sp.																											1																						2						1																		
Scirpus sp.																																																																									
Scirpus setaceus																																																1																									
cf. *Scirpus* sp.																						1					7			7		7		7		1									3		3			1				1	5	1	3		20		4	2	24	1									
Carex sp.									2																	1				41		3		9											3		52		6		2			1	6		11			4		1			3	1	1	3	2	1	1	1	
Small Poaceae				1					2																					2								1					5											1																				
Poa annua																																																																									
Bromus sp.																														1																	2																										
Danthonia decumbens																																																																				1					
Other Remains:																																																																									
Burnt Indeterminate Bone		1																						1																																																	
Fish Bone (Unburnt)		3																																				1																			6					2											
Small Mammal Bone											5			3																	3	10+		1				3			3				10+				1							4										3		1					
Silica bubbles																																																																									

Table 26: Burland, Trondra: Carbonised Plant and Other Remains from Phase Four:

Burland, Trondra: Phase Four Contexts (F.No):	**118**	**149**	**505**	**510**	**523**	**526**	**534**	**539**
Carbonised Cereal Grain and Chaff:								
Avena sp.	1			8				
cf. *Avena* sp.								
Hordeum vulgare var. *vulgare*	8	3	4	70	10	3		3
Hordeum vulgare var. *vulgare* (twisted)	6		1	11	4	2		3
Hordeum vulgare var. *nudum*								
Hordeum vulgare cf. var. *nudum*	2			1				
Hordeum vulgare sl.	19	2	4	139	15	6	3	10
cf. *Hordeum* sp.		4				4		3
Hordeum vulgare sl. spikelets								
cf. *Triticum aestivum* sl.								
Cerealia / Poaceae stem fragment						5		1
Indeterminate cereal chaff				2				
Indeterminate Cereal (+embryo)	16	3	2	94	19	18	4	7
Indeterminate Cereal (-embryo)	3	1		50	20	12	2	6
Carbonised Wild Resources:								
Burnt Peat fragments		2	48	108	1			
Burnt Vesicular (dung or other?)				1				
Carbonised Seaweed		3		3			1	1
Calluna stems (roots and twigs)	10+			3		3		
Calluna leafy shoots						1		
Calluna flower capsules						2		
Cyperaceae type rhizomes								
Indeterminate rhizomes				1		1		
Carbonised Weeds:								
Ranunculus sp.								
Ranunculus repens								
Ranunculus bulbosus								
Chenopodium album					5			
Montia fontana ssp. *fontana*							1	
Stellaria media		3		19		8	2	20
Spergula arvensis					1			
Silene dioica								
Polygonum sp.								
Polygonum aviculare sl.								1
Polygonum arenastrum				1				
Rumex sp.				1				
Rumex acetosa								
cf. *Rumex* sp.								
Capsella bursa-pastoris								
Brassica sp.						2		
Empetrum nigrum						1		
Linum usitatissimum								
cf. *Linum sp.*								
Galeopsis tetrahit				1			1	1
Prunella vulgaris								
Plantago lanceolata								
Galium aparine								
Sambucus nigra								
cf. *Potamogeton* sp.								
Eleocharis sp.								
Scirpus sp.				1				1
Scirpus setaceus								
cf. *Scirpus* sp.								
Carex sp.				4		1	1	
Small Poaceae					1			
Poa annua						2		
Bromus sp.								
Danthonia decumbens				5		2		
Other Remains:								
Burnt Indeterminate Bone								
Fish Bone (Unburnt)								
Small mammal bone					1	1		
Slag bubbles								

Burland, Trondra: Phase Five Contexts (F.No):	108	109	112	113	115	127	133	136	137	139	140	144	168	173
Carbonised Cereal Grain and Chaff:														
Avena sp.	2		10				1	1						
cf. *Avena* sp.														1
Hordeum vulgare var. *vulgare*	3		6				4				3	1		
Hordeum vulgare var. *vulgare* (twisted)	1		9			1								
Hordeum vulgare var. *nudum*														
Hordeum vulgare cf. var. *nudum*			3		2									
Hordeum vulgare sl.	6	1	13	3	2	5	2	2	3				1	
cf. *Hordeum* sp.			9											
Hordeum vulgare sl. spikelets														
cf. *Triticum aestivum* sl.														
Cerealia / Poaceae stem fragment														
Indeterminate cereal chaff														
Indeterminate Cereal (+embryo)	27		13	1			1							
Indeterminate Cereal (-embryo)	2		9											
Carbonised Wild Resources:														
Burnt Peat fragments									3	5+				
Burnt Vesicular (dung or other?)														
Carbonised Seaweed	2	1				5	1	5		1				
Calluna stems (roots and twigs)					5									
Calluna leafy shoots														
Calluna flower capsules														
Cyperaceae type rhizomes														
Indeterminate rhizomes														
Carbonised Weeds:														
Ranunculus sp.														
Ranunculus repens														
Ranunculus bulbosus														
Chenopodium album														
Montia fontana ssp. *fontana*														
Stellaria media		2		1			1				3			
Spergula arvensis			5											
Silene dioica														
Polygonum sp.														
Polygonum aviculare sl.														
Polygonum arenastrum														
Rumex sp.													1	
Rumex acetosa														
cf. *Rumex* sp.				1							1			
Capsella bursa-pastoris														
Brassica sp.														
Empetrum nigrum														
Linum usitatissimum														
cf. *Linum sp.*														
Galeopsis tetrahit			5											
Prunella vulgaris														
Plantago lanceolata														
Galium aparine														
Sambucus nigra														
cf. *Potamogeton* sp.														
Eleocharis sp.														
Scirpus sp.														
Scirpus setaceus														
cf. *Scirpus* sp.														
Carex sp.			1								2			
Small Poaceae														
Poa annua														
Bromus sp.														
Danthonia decumbens														
Other Remains:														
Burnt Indeterminate Bone														
Fish Bone (Unburnt)														
Small mammal bone														
Slag bubbles				2										

Table 28: Burland, Trondra: Carbonised Plant and Other Remains from Phase Six:

Burland, Trondra: Phase Six Contexts (F.No):	**104**	**105**	**501**	**506**	**507**
Carbonised Cereal Grain and Chaff:					
Avena sp.	1	1		1	
cf. *Avena* sp.					
Hordeum vulgare var. *vulgare*		25		2	
Hordeum vulgare var. *vulgare* (twisted)		2		1	
Hordeum vulgare var. *nudum*					
Hordeum vulgare cf. var. *nudum*					
Hordeum vulgare sl.	9	28	3		3
cf. *Hordeum* sp.				4	3
Hordeum vulgare sl. spikelets					
cf. *Triticum aestivum* sl.					
Cerealia / Poaceae stem fragment					
Indeterminate cereal chaff					
Indeterminate Cereal (+embryo)		27			10
Indeterminate Cereal (-embryo)		8		1	3
Carbonised Wild Resources:					
Burnt Peat fragments			7	17	8
Burnt Vesicular (dung or other?)					
Carbonised Seaweed		2			
Calluna stems (roots and twigs)		10+			5
Calluna leafy shoots					
Calluna flower capsules					
Cyperaceae type rhizomes					
Indeterminate rhizomes					
Carbonised Weeds:					
Ranunculus sp.					
Ranunculus repens					
Ranunculus bulbosus					
Chenopodium album					
Montia fontana ssp. *fontana*					
Stellaria media					
Spergula arvensis		1			
Silene dioica					
Polygonum sp.					
Polygonum aviculare sl.					
Polygonum arenastrum					
Rumex sp.					
Rumex acetosa					
cf. *Rumex* sp.					
Capsella bursa-pastoris					
Brassica sp.					
Empetrum nigrum		1			
Linum usitatissimum					
cf. *Linum sp.*					
Galeopsis tetrahit					
Prunella vulgaris					
Plantago lanceolata					
Galium aparine					
Sambucus nigra					
cf. *Potamogeton* sp.					
Eleocharis sp.					
Scirpus sp.					
Scirpus setaceus					
cf. *Scirpus* sp.					
Carex sp.					
Small Poaceae		1			
Poa annua					
Bromus sp.					
Danthonia decumbens		1			
Other Remains:					
Burnt Indeterminate Bone					
Fish Bone (Unburnt)					
Small mammal bone					
Slag bubbles					

Burland Trondra 2002 Subsamples (F.No):	**570**	**579**	**596**	**606**	**525**	**546**	**551**	**558**	**560**	**566**	**574**	**583**	**592**	**523**	**506**
Stratigraphic Phase:	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**4**	**6**
Volume (Litres):	**1**	**1**	**1**	**1**	**0.5**	**1**	**1**	**1**	**1**	**0.5**	**1**	**1**	**1**	**0.5**	**1**
Carbonised Cereal Grains and Chaff:															
Avena sp.									1						
Hordeum vulgare var. *vulgare*	19		1			3	8		6						
Hordeum vulgare var. *vulgare* (twisted)	5						2		5					1	
Hordeum vulgare sl.	16						8		4						
cf. *Hordeum* sp.				1											
Hordeum vulgare sl. Spikelets	1														
Cerealia / Poaceae stem fragments							1								
Indeterminate Cereal chaff	1														
Indeterminate Cereal (+embryo)	16						8							1	
Indeterminate Cereal (-embryo)	9						2								
Carbonised Wild Resources:															
Burnt peat fragments	100+	10			15+	5		3	3	20+			4		3
Calluna stems (roots and twigs)	1		1			10+					2	25+	10+		
Carbonised Weeds:															
Carex sp.									1						
Other Remains:															
Burnt Indeterminate Bone								19							
Unburnt Indeterminate Bone						1		5							10
Fish Bone (Unburnt)										1					
Pottery sherds		1	1							1	1				
Charcoal:															
Pinus sylvestris											1.2g (2)				

Table 29: Burland Trondra 2002 Subsamples: Carbonised Cereal Grains, Chaff, Weeds, Charcoal and Other Remains.

Burland Trondra Charcoal Identifications:	***Alnus***	***Corylus***	***Quercus***	***Pinus sylvestris***	***Larix / Picea***	**Coniferous Type**	**Indet.**
Phase 2 Samples:							
F.589		1.6g (2)					
F.631		0.1g (1)	0.2g (1)				
F.632	0.1g (1)						
Phase 3 Samples:							
F.107				1.2g (1)			
F.119						0.4g (1)	0.4g (2)
F.128				4.5g (8)	0.3g (1)		
F.135			0.6g (1)				
F.157			0.5g (1)				
F.174				2.3g (2)			
F.513						2.3g (2)	0.5g (1)
F.517			2.9g (1)	0.4g (1)			
F.518						1.2g (2)	
F.522		0.1g (1)				0.3g (1)	
F.537		1.4g (3)					
S.F.542				2.4g (1)			
F.546				2.2g (3)			
F.551				0.9g (1)			
F.553							0.1g (1)
F.574 (From Subsample)				1.2g (2)			
F.580		0.3g (2)					0.5g (1)
F.593		2.5g (3)					
Phase 4 Samples:							
F.526				5.6g (6)			
F.534				0.8g (1)			
Phase 5 Samples:							
F.112	1.2g (1)						
F.140				0.9g (1)			
Phase 6 Samples:							
F.506				2.3g (1)			

Table 30: Burland Trondra: Summary of samples containing charcoal.

(Note: Figures in brackets represent actual counts)

5.5: Discussion of the Results:

5.5.1: Overview:

A total of 2999 litres of bulk sample sediment were processed from the excavations at Burland. The identifications of environmental material from the bulk samples are presented in summary form by phase in **table 31**. This information was then utilised to generate summary histograms, **fig. 38**, **fig. 39(a) and 39(b)**, **fig. 40** and **fig. 41**. A further 14.5 litres were laboratory sieved from the available subsamples, and these data are summarized by phase in **table 33** and grouped for interpretation in **fig. 42**. Charcoal species from all samples are summarized by phase and compared with the presence of slag, in **table 34** and **fig. 43**.

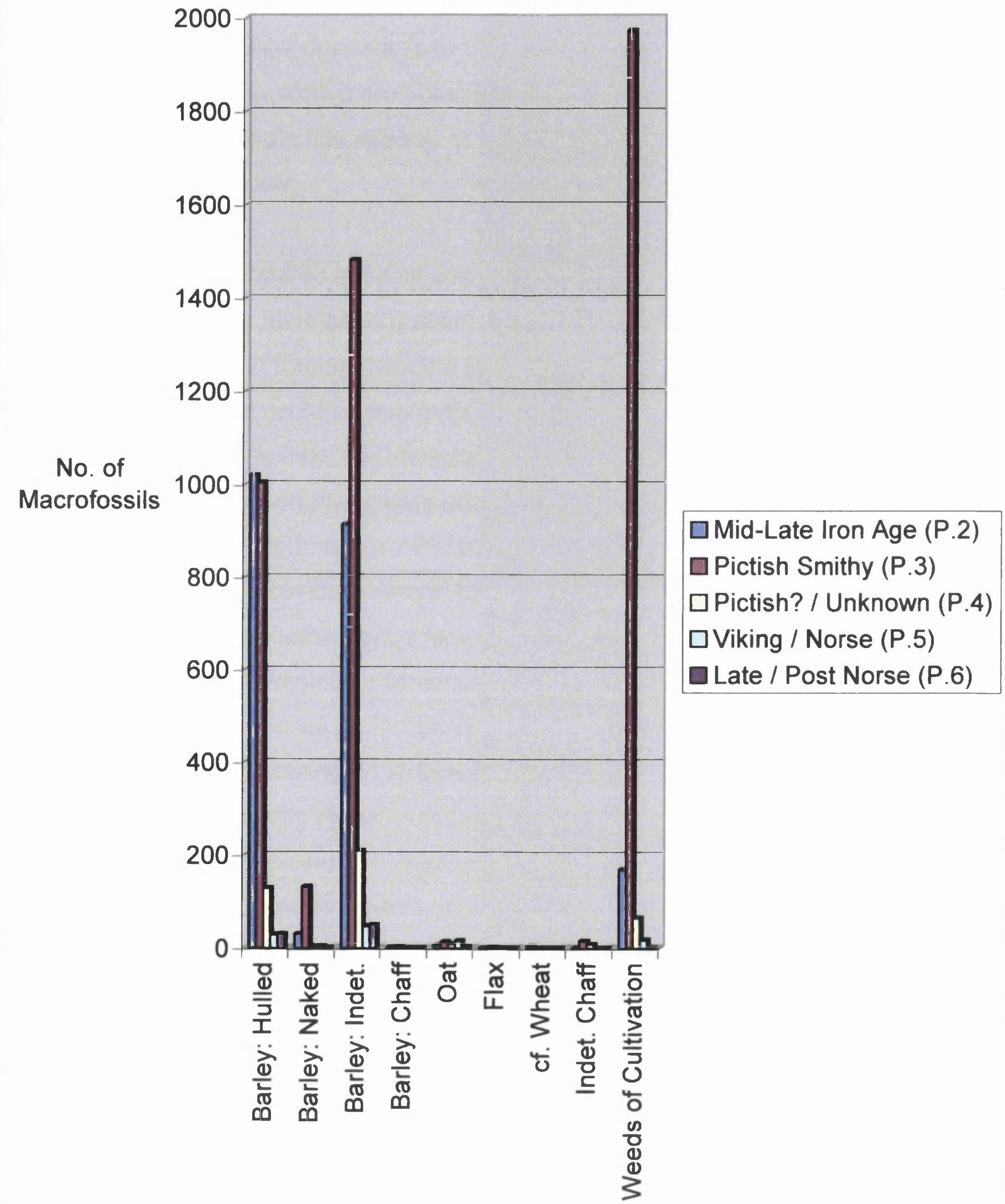
5.5.2: Cultivated Plants:

Barley (*Hordeum vulgare* sl.) was the most commonly recovered cereal species across all phases (see **fig. 38**). Many hundreds of these grains were identified as hulled barley (*Hordeum vulgare* var. *vulgare*) with the presence of twisted grain throughout the samples strongly suggesting that the main species present were six-rowed hulled barley. From the Mid-Late Iron Age and Pictish dated deposits hulled barley dominated the assemblage. The naked form of barley (*Hordeum vulgare* var. *nudum*) was also present, although in smaller quantities, with its presence slightly peaking in the Pictish smithy deposits. Whilst it may have been present as a relict crop, or weed of hulled barley during the Mid-Late Iron Age, the increase in naked grain in the Pictish period may suggest a renewed attempt at cultivating this variety. Both naked and hulled varieties continued to be present in the Viking / Early Norse structure in small amounts, although only a small part of this building was excavated. By the Late / Post Norse period, naked barley has completely disappeared at this site, whilst hulled grains remained in small

BURLAND, TRONDRA: PHASE:	TWO	THREE	FOUR	FIVE	SIX
Archaeological Strat.	**Early Activity**	**Structure 2**	**Structure 3**	**Structure 1**	**Abandonment**
Proposed Dating:	**Mid-Late Iron Age**	**Pictish Smithy**	**Pictish? / Unknown**	**Viking / Norse**	**Late / Post Norse**
Total Sample Litres:	658	1775	118	215	240
Cultivated Plants:					
Barley: Hulled	1019	1004	128	28	30
Barley: Naked	30	131	3	5	0
Barley: Indet.	913	1482	209	47	50
Total Barley Grain Count:	1962	2617	340	80	80
Barley: Chaff	1	2	0	0	0
Oats	6	13	9	15	3
Flax	0	2	0	0	0
cf. Wheat	4	0	0	0	0
Indet. Chaff	0	15	8	0	0
Indet. Cereal	130	816	163	42	37
Weeds of Cultivation	168 (5 Sp.)	1972 (8 Sp.)	65 (7 Sp.)	17 (3 Sp.)	1 (1 Sp.)
Wild Resources:					
Peat	38	398	159	8	32
Heather stems	1665+	5000+	16+	5	15+
Seaweed	0	350	8	15	2
Charcoal	2.0g (5)	28.2g (41)	6.4g (7)	2.1g (2)	2.3g (1)
Burnt Vesicular (dung or other?)	1	6	1	0	0
Other Remains:					
Fish Bone	0	4	0	0	0
Mammal Bone	1	9	2	0	0
Slag	7	47	0	2	0

Table 31: Burland, Trondra: Summary Table of Remains Recovered from all Bulk Samples by Phase.

Fig. 38: Burland, Trondra: Comparative Chart of Cultivated Species and Weeds of Cultivation by Phase:



quantities. When the difference in litres sampled across phases is accounted for there is still a decrease in grain recovered from the Norse deposits.

Possible specimens of bread / club wheat (cf. *Triticum aestivum* sl.) were found in the Mid-Late Iron Age deposits (see chapter 2, **fig. 13**). These rare grains may have been imported from more suitable southern growing areas, or could represent an attempt to cultivate this species at this time. No wheat-type grain was recovered from any other phase.

Oat grain was recovered in small amounts, mostly from the Pictish / Early Norse deposits, and may have been present as a fodder crop or a weed of barley fields. Indeterminate chaff fragments in the form of stem, was recovered from the Pictish deposits only, and could be remnants of straw used for animal fodder. The presence of large numbers of low-growing weeds also suggested that crops were harvested quite low on the straw, perhaps in order to create fodder. Barley chaff was only found in the Iron Age / Pictish deposits and was probably waste from cereal processing activities. Weeds of cultivation, mostly from sandy arable land also peaked in the Pictish period (see 5.5.3), together with the presence of seaweed and burnt vesicular remains (possibly dung, see 5.5.4). This evidence combined with the cereal grain recovery strongly suggested the cultivation of six-row hulled barley occuring on fertilised light sandy arable land during the Pictish period. Flax seeds also made an appearance in the Pictish deposits, and were not found in any other phase. The seeds found were *Linum usitatissimum*, and although this can grow as a weed, it is highly possible that this species was introduced for cultivation at this time, particularly on artificially manured light sandy soils.

The closeness of the excavated structures to the possible broch of Burland, lying on an island offshore and accessed by the nearby (now partially submerged) causeway, indicated the importance of this area during the Iron Age. The structures at Burland may have originated as possible extramural activity areas, providing centres for farming and metalworking activities outwith of or post-dating the broch occupation. These structures continued to be used and developed into the Pictish period, with an apparent intensification of farming practices visible from the environmental and artefactual remains, and an increase in metalworking apparent from other archaeological discoveries.

5.5.3: Weed Ecology:

5.5.3.1: Habitat Categories:

The weed flora from Burland was divided into nine habitat groups, as described below. Actual numbers of recovered macrofossils and species are summarized by phase in **table 32**. These data are then presented pictorally in **fig. 39(a)**. The largest weed category recorded was 'sandy arable land, damp sand, ditches and dunes', and this slightly obscured the other catagories when presented as a histogram. For this reason a second chart was produced, **fig. 39(b)**, with the 'sandy arable' removed for ease of interpretation of the remaining weeds. The following habitat categories were used:

1) Cultivated Plants (non-cereal) / Garden species:

Linum usitatissimum (flax), *Brassica* sp. (cabbages), *Sambucus nigra* (elder).

2) Sandy arable land, damp sand, ditches and dunes:

Ranunculus repens (creeping buttercup), *Chenopodium album* (fat hen), *Stellaria media* (chickweed), *Spergula arvensis* (corn spurrey), *Capsella bursa-pastoris* (shepherd's-purse).

3) Non-sandy arable / waste and disturbed ground:

Polygonum aviculare sl. (knotgrass), *Polygonum arenastrum* (equal-leaved knotgrass), *Galeopsis tetrahit* (common hemp-nettle), *Poa annua* (annual meadow grass).

4) Grassland, grassy meadows / pasture:

Prunella vulgaris (selfheal), *Plantago lanceolata* (ribwort plantain), *Silene dioica* (red campion), *Bromus* sp. (bromes).

5) Damp pasture and sandy coastal pasture, fellfield:

Rumex acetosa (common sorrel), *Ranunculus bulbosus* (bulbous buttercup), *Montia fontana* ssp. *fontana* (blinks).

6) Wetland species: Aquatic, waterside, marsh and mire (base-rich):

Eleocharis sp. (spike-rushes), *Scirpus* (*Isolepis*) *setaceus* (bristle club-rush), cf. *Potamogeton* sp. (pondweeds).

7) Moors, bogs and heath / dry heath:

Empetrum nigrum (crowberry), *Danthonia decumbens* (heathgrass).

8) Shingle beaches:

Galium aparine (cleavers).

9) Miscellaneous species:

Poaceae (grass family), *Ranunculus* sp. (buttercups), *Polygonum* sp. (knotgrasses), *Rumex* sp. (docks), cf. *Rumex* sp. (cf. docks), *Carex* sp. (sedges), cf. *Linum* sp. (cf. flax), Scirpus sp. (club-rushes).

5.5.3.2: Summary of Weed Ecology:

By far the largest category of weeds recovered consisted of species of sandy arable land. These species were present in the Mid-Late Iron Age, but as already mentioned in 5.5.2, underwent a significant increase in the Pictish (phase 3) deposits. If analysed by litre the sediment from the Iron Age (phase 2) produced almost twice the number of barley grains as the Pictish (phase 3), but less than a fifth of the quantity of weeds of cultivation. This may reflect equally on an increase in cereal processing activity occuring on-site during the Pictish period, as on an intensification of agricultural practices at this time. The Iron Age cereals may have been partially processed elsewhere, thus removing some of the larger weed seeds, and delivered to Burland for storage. By the Pictish period the system of power – and indeed the agricultural economy - may have changed considerably, resulting in the need for small family units to produce and process their own cereal grain on a local scale, probably on seaweed or dung fertilised soils. Sandy arable weeds continued to be present in the Norse deposits, although in much smaller quantities. Non-sandy arable weeds occurred in all deposits apart from the Late Norse / abandonment phase, and may reflect the limited use of poorer agricultural land, or be simply opportunist disturbed ground weeds growing locally to the site.

Damp pasture and sandy coastal pasture weeds may have been consumed by animals and arrived on site in the dung of these creatures. Similarly the aquatic species cf. *Potamogeton* (pondweeds) may have been swallowed with drinking water, and excreted. The muddy hooves of domesticates such as cattle, could also have carried these species into animal enclosures enabling weeds to become

Burland, Trondra: Phasing:	TWO	THREE	FOUR	FIVE	SIX
Archaeological Stratigraphy:	**Early Activity**	**Structure 2**	**Structure 3**	**Structure 1**	**Abandonment**
Proposed Dating:	**Mid-Late Iron Age**	**Pictish Smithy**	**Pictish? / Unknown**	**Viking / Norse**	**Late / Post Norse**
Weed Species Ecology:					
Cultivated plants (non-cereal) / garden species	8 (2 sp.)	5 (2 sp.)	2 (1 sp.)	0	0
Sandy arable, damp sand, ditches and dunes	160 (3 sp.)	1956 (5 sp.)	58 (3 sp.)	12 (2 sp.)	1 (1 sp.)
Non-sandy arable / waste and disturbed ground	8 (2 sp.)	16 (3 sp.)	7 (4 sp.)	5 (1 sp.)	0
Grassland, grassy meadows / pasture	4 (2 sp.)	4 (2 sp.)	0	0	0
Damp pasture, sandy coastal pasture and fellfield	2 (2 sp.)	26 (3 sp.)	1 (1 sp.)	0	0
Wetland: Aquatic, waterside, marsh and mire (base rich)	3 (2 sp.)	2 (2 sp.)	0	0	0
Moors, bogs and heath / dry heath	5 (2 sp.)	9 (2 sp.)	8 (2 sp.)	0	2 (2 sp.)
Shingle beaches and shores	0	4 (1 sp.)	0	0	0

Table 32: Burland, Trondra: Recovered Weed Ecology (All Bulk Samples) by Phase.

Fig. 39(a): Burland, Trondra: Summary Chart of Recovered Weed Ecology by Phase:

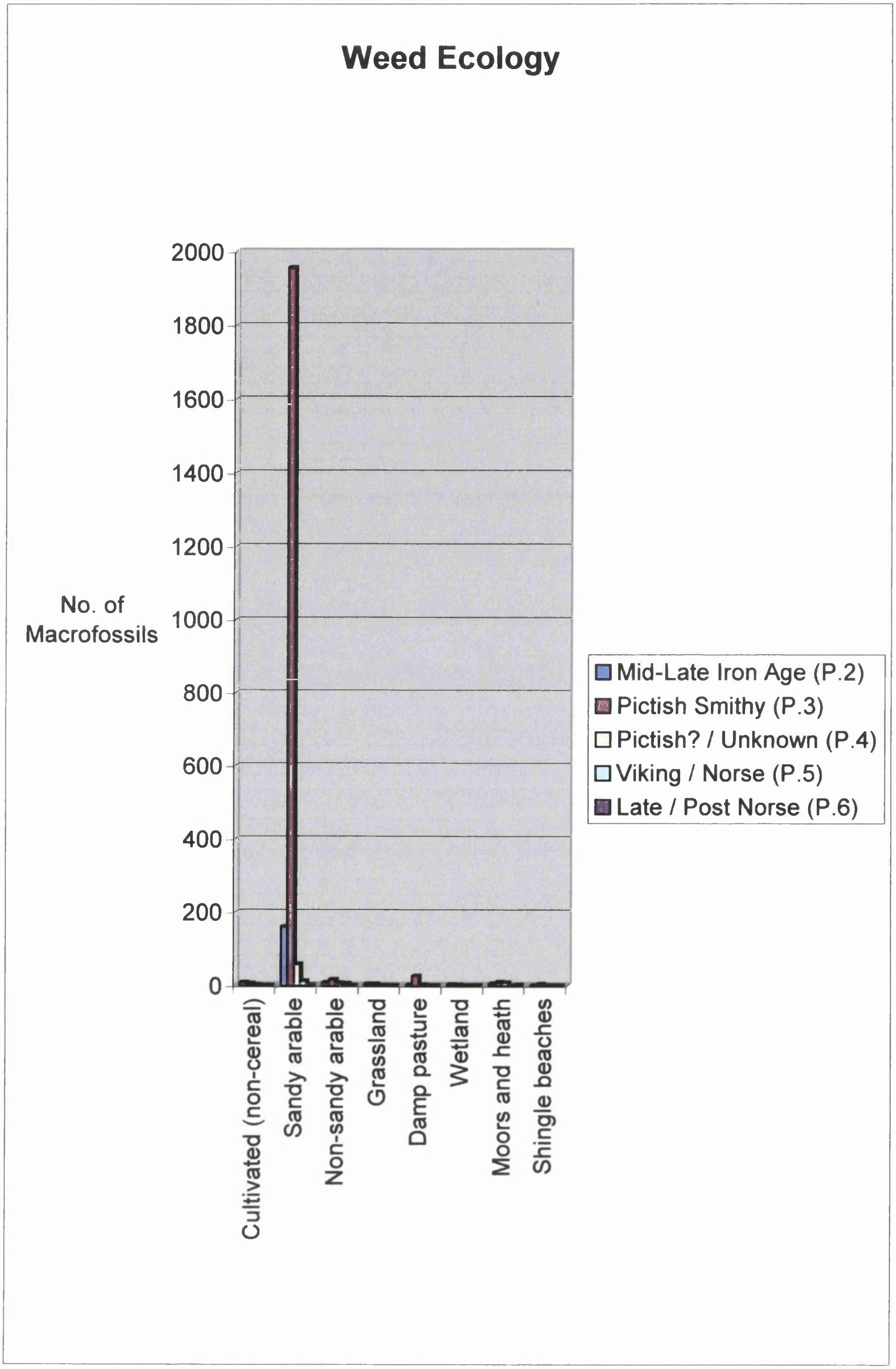
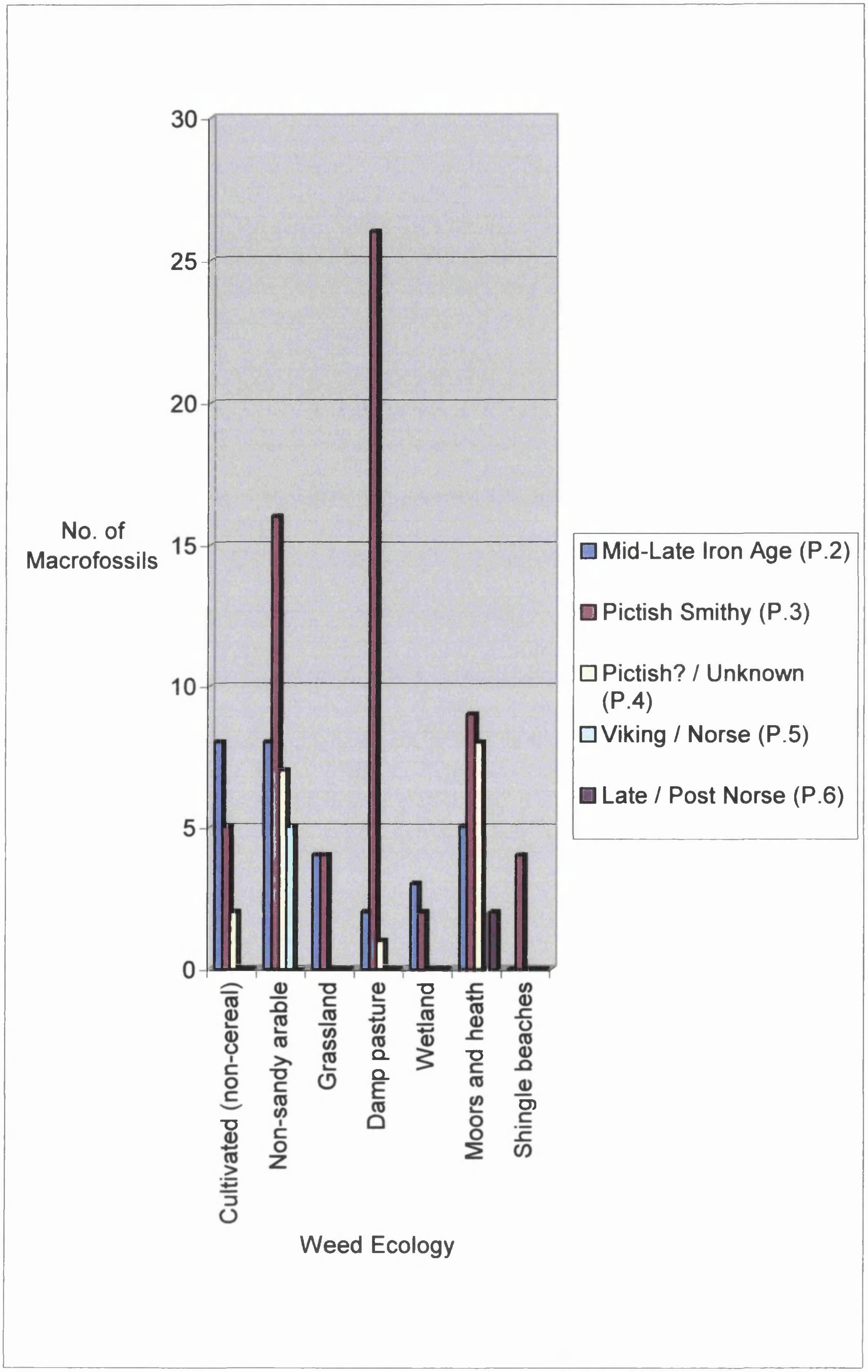


Fig. 39(b): Burland, Trondra: Summary Chart of Recovered Weeds (Sandy Arable Removed) by Phase:



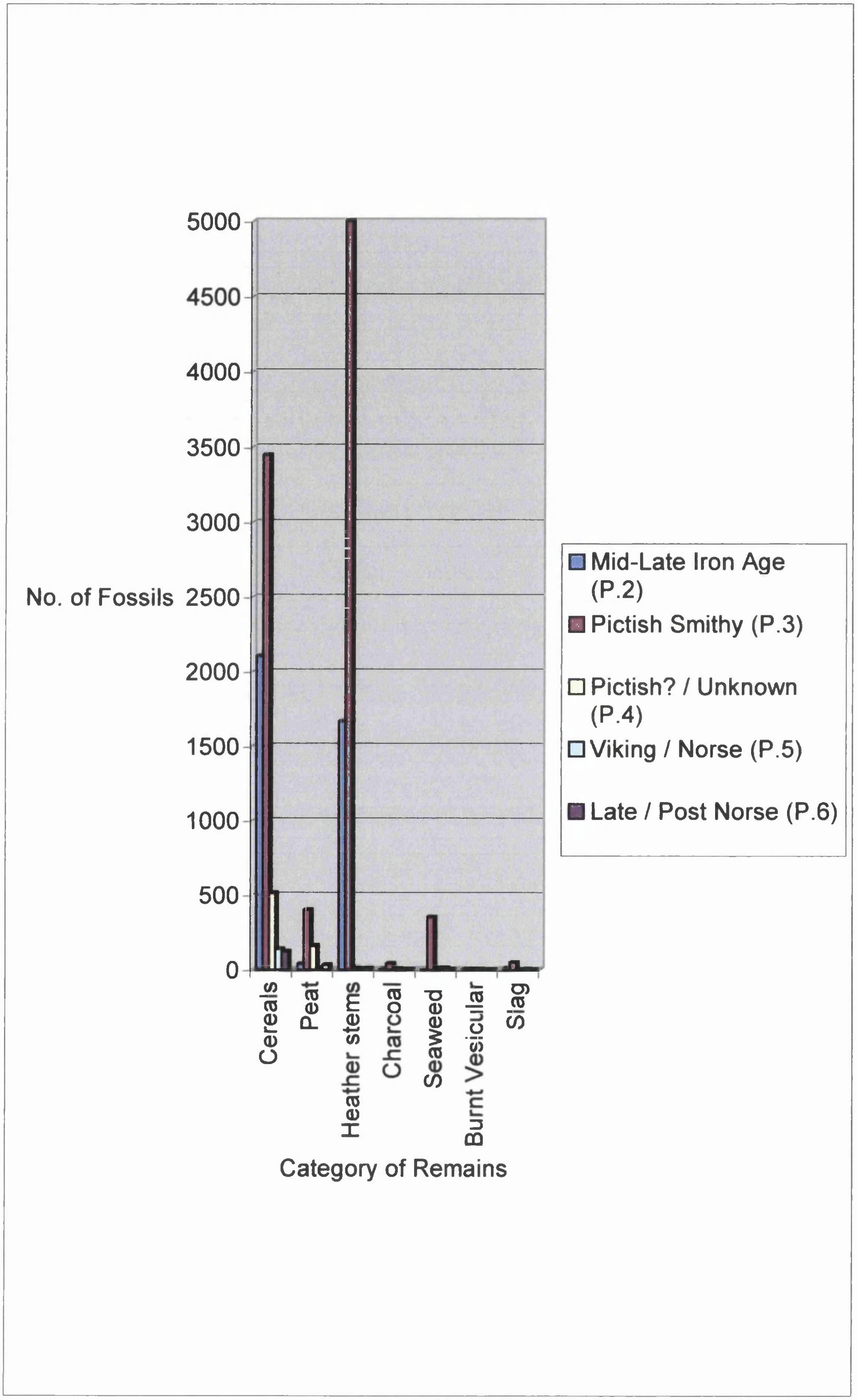
incorporated with straw and dung collected for other purposes. These weeds, and further grassland / grassy pasture species were most apparent in phase two and three (Mid-Late Iron Age and Pictish). All the weed seeds were carbonised, and if they originated in animal dung, then this implies dung was collected, perhaps dried amongst straw, or middened with seaweed for use on arable land, and at some stage burnt on site for fuel or accidently in conflagations. Cutting of grassy turf for use as byre, structural, or fuel material could also have introduced some of these species into the deposits. It should be remembered that the deposits from Burland were not middens, most of the excavated features were metalworking or domestic hearths, with occasional stone-lined tanks set into the floor deposits. The use of various fuels, including dung for metalworking will be discussed in 5.5.5.

Moorland and dry heath species, *Empetrum nigrum* (crowberry) and *Danthonia decumbens* (heathgrass) were present in small amounts in the Iron Age / Pictish deposits. Large quantities of heather stems were also found in the same phases, and therefore these species were probably gathered along with heathy turves used for fuel.

5.5.4: Wild Resources:

The presence of burnt peat, heather and seaweed was plotted against the recovery of cereal grain, charcoal and slag in **fig. 40**. Burnt peat recovery from the deposits was relatively low compared to the presence of heather stems. Deposition of cereal grain and heather however followed a closer pattern of presence. Heather stems were probably used as a bedding surface to dry cereal grain, using peat as fuel, and these elements probably represent wasteage from cereal processing activities, at a peak in the Mid-Late Iron Age and Pictish activity areas, and falling rapidly in the Norse deposits. Heather may also have arrived at the site with peat burnt for fuel, given the large quantities of peat ash excavated on the site.

Fig. 40: Burland, Trondra: Comparison of Cereal Grain, Major Fuel and Wild Resources, and Slag by Phase.



Wetland (marsh and base rich mire) and drier heathland seeds were very rare in the deposits, which may reflect upon the apparent lack of peat recovery (or lack of survival – see section 5.5.7). Wet fen turves or peat may have been re-used many times as fuel for domestic hearths / cereal drying, and repeated burning would destroy most seeds. Recovery of burnt peat fragments from the samples suggested the continued use of this fuel resource in the Norse and later dated deposits.

The occurrence of carbonised seaweed saw a dramatic increase in phase three (Pictish) and this has already been referred to in 5.5.2 and 5.5.3.2, however seaweed is included in **fig. 41** for comparative purposes. This resource was most probably gathered on local beaches within the general environs of Burland, middened with dung and burned, either by accident or as an alternative fuel source.

5.5.5: Charcoal and Other Fuel:

The recovery and identification of wood charcoal from Burland was extremely important given the large quantity of metalworking debris recovered during excavation. Overall the total amount of charcoal recovered from the bulk and analysed subsamples amounted to 42.2g, with 29.4g of this originating in the Pictish smithy deposits. Although these are relatively small amounts (compared to say the 1000g of willow found by C. Dickson (1994) in the furnace hearth from Howe), the comparative recovery figures show that most of this charcoal was consumed by the metalworking smithy (see **table 34** and **fig. 43**). In the Mid-Late Iron Age, slag recovered from the samples, was accompanied by open scrub species hazel and alder, and a small amount of probably imported oak. The peak in slag presence in the Pictish smithy deposits also saw an expansion in the types of species used, particularly in the use of hazel and coniferous species such as Scots pine. This probably reflects a certain degree of opportunism in using whatever woods can be found, such as coniferous types gathered as driftwood, although the amount of oak used also increased at this time. The finding of oak and Scots pine strongly suggested imported species, probably originating on the Scottish Mainland, perhaps as far south as Argyll, and indicated the importance of north – south trade routes during the Pictish period. Trade in finished metal objects as well as raw materials such as ore and charcoal probably followed the same sea routes. By the Norse period the use of wood charcoal appeared to have almost vanished, with only a small amount of Scots pine driftwood present, although very small traces of slag continued to be visible in these deposits. Concurrently the north – south trade routes of the Pictish phases have been replaced by an east – west shipping route dominated by Scandinavian traded products, for instance steatite.

Almost any wood charcoal is preferable to peat when used for smelting, as peat produces sulphur contamination, particularly harmful when iron-smelting (Tylecote 1986: 224). However, peat made into charcoal (as described in 1.5.2.1.2) can be used for smelting and smithing, as the sulphur content is considerably reduced by pre-burning. A good metalurgical wood charcoal should be strong enough to avoid crumbling under pressure in the furnace, and hard charcoals from oak and birch are usually preferred to those from conifers (Tylecote 1986: 225). At Burland wood charcoal seems to have been used where possible, but other alternative fuels, such as peat, have also come into play. Waste from cereal processing activities may also have been used as fuel. Dung is particularly useful for this purpose when used as an adhesive to make cakes of cereal chaff and other waste products, which are then dried out before use. The cereal content significantly improves the quantity of heat produced (Tylecote 1986: 224). This is possibly the means by which burnt vesicular remains, seaweed and cereal processing waste have come to be incorporated into the metalworking hearth deposits.

5.5.6: Other Remains:

Fig. 41 illustrates the recovery of fish and mammal bone, compared to the presence of cereal grain and seaweed. Arable resources would appear to far outweigh the importance of fish and animal resources on this site based upon this chart. However, bone preservation at the site overall was very poor. The high quantities of fuel ash and metalworking waste in the soil matrix could have contributed to the decay of organic material such as bone, and indeed bone itself may have been used as a fuel, as some fragments were found burnt. Where preserved, fish and mammal bone were mostly recovered from phase 2 and 3. No fish bone was recorded from the Norse phases, but these features were only partly excavated.

5.5.7: Comparison of Processing Methods:

The subsamples produced a similar range of macrofossil species to the samples that were processed by bulk flotation (see **fig. 42**). The total number of litres laboratory processed per phase is presented in **table 33**, along with a gross breakdown of the species recovered, for comparison with the bulk material. Proportions of cereal grain recovered between floated and laboratory processed samples were quite similar when differences in the total litres of sediment processed were taken into account. Perhaps the most surprising result of the comparative analysis was the almost complete lack of weed seeds recorded from the subsamples. As the subsamples were sieved to >250μm it might have been expected that a greater recovery of smaller sized weed seeds would occur. However, only a single *Carex* sp. (sedge) was present. In respect of recovery of weeds and cereal grains it would appear from this brief analysis that bulk flotation had produced very good results, with little apparent loss, and indeed had succeeded in floating more weeds than were recovered by laboratory sieving.

The largest recovery difference was noticed in the heavier 'sinkable' portion of the samples, particularly in respect to the presence of burnt peat. If phase 2 is taken as an example, only 4 litres of subsample were processed, and these produced 110+ burnt peat fragments. A total of 658 litres were bulk processed from this phase, but produced only 38+ peat fragments. If the figures are directly compared (ignoring differences in contexts and so forth), one could predict 658 litres producing over 18,000 fragments of burnt peat. Recovery of indeterminate small bone fragments was also greater when the samples were laboratory sieved, although not to the same extent as with the peat. These differences may have arisen for a number of reasons. Firstly, material forming the residue in the flotation tank is subject to a great deal of manual handling, and may become fragmented and lost through the mesh. Secondly peat burnt to produce peat charcoal (as proposed in section 5.5.5) is extremely brittle and powdery (Tylecote 1986: 224), and may not survive being submerged in water and broken down by hand amongst sediment. The author would propose future experimental work to test this, as time was not available within the constraints of the current research. Thirdly the subsamples were sorted with the aid of a binocular microscope, whereas the residues were sorted by eye in natural light, and much material could have been missed amongst a general matrix of black silty residue.

The results from this analysis indicated that care in handling material during the flotation stage could be an extremely important factor in the recovery of the 'heavier' portion of the sample, and that adequate facilities for the sorting of the residue portions may increase the overall recovery of material.

Burland, Trondra: Phasing:	**Phase 2**	**Phase 3**	**Phase 4**	**Phase 6**
Archaeological Stratigraphy:	**Early Activity**	**Structure 2**	**Structure 3**	**Abandonment**
Proposed Dating:	**Mid-Late Iron Age**	**Pictish Smithy**	**Pictish? / Unknown**	**Late / Post Norse**
Subsample Litres:	4	8	1.5	1
Cultivated Plants:				
Barley: Hulled	25	24	1	0
Barley: Indet.	17	12	0	0
Barley: Chaff	1	0	0	0
Oat	0	1	0	0
Indet. Chaff	1	1	0	0
Indet. Cereal	16	8	1	0
Wild Resources:				
Peat	110+	50+	0	3
Heather stems	2	47+	0	0
Charcoal	0	1.2g (2)	0	0
Other:				
Fish Bone	0	1	0	0
Indet. Bone	0	25	0	10

Table 33: Burland, Trondra: Summary Table of Remains Recovered from the Subsamples by Phase.

Burland, Trondra: Phasing:	**Phase 2**	**Phase 3**	**Phase 4**	**Phase 5**	**Phase 6**
Archaeological Stratigraphy:	**Early Activity**	**Structure 2**	**Structure 3**	**Structure 1**	**Abandonment**
Proposed Dating:	**Mid-Late Iron Age**	**Pictish Smithy**	**Pictish? / Unknown**	**Viking / Norse**	**Late / Post Norse**
Charcoal (All Samples):					
Larix / Picea	0	0.3g (1)	0	0	0
Pinus sylvestris	0	15.1g (19)	6.4g (7)	0.9g (1)	2.3g (1)
Coniferous Type	0	4.2g (6)	0	0	0
Quercus	0.2g (1)	4.0g (3)	0	0	0
Alnus	0.1g (1)	0	1.2g (1)	0	0
Corylus	1.7g (3)	4.3g (9)	0	0	0
Indet. Charcoal	0	1.5g (5)	0	0	0
Industrial Waste:					
Slag	7	47	0	2	0

Table 34: Burland, Trondra: Summary Table of Charcoal and Industrial Waste (All Bulk and Subsamples) by Phase. (Note: Figures in brackets represent actual counts).

Fig. 41: Burland, Trondra: Recovered Fish and Other Bone, compared with Cereal Grain and Seaweed by Phase.

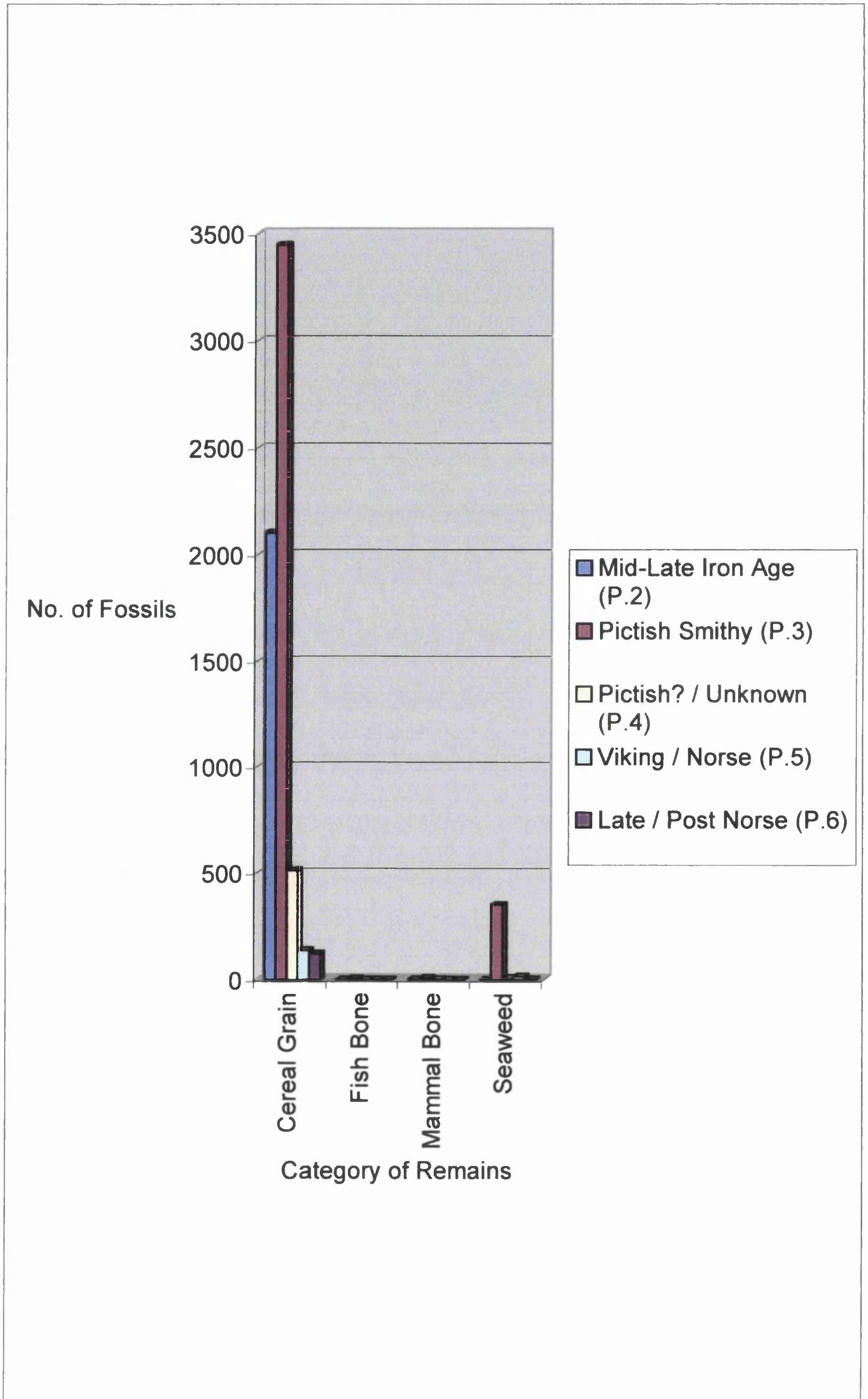


Fig. 42: Burland, Trondra: Environmental Remains Recovered from the Subsamples:

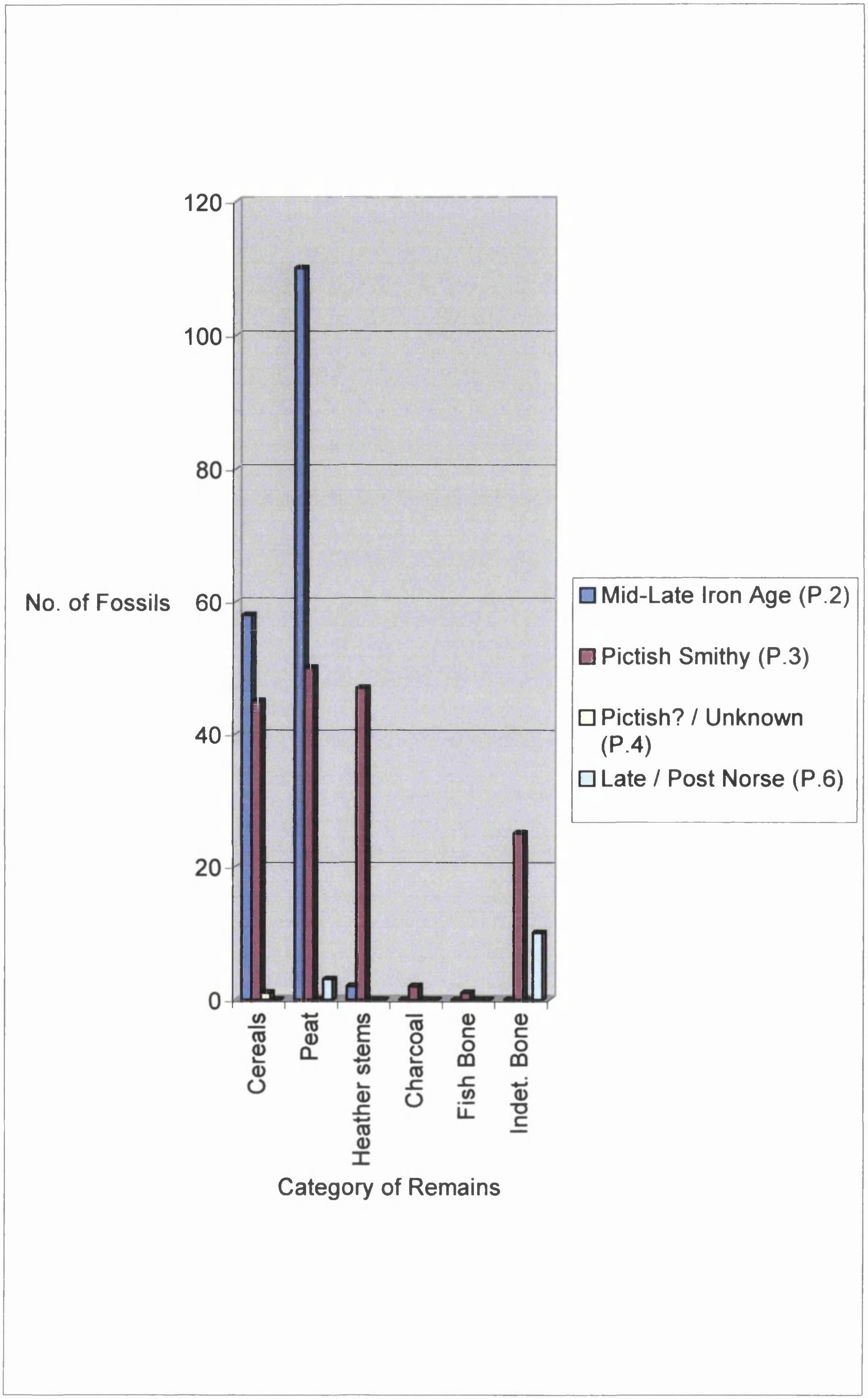
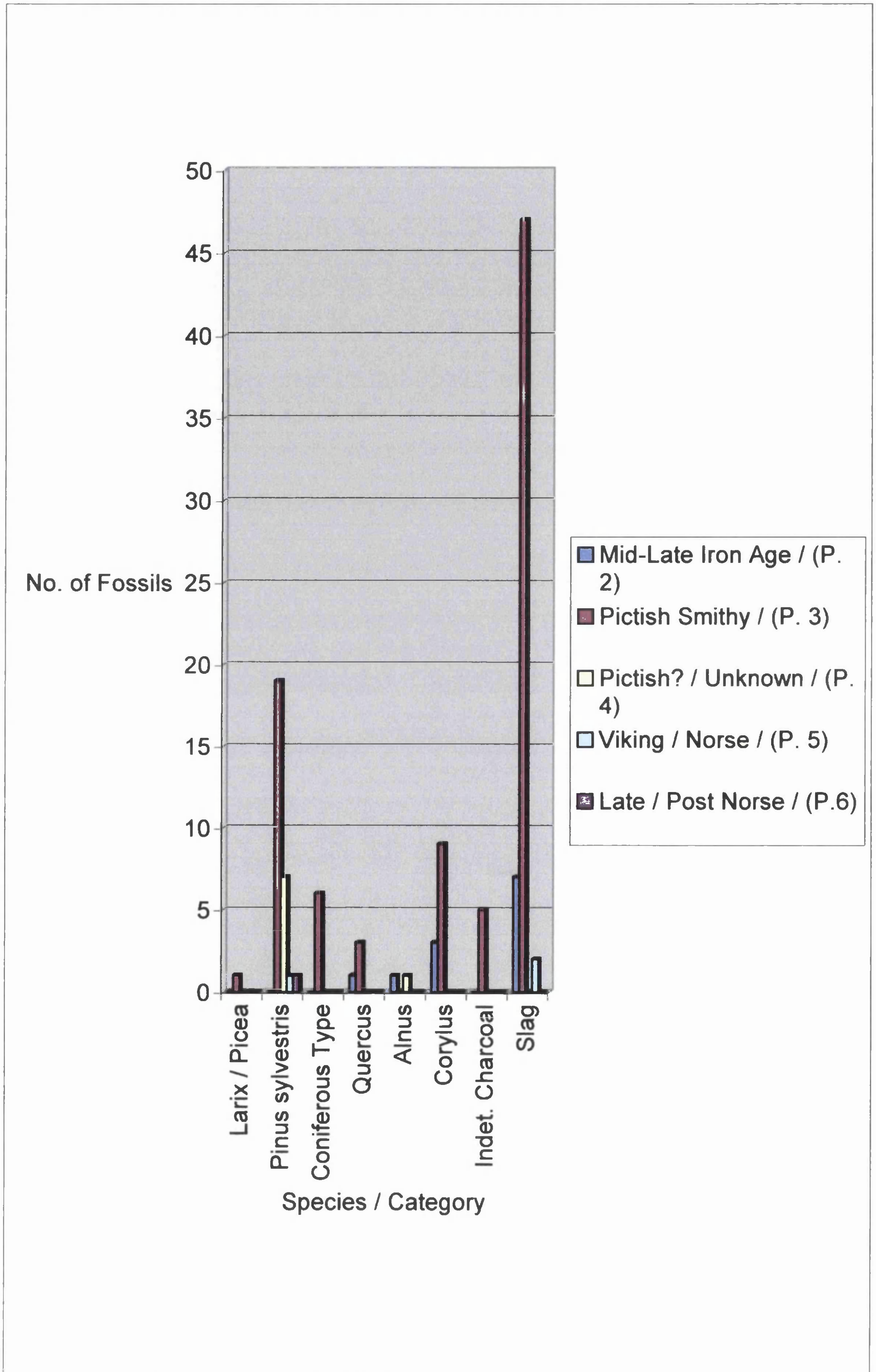


Fig. 43: Burland, Trondra: Summary Chart of Recovered Charcoal and Slag by Phase:



Chapter Six:

6: Soterberg, Unst, Shetland:

6.1: Location of Site and Archaeological Background:

During the summer of 1997, a six-week excavation was carried out on the northeastern coast of the island of Unst, Shetland. The excavated site, known locally as Soterberg, was located on a north-east-facing hillside overlooking the Bay of Haroldswick. **Fig. 44** shows the location of the site on Unst. The excavation was conducted as a joint project between the University of Glasgow and the University of Copenhagen, involving students and staff from both institutions. The project was directed by Mr. Steffan Stumman Hansen and Ms. Anne-Christine Larsen both of Copenhagen University, with overall management strategy provided by the Shetland Amenity Trust under the umbrella of VESARP. On-site archaeological supervision was provided by Mr. K. Brady, with planning supervision by Ms. R. Harry, and environmental supervision by the author, all of Glasgow University. All context information and drawings used for the purposes of this thesis are based upon the site records compiled by Mr. Brady and Ms. Harry, together with the author's environmental record sheets. The author was present on-site for the whole season.

6.2: Archaeological Excavation 1997 Season:

6.2.1: Location of Trenches:

The site was located on a raised boggy hillside within a landscape rich in prehistoric and more recent historical remains. **Plate 9** was taken at the beginning of the excavation, looking west across the site, with the topsoil removed from trench two in the foreground, revealing one of many wall features. Initial investigation of the site revealed that it consisted of a prominent mound surrounded by numerous collapsed building stones. Still visible was evidence for a recent planticrub (C.037) built on top of the mound. Planticrubs were walled enclosures, built of peat or stone and normally date to the 19th century onwards. However similar constructions may have been used much earlier (Leask *et al* 1998: 88). These structures were commonly used for growing kale (cabbage) plants. Planticrubs were often constructed from stones quarried from ancient buildings, as these provided a convenient and concentrated source of building material. This appears to have been the case at Soterberg where the planticrub was found to be overlying a Norse style building.

It became obvious during the course of the excavation that it would not be possible to excavate the entire sequence of occupation of the site within one season. This was due to the complexity and apparent multi-period nature of the archaeological deposits that were discovered. It was highly possible that continuous human occupation within one close location had resulted in the formation of this raised mound. Two trenches were opened running in a north-south alignment across the mound (trenches 1 and 2). A further trench (trench 3) was opened along the southern wall of the planticrub between trenches 1 and 2. Both trenches 1 and 2 were extended in a northerly direction when it became apparent that more archaeological features existed in these areas. **Plate 10** shows excavation in progress at Soterberg, with trench 1 to the left of the photograph and trench 2 to the right. This picture was taken looking north across the Bay of Haroldswick, with the hills of Saxa Vord in the background.

6.2.2: Stratigraphic Phasing:

Table 35 summarizes the site chronology used in the following phases.

Fig. 44: Map of Unst, showing locations of Soterberg and Setters (after Guy 1996) (Unst covers approx. 47 square miles).

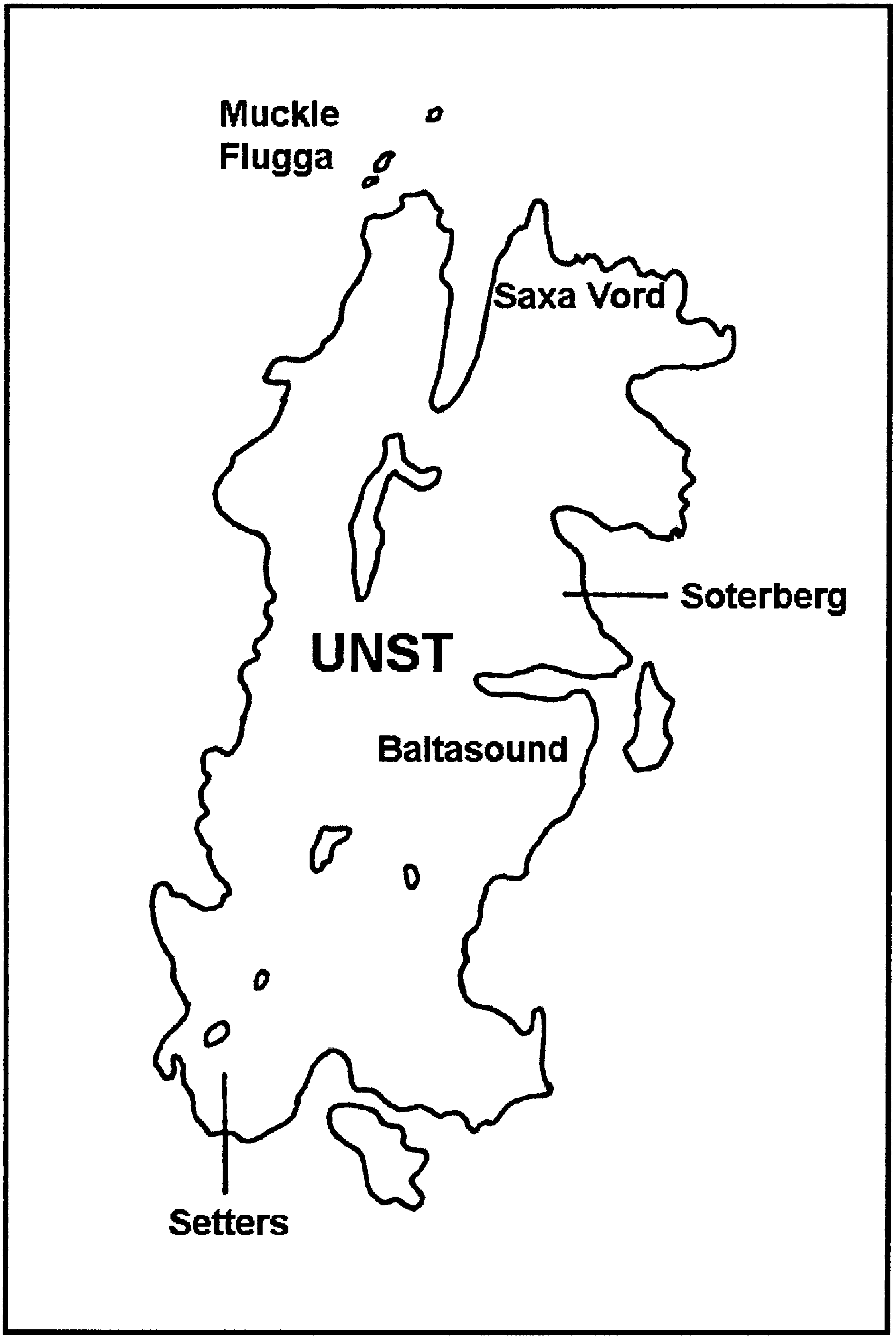


Plate 9: Soterberg, Unst, Shetland. Start of excavation 1997 (looking west, trench two topsoil removed). (Photo: D. Alldritt).

Plate 10: Soterberg, Unst, Shetland. Looking north across the Bay of Haroldswick, 1997. (Photo: D. Alldritt).

Table 35: Soterberg, Unst, Dating and Phasing Concordances:

Period	Phase	Contexts	Dating
Pre-Norse / Late Iron Age	Trench Two Extension	021, 035, 036, 038, 047, 048, 063, 064, 079, 081, 082.	Artefactual and Structural: Iron Age pottery, thick broch-like walls, cellular structures with hearths.
Norse	Trench One	002, 004, 005, 007, 012, 022, 027, 028, 038, 044, 049, 050, 057, 059, 061, 064, 066, 074, 077, 079, 080, 081, 082, 084, 085, 094, 095.	Artefactual and Structural: Steatite pottery, fishing weight and loom weights. Rectangular thick walled building with central hearth.
Norse	Trench Two	010, 011, 013, 014, 015, 016, 033, 034, 035, 036, 037, 038, 052.	Artefactual and Structural: Part of same building as above.
Norse	Trench Three	016, 041, 043, 083, 085, 091, 096, 098.	Stratigraphic: structurally related to building in trench one.
Unknown	Trench One Extension	004, 012, 068	None.

6.2.2.1: Norse: Trench 1 Western Interior Norse Structure:

The excavation of trench 1 revealed two walls, C.005 and C.004 believed to be of a Norse building, enclosing two occupation surfaces, C.002 and C.028, and a hearth C.027, consisting of successive red and grey ash layers. A number of Norse artefacts were recovered during the excavation of the western interior, including (from C.028) spindle whorls, loom weights, steatite pottery and line / net sinkers also of steatite. The fishing weights were found resting against wall C.005. Outside this wall a series of large angular flagstones had been laid to create a flat surface C.006. Below surface C.028 was a natural clay layer C.074, and a small slot trench was inserted into this to discover the undisturbed natural subsoil C.095. Traces of a series of post or stakehole cuts C.084, C.085 and C.094 were found cut into C.074, probably representing internal support structures for the house.

6.2.2.2: Unknown: Trench 1 Extension Northwestern Exterior:

Outwith the possible wall (C.004) of the Norse building, a semi-circular wall C.012 was discovered. As this trench was further extended northwards another wall line C.068 running beneath and on a different alignment to C.012 was found. This structure predated C.012. Layers of clay, rubble, ash and charcoal flecks were found outside C.004. With the limited time available it was unfortunately not possible to further excavate these external features and ascertain their relationship to the Norse building. When combined with the evidence for external features uncovered in the trench 2 extension it became apparent that a number of different occupation / structural phases had occurred on this site.

6.2.2.3: Norse: Trench 2 Eastern Interior of Structure:

In trench 2 the topsoil was removed from the interior of the Norse house and a clay surface C.010 was found. In the southern part of the trench a stone wall C.014 was found surrounded by rubble C.015 which was probably part of the Norse building. Further south of this possible Norse structure the wall of a rectangular enclosure C.016 was found. In the northern part of the trench the possible northerly wall (C.036) of the Norse house was found sited below the planticrub wall C.037. Outwith of this wall line was a deposit of sticky black peaty material C.052, which was probably formed from stacks of turf that had decayed *in situ*.

6.2.2.4: Pre-Norse / Late Iron Age: Trench 2 Extension Northeastern Exterior:

Trench 2 was extended down the slope of the mound in a northerly direction beyond wall C.036. This part of the excavation produced some interesting structural remains, consisting of a series of curved wall lines, hearth places and other features, outwith the Norse structure, which suggested a much earlier date for the original occupation of this site than had previously been recognised. The findings of large amounts of Iron Age pottery combined with the style of architectural features excavated strongly suggested a Pre-Norse date for the origin of these structures.

Beyond the northern Norse wall the first feature to be discovered was a hearth place consisting of flagstones C.063 and surrounded by an ashy charred layer C.064. Within the flagstone settings a mixture of burnt clay and ash C.079 was found, which probably acted as a binding material to keep the stones in place. Further areas of combustion were apparent in contexts C.081 and C.082 both of which lay to the north of the hearth and were rich in burnt clay and flecks of charcoal. The areas around the hearth produced large amounts of Iron Age style pottery and was bordered on its northern side by a line of flat flagstones (C.021), which may have been an area of paving or a wall.

A series of four, curved wall lines of different orientations and stone sizes were discovered as the excavation progressed. Beyond the fourth wall a set of large angular flagstones were found, followed by an ashy charcoal rich sand and clay layer (C.048) which continued up to another curved wall line (C.047). These structural features could be enclosures, houses, or other buildings predating the Norse occupation of the site. The brief excavation of these features during 1997 could only hint at the extent of settlement archaeology that still awaits investigation on this site, and the potential for further discovery of multi-period occupation is great.

6.2.2.5: Norse: Trench 3 Southwestern Interior:

Trench 3 consisted of a small trial trench placed in the southern part of the site between trenches 1 and 2. Part of the planticrub wall was removed and the curved wall of enclosure C.016 was found to continue from trench two. An area of flagstone pavement C.098 was found in the western part of the trench, together with areas of burnt clay and charcoal flecks (C.091 and C.096). Collapsed rubble probably originating from the walls of the Norse house was also present in this trench.

6.3: Environmental Sampling and Processing:

6.3.1: Sampling Strategy:

Areas thought to have the highest potential for the preservation of carbonised remains were prioritised for sampling. These contexts included hearth features, burnt areas and possible occupation surfaces. Compacted clay floors contemporary with the hearth structures were also sampled. A large part of the archaeology of the site consisted of the structural remains of stone walls and areas of rubble and building collapse. This reduced the areas available for viable sampling. No midden material was found during the excavations, and perhaps surprisingly for a Norse house, only a few tiny fish and mammal bone fragments were discovered. Dr. J. H. Barrett under the VESARP directive had provided instructions for the sampling and processing of fish middens should the need arise, but this proved unnecessary.

A total of seventy-four bulk environmental soil samples were taken of approximately 10 litres each, with the aim of having at least 20 litres from each context where this was possible. A total of thirty-seven different contexts were sampled from around the site. A list of the samples taken together with weights and volumes are provided in **table 36**.

6.3.2: Sample Processing:

All samples were processed using the flotation methodology described in chapter 2.2.3.2. This was carried out whilst on Unst in order to reduce the transportation costs of returning bulk samples to Glasgow. A small 0.5 to 1 litre subsample was systematically removed from every context sampled prior to flotation. This set of subsamples was returned to Glasgow for further analysis by the author and potentially for other specialists also. Bulk samples were floated to >300μm, subsamples processed to >250μm.

6.3.3: Sample Analysis:

All residues were returned to Glasgow and sorted by the author. Some of the samples had proven very difficult and time-consuming to float due to the heavy clay nature of some of the sediment, even where the samples had been soaked for several days, processed and the residues re-floated. Only a few carbonised plant remains were recovered from these samples, and it is not known whether this was due to the difficulty of processing them or reflects the actual level of deposition on-site. An attempt was made to test this recovery by laboratory seiving a small selection of the 1 litre subsamples for comparison with the floated material.

Table 36: Soterberg, Unst Excavation 1997: List of Samples:

Bulk Environmental Samples (1997):	Volume (l)	Weight (Kg)	Processing	Sieve Size
S.001 (C.001) Trench One	20	21	Floated on site	>300um
S.002 (C.002) Trench One	20	22	Floated on site	>300um
S.003 (C.002) Trench One	1	1	Lab Sieved	>300um
S.007 (C.007) Trench One	20	16	Floated on site	>300um
S.008 (C.002) Trench One	1	1	Lab Sieved	>300um
S.009 (C.002) Trench One	1	1	Lab Sieved	>300um
S.010 (C.012) Trench One	20	9	Floated on site	>300um
S.011 (C.027) Trench One	10	7	Floated on site	>300um
S.012 (C.028) Trench One	10	8	Floated on site	>300um
S.016 (C.002) Trench One	5	0.5	Floated on site	>300um
S.018 (C.028) Trench One	20	18	Floated on site	>300um
S.022 (C.028) Trench One	10	11	Floated on site	>300um
S.025 (C.059) Trench One	20	16	Floated on site	>300um
S.044 (C.066) Trench One	10	8	Floated on site	>300um
S.045 (C.027) Trench One	14	10	Floated on site	>300um
S.046 (C.083) Trench One	5	2.25	Floated on site	>300um
S.047 (C.085) Trench One	3	1.5	Floated on site	>300um
S.049 (C.074) Trench One	10	10	Floated on site	>300um
S.050 (C.093) Trench One	1	1	Floated on site	>300um
S.026 (C.009) Trench One Ext.	20	14	Floated on site	>300um
S.004 (C.013) Trench Two	20	12	Floated on site	>300um
S.005 (C.011) Trench Two	7	6	Floated on site	>300um
S.006 (C.010) Trench Two	20	14	Floated on site	>300um
S.013 (C.034) Trench Two	10	11	Floated on site	>300um
S.014 (C.036) Trench Two	10	9	Floated on site	>300um
S.015 (C.038) Trench Two	20	22	Floated on site	>300um
S.020 (C.035) Trench Two	20	14.5	Floated on site	>300um
S.021 (C.034) Trench Two	30	30	Floated on site	>300um
S.029 (C.033) Trench Two	10	8	Floated on site	>300um
S.032 (C.052) Trench Two	40	15	Floated on site	>300um
S.036 (C.052) Trench Two	20	13	Floated on site	>300um
S.017 (C.038) Trench Two Ext.	10	11	Floated on site	>300um
S.019 (C.035) Trench Two Ext.	5	9	Floated on site	>300um
S.023 (C.022) Trench Two Ext.	20	18	Floated on site	>300um
S.024 (C.038) Trench Two Ext.	10	8	Floated on site	>300um
S.027 (C.044) Trench Two Ext.	10	9	Floated on site	>300um
S.028 (C.057) Trench Two Ext.	20	14.5	Floated on site	>300um
S.030 (C.050) Trench Two Ext.	20	14.5	Floated on site	>300um
S.033 (C.061) Trench Two Ext.	10	8.5	Floated on site	>300um
S.034 (C.049) Trench Two Ext.	20	19	Floated on site	>300um
S.035 (C.064) Trench Two Ext.	20	15.5	Floated on site	>300um
S.037 (C.079) Trench Two Ext.	10	6	Floated on site	>300um
S.038 (C.080) Trench Two Ext.	10	6	Floated on site	>300um
S.039 (C.081) Trench Two Ext.	10	6.5	Floated on site	>300um
S.040 (C.082) Trench Two Ext.	10	7.5	Floated on site	>300um
S.041 (C.077) Trench Two Ext.	20	18	Floated on site	>300um
S.031 (C.041) Trench Three	20	17	Floated on site	>300um
S.042 (C.091) Trench Three	20	14.75	Floated on site	>300um
S.043 (C.043) Trench Three	20	18	Floated on site	>300um
S.051 (C.096) Trench Three	10	8.5	Floated on site	>300um

Testing 20% of the total number of samples would have meant lab sieving approximately 14 subsamples. A selection was made from the samples that had produced the most material by flotation. Various soaking methods were used including breaking down by hand and then soaking in cold water for many days, and soaking in warm water and frequently stirring. Dr. Ramsay suggested the use of a water softener such as Calgon, in order to chemically break down the clay. However, research by de Moulins (1996: 154) has shown that a pre-treatment with deflocculent produces very poor results and is extremely destructive in clay and gravel rich samples. In addition Calgon treatment is an extremely slow process adding little to the efficiency of the method compared to plain water (Greig 1989: 43). The author continued with the soaking in water method but abandoned the process after sieving eight samples and succeeding only in producing a few modern rootlets. Manual breaking down of the clay in a glass beaker required such force that it might have destroyed all but the most resilient of remains and de Moulins has shown that chemical methods can be very damaging. Dr. Housley subsequently suggested the use of hydrogen peroxide for use on clay-rich samples. However the overall sparsity of plant macrofossils recovered from the samples meant that comparability of recovery methods was very difficult to test on this site. De Moulins work concluded that the most efficient method for clay-rich samples was flotation in a Siraf machine with no pre-treatment, but there should be an awareness that only about 40% of material would be retrieved in the flot, and ca. 10% more from the residue.

6.4: Results:

The raw environmental data recovered from the samples are presented in gatefold form in **table 37**. The following samples produced no carbonised plant material of other environmental remains and are not included in the table: S.001, C.001; S.003, C.002; S.009, C.002; S.049, C.074; S.050, C.093.

Raw data **table 37** is presented on the following page.

Soterberg, Unst. Trenches:	T.1:S.002	S.007	S.008	S.010	S.011	S.012	S.016	S.018	S.022	S.025	S.044	S.045
Carbonised Cereal Grain and Chaff:	C.002	C.007	C.002	C.012	C.027	C.028	C.002	C.029	C.028	C.059	C.066	C.027
Indeterminate Cerealia / Poaceae stem fragments							1				2	
Avena sp.				2		1						2
cf. Avena sp.				1								
Hordeum vulgare var. vulgare				1	2							12
Hordeum vulgare var. vulgare (twisted grain)				1								2
Hordeum vulgare var. nudum												
Hordeum vulgare cf. var. nudum											1	
Hordeum vulgare sl.				3	1	4		2	1			6
cf. Hordeum sp.				1		9				1		5
Indeterminate cereal grain (+embryo)				4	1	8		5	1	4		14
Carbonised Wild Resources:												
Burnt Peat fragments	2.0g(11)	<0.05g(2)	1.0g(5)	1.55g(58)	0.5g(12)	3.35g(46)	0.05g(3)	0.4g(2)	0.1g(2)	1.6g(4)	0.1g(2)	1.1g(12)
Burnt Vesicular (coal or other?)						16.4g(1)						
Corylus avellana nut shell fragments												
Calluna stems (roots / twigs)	<0.05g(1)	<0.05g(3)		0.1g(5)	0.2g(20)	0.2g(12)		0.25g(14)	0.05g(2)	0.1g(2)	<0.05g(6)	0.3g(33)
Calluna leafy shoots												
Indeterminate root / twig fragments				<0.05g(1)						<0.05g(1)	0.05g(6)	
Carbonised Seaweed fragments				<0.05g(2)	<0.05g(2)			<0.05g(1)			<0.05g(1)	<0.05g(1)
Cyperaceae Rhizome fragments		<0.05g(1)				<0.05g(1)						
Carbonised Bud								1				
Concreted (decayed) turf fragments												
Carbonised Weeds:												
Chenopodium album				2	1	1	1					
Stellaria media			1	5		4	8		3		11	
Spergula arvensis					1						1	
Silene dioica												
Polygonum aviculare sl.												
Polygonum cf. arenastrum												
Polygonum sp.					1							
Rumex acetosa				2		1			4			
Rumex acetosella					1	1						
Rumex crispus												
Rumex sp.							5		1		3	
Empetrum nigrum												
Euphorbia helioscopia					1							
Stachys sp.											2	
Ajuga reptans												
Eleocharis sp.												
Scirpus cf. lacustris												
Carex hostiana												
Carex cf. flacca												
Carex sp.												
Poa sp.								1				
Bromus sp.							1					
Small Poaceae							1					
Danthonia decumbens							1					
Charcoal:												
Picea												
cf. Picea												
Larix												
cf. Larix												
Larix / Picea												
Pinus sylvestris												
cf. Pinus												
Indeterminate Coniferous type												
Quercus												
cf. Quercus												
Betula				0.1g(1)								
Alnus												
Corylus								0.1g(1)		0.1g(2)	<0.05g(1)	
Salix								<0.05g(2)				
cf. Salix									<0.05g(1)		<0.05g(1)	
Prunus spinosa												
Indeterminate Charcoal		0.3g(15)	<0.05g(1)	<0.05g(2)	0.15g(2)	0.2g(9)		0.15g(6)	<0.05g(2)	0.1g(3)	0.1g(8)	0.05g(3)
Non-Plant: Marine Mollusc Shell and Bone:												
Indeterminate Marine Mollusc shell fragment												
Fish Bone (unburnt)											0.1g(4)	
Mammal Bone (unburnt)	<0.05g(3)											
Indeterminate Bone (burnt)			<0.05g(1)	0.15g(3)		1.2g(13)		0.4g(5)	0.05g(2)	0.15g(2)	0.05g(5)	<0.05g(1)
Indeterminate Bone (Unburnt)												
Non-Plant: Other:												
Industrial Residue (slag)								0.05g(1)				0.1g(5)
Pottery fragment (Steatite gritted)									0.4g(1)			
Pottery fragment (black)										4.7g(2)		

Soterberg, Unst. Trenches:	S.046	S.047	T.1Ex:S.026	T.2:S.004	S.005	S.006	S.013	S.014	S.015	S.020	S.021	S.029	S.032	S.036	T.2Ex:S.017	S.019
Carbonised Cereal Grain and Chaff:	C.083	C.085	C.009	C.013	C.011	C.010	C.034	C.036	C.038	C.035	C.034	C.033	C.052	C.052	C.038	C.036
Indeterminate Cerealia / Poaceae stem fragments									1	1						
Avena sp.										4						
cf. Avena sp.										1						
Hordeum vulgare var. vulgare				1				1		1	6					2
Hordeum vulgare var. vulgare (twisted grain)				1							3					
Hordeum vulgare var. nudum																
Hordeum vulgare cf. var. nudum															2	
Hordeum vulgare sl.								4	1							
cf. Hordeum sp.		1					2									1
Indeterminate cereal grain (+embryo)						3	2	1	2	3	6				1	3
Carbonised Wild Resources:																
Burnt Peat fragments	0.6g(5)	0.2g(7)		4.6g(55)		0.05g(3)	<0.05g(1)	6.4g(41)	1.3g(8)	5.15g(42)	31.6g(257)	0.4g(12)	<0.05g(1)			2.7g(52)
Burnt Vesicular (coal or other?)																
Corylus avellana nut shell fragments																
Calluna stems (roots / twigs)	0.25g(15)	0.8g(31)	<0.05g(2)	<0.05g(3)	<0.05g(2)		<0.05g(1)	0.2g(14)	0.15g(7)	1.2g(23)	0.3g(15)	<0.05g(2)		<0.05g(3)	0.15g(3)	<0.05g(2)
Calluna leafy shoots										1						
Indeterminate root / twig fragments											0.05g(2)		<0.05g(1)			
Carbonised Seaweed fragments								0.1g(6)		<0.05g(1)				<0.05g(2)		
Cyperaceae Rhizome fragments									<0.05g(1)	<0.05g(1)	0.05g(1)					
Carbonised Bud																
Concreted (decayed) turf fragments								0.15g(14)					0.5g(2)	3.8g(8)		
Carbonised Weeds:																
Chenopodium album			6		2				4		3					
Stellaria media	3	1					1	1			1				1	
Spergula arvensis																
Silene dioica											1					
Polygonum aviculare sl.												1				
Polygonum cf. arenastrum																
Polygonum sp.																
Rumex acetosa																1
Rumex acetosella																
Rumex crispus																
Rumex sp.	1							1		1	2	1				
Empetrum nigrum															1	
Euphorbia helioscopia																
Stachys sp.																
Ajuga reptans											1					
Eleocharis sp.																
Scirpus cf. lacustris																
Carex hostiana																
Carex cf. flacca																
Carex sp.																
Poa sp.																
Bromus sp.																
Small Poaceae																
Danthonia decumbens										1						
Charcoal:																
Picea																
cf. Picea																
Larix																
cf. Larix																
Larix / Picea						0.05g(1)										
Pinus sylvestris							0.05g(1)		0.1g(2)	0.35g(5)						
cf. Pinus																
Indeterminate Coniferous type									2.5g(23)							
Quercus											0.15g(2)					
cf. Quercus																
Betula																
Alnus									0.2g(2)							
Corylus																
Salix																
cf. Salix																
Prunus spinosa																
Indeterminate Charcoal	<0.05g(1)	0.2g(16)	0.25g(13)	0.2g(13)			<0.05g(1)	0.3g(8)	0.75g(41)	0.9g(88)	0.35g(26)	<0.05g(7)			0.1g(3)	
Non-Plant: Marine Mollusc Shell and Bone:																
Indeterminate Marine Mollusc shell fragment						<0.05g(5)	0.2g(1)		<0.05g(1)	<0.05g(1)						
Fish Bone (unburnt)								<0.05g(1)			<0.05g(1)					
Mammal Bone (unburnt)															0.1g(1)	
Indeterminate Bone (burnt)			0.1g(4)	0.5g(24)			0.1g(1)	0.65g(22)	0.65g(14)	0.8g(17)	0.6g(9)				<0.05g(1)	<0.05g(5)
Indeterminate Bone (Unburnt)											<0.05g(1)					
Non-Plant: Other:																
Industrial Residue (slag)																
Pottery fragment (Steatite gritted)								2.5g(2)	6.8g(3)							
Pottery fragment (black)																

Soterberg, Unst. Trenches:	S.023	S.024	S.027	S.028	S.030	S.033	S.034	S.035	S.037	S.038	S.039	S.040	S.041	T.3:S.031	S.042	S.043	S.051
Carbonised Cereal Grain and Chaff:	C.022	C.038	C.044	C.057	C.050	C.061	C.049	C.064	C.079	C.080	C.081	C.082	C.077	C.041	C.091	C.043	C.096
Indeterminate Cerealia / Poaceae stem fragments					1	1	2	1		1	1		5				4
Avena sp.													1	1	2	1	1
cf. Avena sp.					1												2
Hordeum vulgare var. vulgare		2					1		1					3	1		6
Hordeum vulgare var. vulgare (twisted grain)														2			
Hordeum vulgare var. nudum					3										2		
Hordeum vulgare cf. var. nudum					1			1									
Hordeum vulgare sl.	1	6			2	1	1	3	2	2				6			10
cf. Hordeum sp.			2								1	1	2	7			
Indeterminate cereal grain (+embryo)	2	4	2	2	6	1		8		1	1	3	7		3		6
Carbonised Wild Resources:																	
Burnt Peat fragments	4.05g(32)	0.65g(13)	0.8g(20)	0.5g(12)	2.8g(42)	0.05g(1)	6.25g(71)	8.5g(120)	0.1g(4)		4.7g(59)	0.3g(4)	1.3g(18)	0.7g(13)	1.8g(10)		1.9g(25)
Burnt Vesicular (coal or other?)																	
Corylus avellana nut shell fragments																	0.1g(2)
Calluna stems (roots / twigs)	0.15g(3)	0.15g(7)	<0.05g(1)		0.35g(10)		0.35g(40)	0.3g(12)	<0.05g(7)	<0.05g(1)	0.3g(40)		0.1g(7)	0.25g(12)	<0.05g(15)		0.1g(21)
Calluna leafy shoots																	
Indeterminate root / twig fragments						<0.05g(2)	0.2g(3)		<0.05g(1)								
Carbonised Seaweed fragments		<0.05g(1)				0.1g(18)	<0.05g(3)	<0.05g(3)			0.05g(5)	<0.05g(2)	0.1g(4)	0.05g(4)	<0.05g(1)		0.5g(12)
Cyperaceae Rhizome fragments								<0.05g(1)			0.2g(2)				4		
Carbonised Bud																	
Concreted (decayed) turf fragments																	
Carbonised Weeds:																	
Chenopodium album			3		1			2	1				1				
Stellaria media	1			2	2	1		4	6		1	3	3	6	9		77
Spergula arvensis		1															16
Silene dioica																	
Polygonum aviculare sl.																	1
Polygonum cf. arenastrum															1		
Polygonum sp.															1		
Rumex acetosa	1													3	1		
Rumex acetosella																	
Rumex crispus																	2
Rumex sp.															1		3
Empetrum nigrum	1				1			1									
Euphorbia helioscopia																	
Stachys sp.																	
Ajuga reptans																	
Eleocharis sp.																	4
Scirpus cf. lacustris																	2
Carex hostiana									1								
Carex cf. flacca															2		
Carex sp.			1				2										
Poa sp.																	
Bromus sp.																	
Small Poaceae		1													1		
Danthonia decumbens												1					
Charcoal:																	
Picea		0.2g(1)															
cf. Picea		0.2g(3)															0.1g(1)
Larix		0.25g(1)															
cf. Larix									<0.05g(1)								
Larix / Picea							<0.05g(2)										
Pinus sylvestris		0.1g(2)													<0.05g(1)		
cf. Pinus											0.1g(4)				<0.05g(1)		
Indeterminate Coniferous type		0.2g(3)						0.05g(1)		0.6g(12)				0.05g(1)	<0.05g(1)		
Quercus								1.25g(6)				0.1g(1)					
cf. Quercus											<0.05g(2)						
Betula												0.1g(2)					
Alnus																	
Corylus											<0.05g(1)						
Salix											0.1g(5)			0.1g(2)			0.1g(1)
cf. Salix					0.05g(1)												
Prunus spinosa											<0.05g(2)						
Indeterminate Charcoal	0.25g(10)	0.2g(5)	<0.05g(2)	0.05g(6)	<0.05g(3)		0.1g(3)	0.35g(23)	0.1g(11)	0.5g(24)	0.1g(22)	0.4g(25)		0.2g(6)	<0.05g(9)		0.3g(5)
Non-Plant: Marine Mollusc Shell and Bone:																	
Indeterminate Marine Mollusc shell fragment		<0.05g(1)				<0.05g(1)											
Fish Bone (unburnt)						<0.05g(1)		0.1g(1)									0.05g(1)
Mammal Bone (unburnt)					0.7g(3)			0.6g(47)									0.2g(10)
Indeterminate Bone (burnt)	0.8g(13)	2.35g(36)		<0.05g(3)	0.2g(8)	<0.05g(1)	1.6g(42)	0.2g(5)	<0.05g(1)	0.2g(9)			0.45g(5)	<0.05g(2)			
Indeterminate Bone (Unburnt)							2.0g(1)	<0.05g(1)			0.4g(12)						
Non-Plant: Other:																	
Industrial Residue (slag)					0.1g(1)		0.05g(1)				0.05g(1)						
Pottery fragment (Steatite gritted)		10.2g(2)					7.8g(3)	2.2g(1)									
Pottery fragment (black)																	

6.5: Discussion of the Results:

6.5.1: Overview:

A total of 703 litres of sampled sediment were processed during the excavations at Soterberg. The results from the samples were divided by trench and allocated to phases, either Pre-Norse, Norse or Unknown depending upon the context records available. This data is presented in summary form in **table 38**. From this table a series of summary histograms were produced, consisting of **fig. 45** which compares cereal species and weeds of cultivation by phase; **table 39** and **fig. 46** illustrating the ecology of weed species recovered by phase; and **fig. 47** which compares cereal grain and major fuel and wild resources by phase. The results from the identification of wood charcoal are presented in a separate summary table, **table 40**, and illustrated using two histograms, **fig. 48(a) and 48(b)**. The following sections discuss the results presented in all the summary histograms.

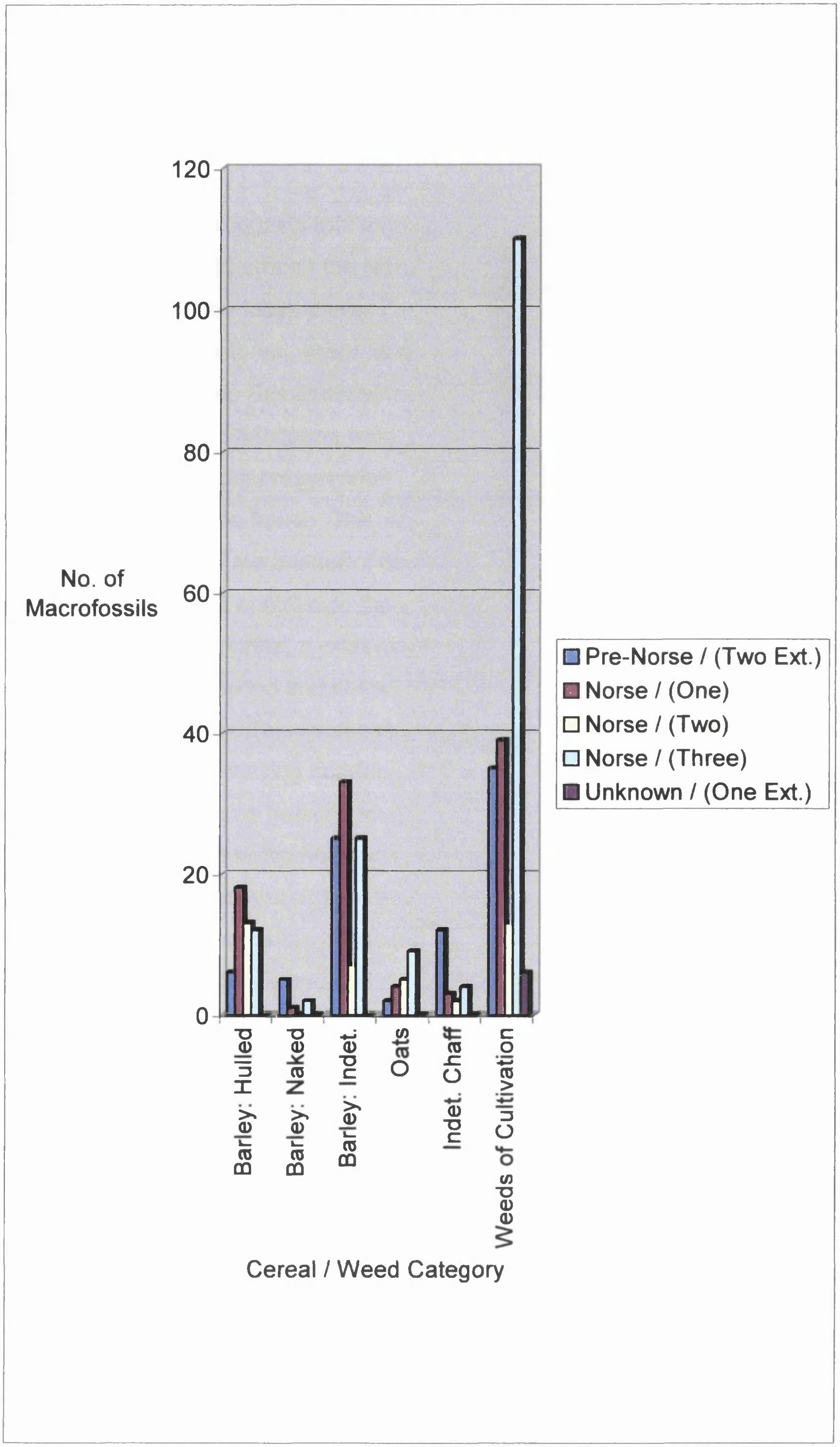
6.5.2: Cultivated Plants:

Barley was the dominant cereal crop species recovered across the phases, with the majority of grain identified as *Hordeum vulgare* sl. Hulled barley (*Hordeum vulgare* var. *vulgare*) was also recorded together with smaller amounts of naked barley (*Hordeum vulgare* var. *nudum*), and the numbers recovered varied by trench. Some of the hulled barley was twisted through its axis, and this pointed to the presence of six-row hulled barley, also known as bere barley in the north of Scotland. Oats were also present in the samples but again only small amounts were found. The actual number of recovered grains was quite small, with less than 140 grains of identifiable material found in any phase. However, when the relative proportions of cereal species present were compared across the site as a whole it produced some interesting results. **Fig. 45** illustrates the recovery of various cereal species by trench / phase and compares this with the presence of weeds of

Soterberg, Unst: Phasing:	Pre-Norse	Norse	Norse	Norse	Unknown
Trench:	Two Ext.	One	Two	Three	One Ext.
Location:	N.E. Exterior	W. Interior	E. Interior	S.W. Interior	N.W. Exterior
Total Sample Litres:	205	168	207	70	20
Cultivated Plants:					
Barley: Hulled	6	18	13	12	0
Barley: Naked	5	1	0	2	0
Barley: Indet.	25	33	7	25	0
Total Barley Count:	36	52	20	39	0
Oats	2	4	5	9	0
Indet. Cereal	41	37	17	9	0
Indet. Chaff	12	3	2	4	0
Weeds of Cultivation	35 (3 sp.)	39 (3 sp.)	13 (3 sp.)	110 (4 sp.)	6 (1 sp.)
Wild Resources:					
Peat	448 (32.7g)	171 (12.6g)	420 (49.6g)	48 (4.4g)	0
Heather stems	133 (2.05g)	144 (2.4g)	72 (2.15g)	48 (0.15g)	2 (<0.05g)
Seaweed	36 (0.45g)	7 (0.25g)	9 (0.2g)	17 (0.6g)	
Charcoal	187 (5.8g)	77 (1.95g)	220 (9.5g)	28 (1.05g)	13 (0.25g)
Burnt Vesicular (coal or other?)	0	1 (16.4g)	0	0	0
Other Remains:					
Fish Bone	2 (0.15g)	4 (0.1g)	2 (0.1g)	1 (0.05g)	0
Other bone (mammal + bird)	195 (9.9g)	35 (2.15g)	88 (3.35g)	12 (0.25g)	4 (0.1g)
Slag	3 (0.2g)	6 (0.15g)	0	0	0

Table 38: Soterberg, Unst: Summary Table of Cereal Grain and other Environmental Remains from the Trenches.

Fig. 45: Soterberg Unst: Cereal Remains and Weeds of Cultivation by Phase.



cultivation. This chart shows the occurrence of hulled barley in the pre-Norse increasing during the Norse phases, whilst naked barley decreases in the Norse. Similarly oats are found in small amounts in the pre-Norse, and this increases slightly in the Norse phases.

This histogram also suggests that it might be possible to detect specific activity areas occurring in and around the Norse settlement, possibly where cereal processing could have taken place. The samples from trenches 1 and 2 mostly originate in hearth features, where little chaff was present, although weeds of cultivation were found. This material may have resulted from cooking activities and these areas within the habitation were probably regularly swept clean, producing few opportunities for the preservation / retention of grain on the hard compacted clay floor surface of the house. This situation is reflected in the remains recovered from opposite ends of the interior of the house – in the trench 1 hearths to the west, and the trench 2 contexts to the east. However, in the southwest interior, where trench 3 was located, a relatively large peak in weeds of cultivation was seen accompanying hulled and naked barley grain, together with a slight (although small) increase in oats. This evidence could suggest that this portion of the house was where cereal processing activities took place – or where residual rubbish from the interior hearth places became trapped as it was swept out of the house. The excavation of this part of the house revealed a flagged stone floor and areas of burning / charcoal amongst clay, so it is likely that domestic activities were occurring here, but impossible to ascertain exactly what this involved based upon the limited archaeological investigations in this area of the site.

6.5.3: Weed Ecology:

6.5.3.1: Habitat Categories:

The carbonised weed seeds from Soterberg were divided into eight ecological groups for interpretation purposes. These were:

1) Sandy arable land, damp sand, ditches and dunes:

Chenopodium album (fat hen), *Stellaria media* (chickweed), *Spergula arvensis* (corn spurrey).

2) Non-sandy arable / waste and disturbed ground:

Polygonum aviculare sl. (knotgrass), *Polygonum arenastrum* (equal-leaved knotgrass), *Stachys* sp. (woundwort).

3) Grassland, grassy meadows / pasture:

Ajuga reptans (bugle), *Silene dioica* (red campion), *Bromus* sp. (brome).

4) Damp pasture, sandy coastal pasture and fellfield:

Rumex acetosa (common sorrel), *Euphorbia helioscopia* (sun spurge).

5) Wetland: Aquatic, waterside, marsh and mire (base rich):

Carex hostiana (tawny sedge), *Scirpus* cf. *lacustris* (cf. common club-rush), *Eleocharis* sp. (spike-rushes).

6) Moors, bogs and heath / dry heath:

Rumex acetosella (sheep's sorrel), *Empetrum nigrum* (crowberry), *Danthonia decumbens* (heathgrass), *Carex* cf. *flacca* (cf. glaucous sedge).

7) Shingle beaches and shores:

Rumex crispus (curled dock).

8) Miscellaneous:

Polygonum sp. (knotgrass), *Rumex* sp. (docks), *Carex* sp. (sedges) Poaceae (grass family), *Poa* sp. (meadow-grasses).

6.5.3.2: Summary of Weed Ecology:

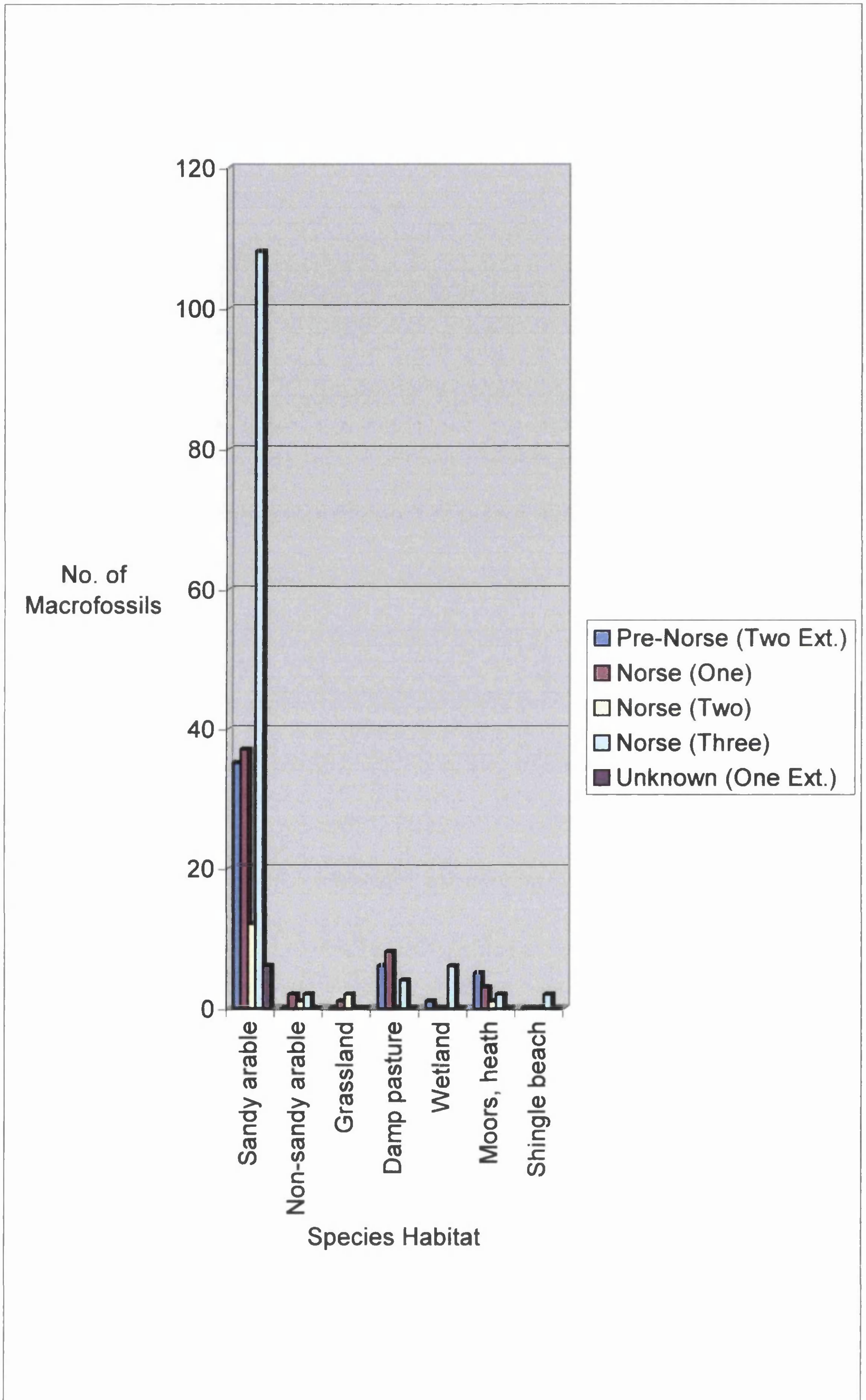
The main category of weeds recovered from Soterberg consisted of species of sandy arable land, suggesting that these weeds arrived on-site with a cereal crop grown on fertile, probably base-rich, soil. Far fewer weeds were present in the other catagories listed above. **Table 39** and **fig. 46** illustrate the distribution of the various weed species by phase. From this histogram it can be seen that the use of sandy arable land does not appear to have changed between the pre-Norse and Norse contexts (whilst numbers of actual macrofossils increases in the Norse, the number of different species found does not). However, weeds of non-sandy arable ground and grassland are only present in the Norse phases, perhaps suggesting a slight expansion of agriculture onto rougher, less productive agricultural land.

Species of moors, bogs and dry heath were slightly more prevalent in the pre-Norse phase although their presence continued into the Norse phases. Species of wetter ground, such as marsh and base-rich mire had a reverse pattern to this and increased in the Norse phases, although again the numbers recorded were small. The presence of these species suggested the continued use of gathered resources such as peat for domestic purposes. Similarly, grassy turves may have been cut for fuel, and this practice may have been a necessity in areas of limited woodland fuel

Soterberg, Unst: Phase:	Pre-Norse	Norse	Norse	Norse	Unknown
Weed Species Ecology: Trench:	Two Ext.	One	Two	Three	One Ext.
Non-Sandy Arable / waste and disturbed ground	0	2 (1 sp.)	1 (1 sp.)	2 (2 sp.)	0
Grassland, grassy meadows / pasture	0	1 (1 sp.)	2 (2 sp.)	0	0
Damp pasture, sandy coastal pasture, fellfield	6 (1 sp.)	8 (2 sp.)	0	4 (1 sp.)	0
Sandy Arable, damp sand, ditches and dunes	35 (3sp.)	37 (2 sp.)	12 (2 sp.)	108 (2 sp.)	6 (1 sp.)
Wetland: Aquatic, waterside, marsh and mire (base rich)	1 (1 sp.)	0	0	6 (2 sp.)	0
Moors, bogs and heath / dry heath	5 (2 sp.)	3 (2 sp.)	1 (1 sp.)	2 (2 sp.)	0
Shingle beaches and shores	0	0	0	2 (1 sp.)	0

Table 39: Soterberg, Unst: Recovered Weed Ecology by Phase.

Fig. 46: Soterberg, Unst: Ecology of the Recovered Weed Species by Phase.



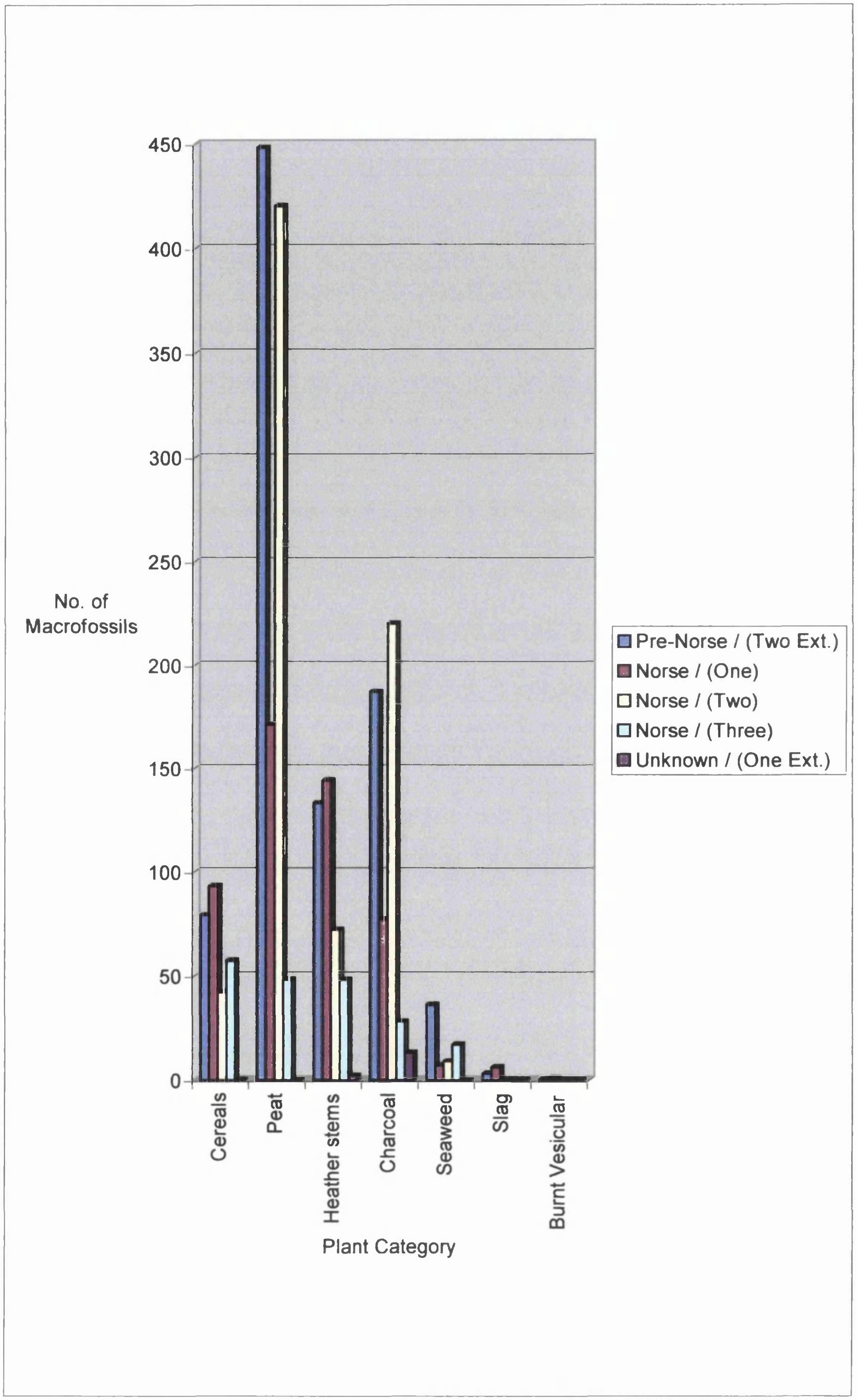
resources. Ethnographic records indicate the cutting of wet fen areas for fuel, with mossy wet grassy turfs producing a great heat and strong sulphurous smell, leaving ashes of a deep terracotta colour (Firth 1972: 2). The Norse hearth feature, C.027, excavated in trench 1, consisted of numerous layers of reddish ash, which may well have originated as wet grassy turf. Similarly animal dung used for fuel on the hearth may have introduced grassland and pasture species into these deposits.

6.5.4: Wild Resources:

Wild resources are presented in histogram form in **fig. 47**. Burnt peat fragments were recovered in abundance from every context sampled at Soterberg, and this resource was probably the major source of domestic fuel. It was present in large amounts in both the pre-Norse and Norse phases, and may have been used on domestic hearths and for cereal drying processes. The use of heathy turves for building material should not be underestimated, particularly for roofing material, and the large numbers of heather stems present in both phases suggest that drier areas of heathland were also being exploited in addition to deeper peats cut for fuel.

Seaweed was recovered in the greatest amount from the pre-Norse phase, although it continued to be present in the Norse levels of the site. Seaweed may have been middened together with animal dung, turf and waste products from processing activities around the farm. Once fermented this material would have made very good fertiliser for arable fields (Fenton 1978: 274). Its presence in the pre-Norse strongly suggested that manuring practices were being carried out at this time, prior to the arrival of Scandinavian settlers.

Fig. 47: Soterberg Unst: Comparison of Cereal Grain, Major Fuel and Wild Resources and Slag by Phase:



6.5.5: Charcoal:

A range of coniferous and deciduous wood charcoal was recovered from Soterberg (see **table 40** for full list of species). **Fig. 48(a)** illustrates the distribution of these charcoal species across the site. The majority of charcoal recorded was very small (<5mm) and poorly preserved, with a considerable amount of damage caused by iron-panning. This effect results in the complete obliteration of the diagnostic features necessary for identification to species, and leaves behind an orange residue in the wood vessels. This is reflected in **fig. 48(a)** where the largest recovered category from all trenches was 'indeterminate charcoal'. The abundance of very fragmentary damaged pieces may suggest that charcoal was re-used many times on industrial and domestic hearths and probably combined with peat to eke out the fuel resource in an area of limited natural woodland.

The 'indeterminate' category somewhat obscured the other species when presented in histogram form. For this reason a second chart (**fig. 48(b)**) was produced with this category removed. Native British species were recovered in small amounts from the trenches. In the pre-Norse phase the widest range of these species was found, consisting of *Quercus* (oak), *Betula* (birch), *Alnus* (alder), *Corylus* (hazel), *Salix* (willow) and *Prunus spinosa* (blackthorn). In the Norse phases however, fewer of these species were present, and smaller quantities of identifiable charcoal were recovered. The habitats available for woodland species to flourish on Shetland were greatly diminished by the spread of blanket peat bog, which was extensive by the Iron Age. Pollen analysis has shown that by this period the range of species found on Shetland was greatly decreased, with many areas reduced to acid bog and heathland (Butler 1999: 7). However, despite the limiting factors of high winds, boggy ground, and salinity, it is possible that some of the species found at Soterberg were native to Unst. Species such as birch and willow can tolerate wet boggy areas, and hazel and blackthorn often grow as scrub. Sheltered locations such as river valleys may have provided habitats for dwarf low growing species. The small amount of oak recovered in the pre-Norse and Norse phases was probably an imported species as this is not likely to have been growing on Unst during these periods.

Coniferous species, recovered from both pre-Norse and Norse phases were probably gathered as driftwood from local shores. J. H. Dickson (1992) discussed the origins and routes of driftwood arriving on the Scottish coast. Spruce and larch are natives of North America and probably arrived on continental drift currents. Scots pine could have arrived from the Scottish mainland as driftwood, or been an imported resource. As with the deciduous woods, a greater range of identifiable species was present in the pre-Norse phase. The importation of wood or ready made charcoal from areas south of Shetland has already been suggested for the Pictish phases at Burland, Trondra, and similar trading patterns may have been occurring at Soterberg, Unst.

Interestingly industrial residue in the form of slag was recovered from the pre-Norse hearth areas, and also from the western part of the Norse house. The deposition of charcoal around the site may in part be related to metalworking activities, with the larger range of species in the pre-Norse phases reflecting the need to use any available wood charcoal for metalworking. The use of wood charcoal in metalworking has already been discussed in chapter 5, suffice to say that oak would have been a preferred species for smelting, and the largest amount of oak found on the site was from a pre-Norse hearth. However, as already discussed, almost any charcoal species is preferable to peat when iron-smelting, unless the peat is prepared as charcoal before use (Tylecote 1986: 224). Slag found in the area of the western Norse hearth suggested that metalworking was also occuring at this later period, although as also seen at Burland, there has been a fundamental change in the trade routes this reflects, with the arrival of Norse settlement signifying an end to the north – south movement of goods and raw materials.

6.6.6: Other Remains:

Small amounts of fish and animal bone were recorded, with the majority of bone present in the pre-Norse trench. The numbers involved were very small and the remains fragmentary so it was difficult to draw any strong conclusions from this other than in terms of presence. Much of the indeterminate bone recovered was burnt. Small dried bones burn very intensively, owing to their organic content, and have been discovered as a fuel source in cupelation hearths on Roman sites in England (Tylecote 1986: 226). It is possible that the bone found at Soterberg was used in a similar fashion for industrial activities.

Little fish bone was found in the Norse contexts, but the discovery of numerous steatite fishing weights, resting against the western interior wall of the Norse house, revealed that this resource played a role in the economy of Soterberg.

Soterberg, Unst: Phasing:	Pre-Norse	Norse	Norse	Norse	Unknown
Trench	Two-Ext.	One	Two	Three	One Ext.
Location	N.E. Exterior	W. Interior	E. Interior	S.W. Interior	N.W. Exterior
Wood Charcoal Species:					
Picea (Spruce)	0.4g (4)	0	0	0.1g (1)	0
Larix (Larch)	0.3g (2)	0	0	0	0
Pinus sylvestris (Scots pine)	0.1g (2)	0	0.5g (8)	<0.05g (1)	0
Coniferous type	0.85g (16)	0	2.5g (23)	<0.1g (2)	0
Quercus (Oak)	1.35g (7)	0	0.15g (2)	0	0
Betula (Birch)	0.1g (2)	0.1g (1)	0	0	0
Alnus (Alder)	0	0	0.2g (2)	0	0
Corylus (Hazel)	<0.05g (1)	0.25g (4)	0	0	0
Salix (Willow)	0.15g (5)	0.15g (4)	0	0.2g (3)	0
Prunus spinosa (Blackthorn)	<0.05g (2)	0	0	0	0
Indeterminate charcoal	2.25g (137)	1.45g (68)	2.6g (184)	0.55g (20)	0.25g (13)
Industrial residue (slag)	0.2g (3)	0.15g (6)	0	0	0

Table 40: Soterberg, Unst: Summary Table of Recovered Charcoal by Trench / Phase. (Note: Figures in brackets represent actual counts).

Fig. 48(a): Soterberg, Unst: Recovered Charcoal Species and Industrial Remains by Phase / Trench:

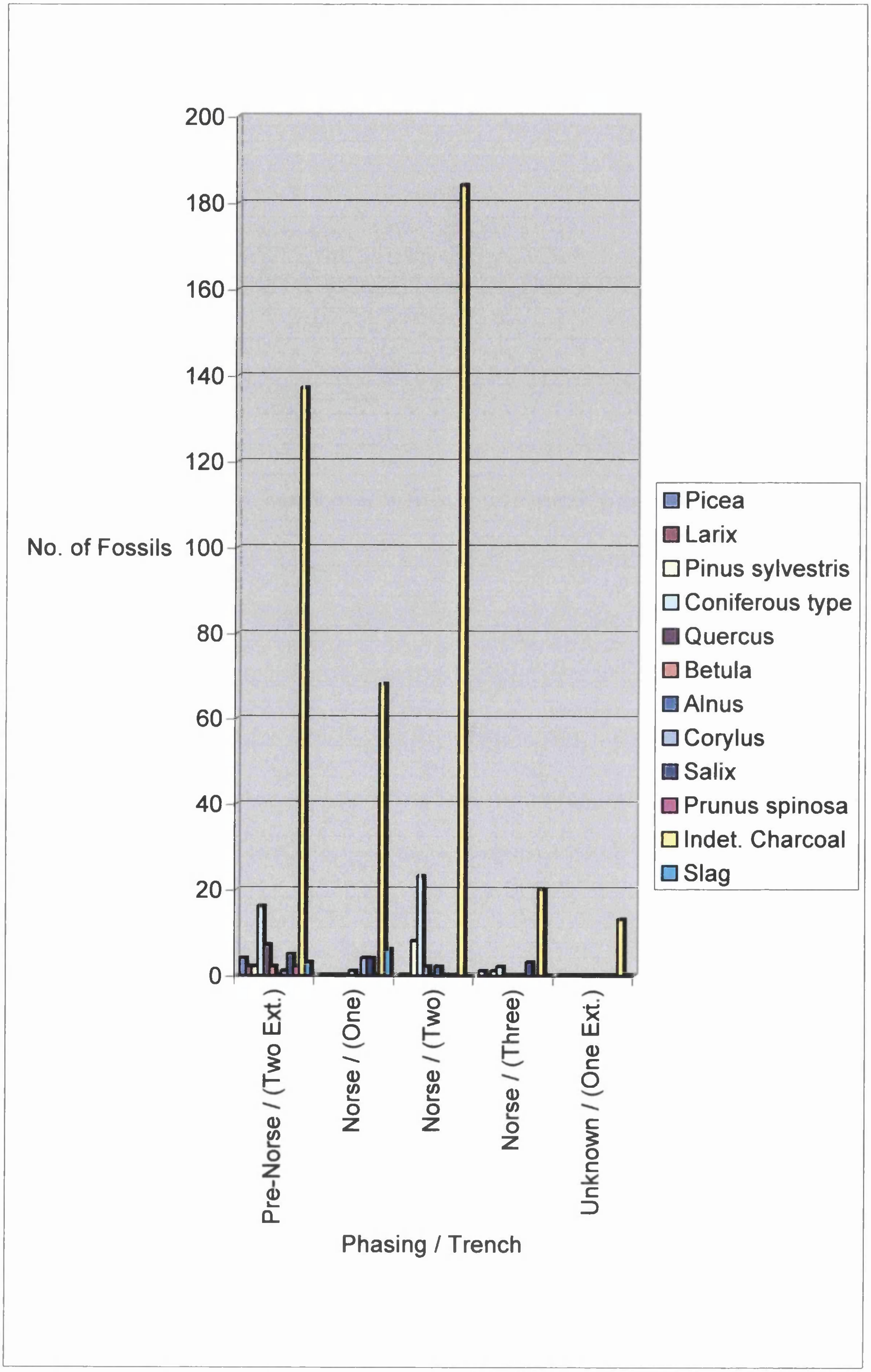
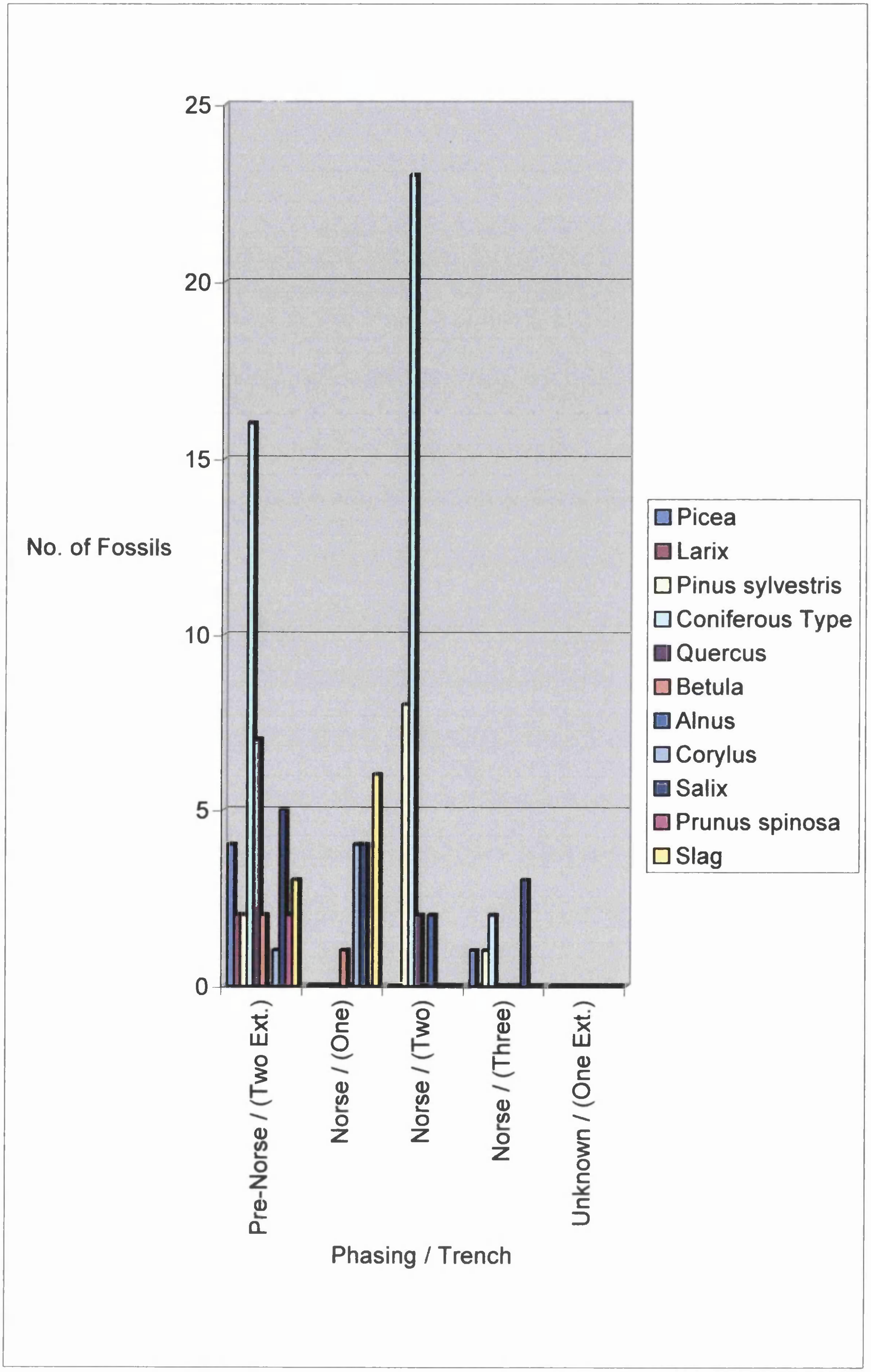


Fig. 48(b): Soterberg, Unst: Recovered Charcoal Species (Indet. Removed) and Industrial Remains by Phase / Trench:



Chapter Seven:

7: Setters, Belmont, Unst, Shetland:

7.1: Location of Site and Archaeological Background:

The excavation of the Norse longhouse on land known as Setters, near Belmont pier on the southwestern coast of Unst took place during three weeks in 1996. The position of the site is given in **fig. 44**, previously presented in chapter 6. The site was located on what is now marginal rough boggy grassland on the lower slopes of Gallow Hill, within a natural hollow. Small rivulets from hillstreams run nearby, and the local vegetation is dominated by sedge and grazed areas of boggy grassland. The project was undertaken by a team of students from the University of Copenhagen, under the direction of Mr. Steffan Stumman Hansen and Ms. Anne-Christine Larsen. Site management was provided by the Shetland Amenity Trust and on-site supervision by EASE archaeological consultants, consisting of Ms. Hazel Moore and Mr. Graham Wilson. Ms. Moore ensured that environmental samples were taken during the course of the excavation.

7.2: Archaeological Excavation 1996 Season:

7.2.1: Location of Trenches:

Initial archaeological survey work had revealed a series of stone built structures, with one of these buildings resembling a large Norse-type dwelling house measuring approximately 20 metres in length by 4 metres in width (Larsen 1997). As the work was of only three weeks duration it was decided to concentrate efforts on characterising the nature of this building. The walls of this house had apparently been constructed from an outer and inner shell of dry stones, with a core of turf, and were some 1 metre thick at each end of the house and 1.5 metres thick in the centre (Larsen 1997). During the excavations it became apparent that a sequence of rebuilding had taken place, with two later and slightly smaller buildings constructed in and to the west of it, partly re-using the older stone foundations. The excavation work produced a number of interesting Norse-style artefacts, including spindle whorls, loom weights and net-sinkers, made of possibly local steatite and serpentine, and schist whetstones. A Norse hanging-lamp carved from serpentine was also found.

7.2.2: Stratigraphic Phasing:

The dating of the site was problematic, and much disagreement and debate ensued between EASE and the staff from Copenhagen. The earliest excavated building was thought by Larsen (1997) to be Viking, perhaps 9^{th} – 10^{th} century, whilst the later structures were perhaps 11^{th} – 12^{th} century. EASE argued that this dating was based upon stylistic and structural comparisons with other Norse sites, and could not readily be imposed upon these features. EASE thought it unwise to impose an early Norse / Viking date on the structure based upon building typology alone, and given the limited investigations that were carried out. In addition the construction of houses using dry-stone walling, often with a turf core, has a long tradition and is not confined to just the Norse period in the Northern Isles (H. Moore pers. comm.). No reliable context information or report material was available on this site at the time of writing, and the information used in this chapter was taken from a short article published in ***Shetland Life*** magazine (Larsen 1997). A very brief summary of the possible chronology of the site as used for this thesis is given in **table 41**.

7.3: Environmental Sampling and Processing:

7.3.1: Sampling Strategy:

A total of 25 bulk environmental soil samples from 13 different contexts were taken by Ms. Hazel Moore during the course of the excavation. Ms. Moore systematically sampled between 20 and 30 litres per context. A list of samples together with weights and volumes is provided in **table 42**.

7.3.2: Sample Processing:

No budget was available to process the samples from Setters, which sat in the EASE storeroom for a number of years. After the author's involvement with the Soterberg excavation, EASE contacted Professor C. D. Morris to suggest the possible incorporation of the Setters material into the author's research. This was agreed and Glasgow University took delivery of the material in 1998.

The bulk samples were processed by flotation utilising GUARD's sieving facilities. The majority of the samples were of light brown silty clay, of a similar nature to the clay floor surfaces sampled by the author from within the house at Soterberg (it would be pure conjecture to say they were the same with no available context information). Very few obvious pieces of charcoal or ashy deposits were noted during the processing stages. The samples were processed following the methodology described in chapter 2.2.3.2. Bulk samples were floated to >300μm. Small 0.5 –1 litre subsamples were taken from each context, boxed and stored at Glasgow University for potential use by other specialists.

7.3.3: Sample Analysis:

The author sorted all residues from Setters and incorporated this data into the site analysis. The heavy clay nature of the sample sediment caused similar problems to those experienced whilst processing the samples from Soterberg, even after many days of pre-soaking the bulk samples in water. With the sparsity of remains

Table 41: Setters, Unst, Dating and Phasing Concordances:

Period	Phase	Contexts	Dating
Early - Late Norse	Unphased	No firm information available. Possibly: 022, 031, 033, 034, 041, 047, 050.	Artefactual and Structural: Steatite pottery, loom weights, net sinkers. Thick regular walled rectangular building.
Post Norse / Post Medieval Crofting	Unphased	No firm information available. Possibly: 001, 013, 015, 019, 030, 044.	Artefactual and Structural: Corroded iron nails and coal suggested possible 1700's dating. Thick walled rectangular building may be croft.

Table 42: Setters, Belmont, Unst Excavation 1996: List of Samples:

Bulk Environmental Samples:	Volume (l)	Weight (Kg)	Processing	Sieve Size
C.001 Area 1	20	32	Floated	>300um
C.013 Area 1	10	15	Floated	>300um
C.015 Area 1	20	22	Floated	>300um
C.019 Area 1	20	27	Floated	>300um
C.022	20	30	Floated	>300um
C.030 Area 1	20	22	Floated	>300um
C.031	20	24	Floated	>300um
C.033 Area 1	30	47	Floated	>300um
C.034	20	30	Floated	>300um
C.041	27	45	Floated	>300um
C.044 Area 1	20	40	Floated	>300um
C.047	20	22	Floated	>300um
C.050	20	33	Floated	>300um

recovered from the flots, and time and budgetary considerations the author took the decision not to laboratory process subsamples from this site.

7.4: Results:

The results from the environmental samples processed from Setters are presented in **table 43**.

Raw data **table 43** is presented on the following page.

Setters, Belmont, Unst:	C.001	C.013	C.015	C.019	C.022	C.030	C.031	C.033	C.034	C.041	C.044	C.047	C.050
Carbonised Cereal Grain and Chaff:	**Area 1**	**Area 1**	**Area 1**	**Area 1**	**(None)**	**Area 1**	**(None)**	**Area 1**	**(None)**	**(None)**	**Area 1**	**(None)**	**(None)**
Indeterminate Cerealia / Poaceae stem fragment	1										2		
Avena sp.		1		1						3	1		
cf. *Avena* sp.											3		
Indeterminate Cereal grain (+embryo)			1	1							6		
Carbonised Wild Resources:													
Burnt peat fragments	4.1g (35)	9.1g (31)	10.4g (40)	4.6g (63)	5.8g (14)	2.6g (8)	1.6g (25)	1.6g (17)	0.4g (1)	7.35g (127)	6.85g (37)	11.8g (44)	1.1g (6)
Burnt Vesicular (coal or other?)	5.55g (21)		18.9g (40)								11.8g (13)		
Carbonised seaweed fragments	<0.05g (1)	<0.05g (2)		<0.05g (1)									
Calluna stems (roots / twigs)	<0.05g (1)	0.1g (4)		0.1g (4)	0.1g (3)		0.25g (29)	0.1g (8)	<0.05g (1)	0.2g (15)		2.1g (11)	
Indeteminate Rhizome fragments				1									
Non-carbonised (dry) peat fragments											2.5g (2)		
Carbonised Weeds:													
Ranunculus repens		1											
Stellaria media	1			3							1		
Spergula arvensis				1									
Viola sp.	1												
Prunella vulgaris										1			
Chrysanthemum segetum			1										
Charcoal:													
Pinus sylvestris	0.1g (1)										0.1g (4)		
Indeterminate Coniferous wood					<0.05g (1)						<0.05g (1)		
Corylus													<0.05g (1)
Indeterminate Charcoal	0.1g (2)			<0.05g (2)		0.1g (1)	<0.05g (2)		<0.05g (1)	<0.05g (2)			
Non-Plant: Bone:													
Fish bone (unburnt)	0.2g (1)												
Mammal bone (unburnt)	0.3g (1)												
Indeterminate bone (unburnt)	<0.05g (1)												
Non-Plant: Other:													
Unburnt coal	2.9g (8)		7.1g (21)	0.2g (1)							6.3g (12)		
Fe object (cf. nail)				1.9g (5)									
Fe object (indeterminate)	8.9g (6)		22.9g (2)			4.0g (15)							
Industrial residue (slag)			0.1g (14)										
Building mortar concretion (charred)		2.0g (1)											
Indeterminate shaped white stone			3.9g (2)										
Modern' glazed pottery	0.5g (1)												

Table 43: Setters, Belmont, Unst: Environmental remains from the samples. (Note: Figures in brackets represent actual counts).

7.5: Discussion of Results:

7.5.1: Overview:

The bulk environmental samples from Setters produced very few carbonised plant macrofossils or other environmental remains, even though a total of 267 litres of sediment were processed. It is possible that with the limited nature of the excavation no deep carbon-rich deposits (e.g. middens) or suitable activity areas (such as hearths or corn drying areas) were encountered. A summary of the recovered data from this site is presented in **table 44**. These data are also presented in histogram form in **fig. 49**.

7.5.2: Cultivated Plants:

Few carbonised cereal grains were recovered from the samples. Of those present the only identifiable species was oat. The small amounts of chaff and weeds of cultivation recovered were not present in sufficient quantities to indicate whether this crop was processed elsewhere or arrived on-site in a partially processed state. The presence of oat species may suggest that more marginal lands were being brought into cultivation. However, the weed ecology pointed to other locations for the production of crops (see below).

7.5.3: Weed Ecology:

7.5.3.1: Habitat Categories:

The weed seeds from Setters fitted into three different categories, summarized as follows:

1) **Sandy arable, damp sand, ditches and dunes:**

Ranunculus repens (creeping buttercup), *Stellaria media* (chickweed), *Spergula arvensis* (corn spurrey), *Chrysanthemum segetum* (corn marigold).

2) Grassland, grassy meadows / pasture:

Prunella vulgaris (selfheal).

3) Miscellaneous:

Viola sp. (violets).

7.5.3.2: Summary of Weed Ecology:

Overall very few weed seeds were recovered, with the majority probably originating from sandy arable land. These species may have arrived on site with a cereal crop and become carbonised during processing / cooking activities. At the present time Setters is on marginal grassland more suited to rough grazing, although there are sandy arable areas on other parts of Unst, such as at Sandwick. It is possible that the oat cereal / sandy arable weeds found at Setters could have been transported from one of the more fertile sandy low-lying areas of Unst for consumption here. Indeed the low-lying bay at Wick of Belmont – some 0.5km from Setters, and currently farmed at Belmont House – may have provided more productive land than that in the immediate vicinity of the excavation.

The single *Prunella vulgaris* recovered may have been growing very local to the site on grassy pasture.

7.5.4: Wild Plant Resources:

Large amounts of burnt peat, together with fewer quantities of carbonised heather stems and seaweed were recovered.

7.5.5: Charcoal:

The only charcoal remains recovered were a very small amount of *Pinus sylvestris* (Scots pine) and a single piece of *Corylus* (hazel). All charcoal pieces were small, mostly less than 1cm. Coniferous wood was probably driftwood collected from nearby shores, whereas hazel may represent limited amounts of locally growing scrub.

7.5.6: Other Remains:

Evidence for fishing or pastoral activities was poorly represented at Setters, with only one small fish bone and two small possible mammal bone fragments recorded. Poor preservation conditions may have resulted in the loss of bone evidence, as the soil matrix of the site was clay rich in some areas and boggy and acidic in others (H. Moore pers. comm.) which can result in bone degradation.

Small fragments (1 – 3cm) of very friable burnt vesicular material resembling burnt coal / coke, were present in three of the thirteen contexts analysed. Unburnt coal was also found in four contexts. There is no known indigenous source of coal on Unst, and records from the late 18th century indicate a trade in coal occurring in parts of Shetland to supplement peat cutting (Fenton 1978: 224). Fenton (1978: 207) also reported the use of coal as ballast for ships arriving from Newcastle to collect kelp from the Northern Isles during the 1700's. Corroded iron nails were also found in the samples from Setters. This evidence could suggest that some of the structures at Setters were more recent than the excavators assumed, and may belong to a more recently abandoned crofting building, perhaps built over a Late Norse house. The recovery of industrial evidence in the form of slag may suggest some metalworking activity occuring at the site, with fuel in the form of coal or charcoal possibly utilised for this process.

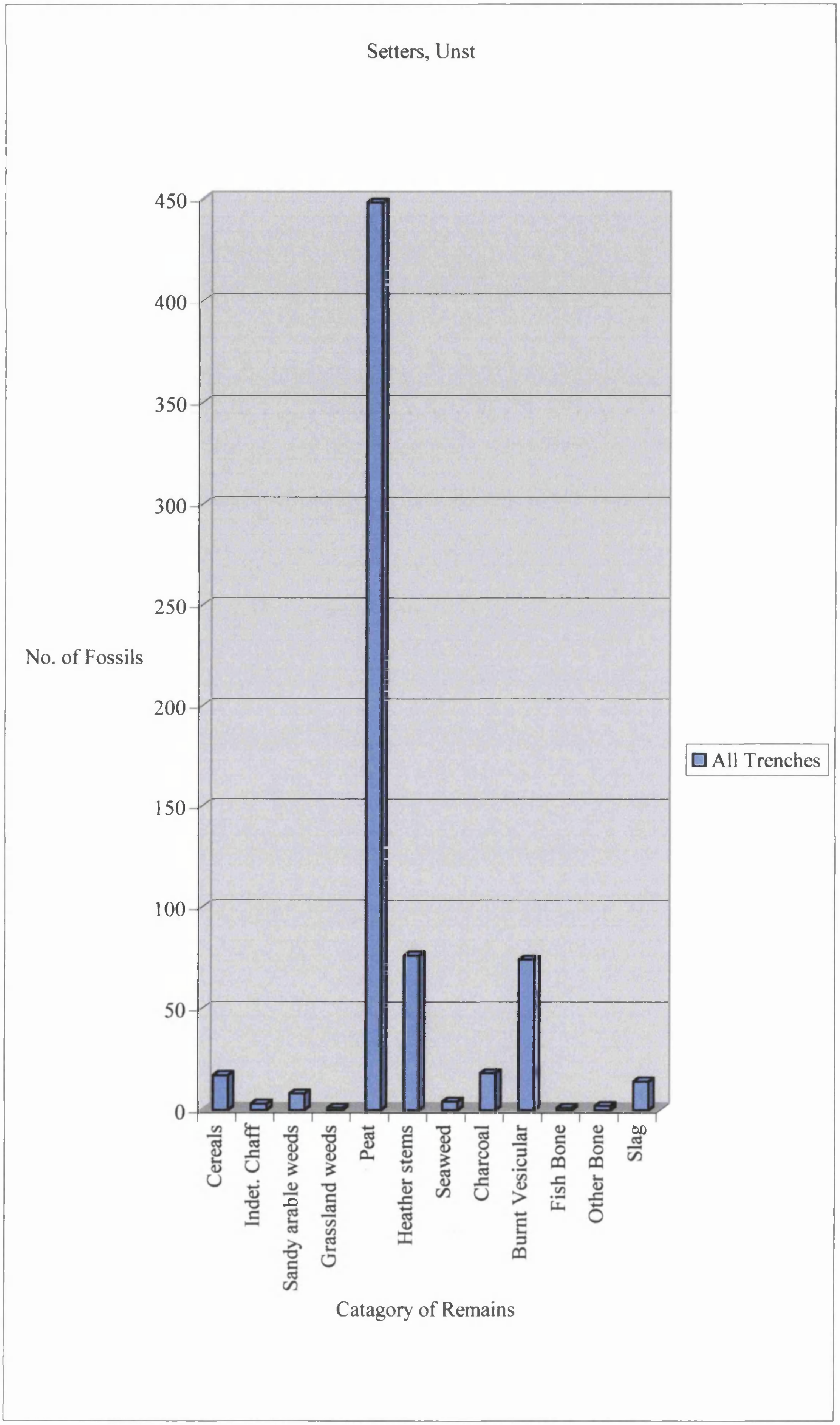
7.5.7: Summary Analysis:

As no secure contextual information is available at the time of writing this section will of necessity be brief. A summary histogram of the recovered evidence is provided in **fig. 49**. This diagram quite clearly indicates the dominant presence of wild resources in the samples, with burnt peat, heather stems and burnt vesicular material recovered in greater actual numbers of fossils than any other catagories. Cereals, chaff and weeds were recorded in such small numbers that very few conclusions can be drawn, other than to say oat was present and the majority of weeds found probably originated from sandy arable land. The discovery of slag sphericals provided an important indication as to metalworking activity occuring at the site, and may be related to the types of fuel resources recovered, such as coal and charcoal. The use of various fuels in metalworking has already been discussed in chapter five.

Table 44: Setters, Belmont, Unst: Summary Table of Plant Remains and Other Environmental Material Recovered from the Samples:

Setters, Belmont, Unst:	No Phasing: All Trenches:
Total Sample Litres:	267
Cultivated Plants:	
Oat	9
Indet. Chaff	3
Indet. Cereal	8
Weeds of Cultivation	8 (4sp.)
Wild Resources:	
Peat	67.3g (448)
Heather stems	3.05g (76)
Seaweed	0.15g (4)
Charcoal	0.75g (18)
Burnt vesicular (coal?)	36.25g (74)
Other Remains:	
Fish Bone	0.2g (1)
Other Bone	0.35g (2)
Slag	0.1g (14)
Weed Ecology:	
Grassland, grassy meadows / pasture	1 (1 sp.)
Sandy Arable, damp sand, ditches and dunes	8 (4 sp.)

Fig. 49: Setters, Unst: Material Recovered from the Bulk Environmental Samples:



Chapter Eight:

8: Discussion:

8.1: Synthesis and Integration of this Study: (Inter-Site Comparison):

8.1.1: Overview:

In this section the environmental data obtained from the five study sites will be compared in order to discuss trends in the temporal and regional recovery of different categories of plant and other environmental and economic material. The overall objectives of the thesis presented in chapter two will be utilised to draw out some of the major economic and environmental themes that have been highlighted during the analysis of the five sites. This discussion will involve a consideration of patterns of change occuring in agricultural economies in Shetland and northern Scotland during the first millennium AD (section 8.1.2). Three major themes of economic change will be considered in this chapter. These changes consisted of, 1) intensification in arable production, 2) expansion in pastoral agriculture leading to surplus (such as dairy produce) for trade, and 3) development of long-distance trade in dried fish. This chapter (section 8.1.3) will also discuss the varying uses of wild resources, such as peat and seaweed on the study sites, and how these relate to patterns of wider change.

Table 48 provides an overall chronology for the five sites based upon **table 1** in chapter 1, and is intended as a guide to both the actual and potential dating of the study sites (firm dates are given as solid lines). **Table 45** (discussed below) presents a five-point scale of recovery for the main resource groups identified from the Shetland sites. **Table 46** (discussed below) presents a similar summary for the mainland Scottish material. Metalworking waste in the form of slag was recovered from all five sites, in varied amounts depending upon phase. The potential relationship between slag and charcoal recovery, and how other fuels can be related to this is presented in **table 47**, also on a five-point scale, and this will be discussed below in section 8.1.4. A description of the five-point scale used in each comparison is provided at the foot of **tables 45** and **46**, and was based upon the actual number of macrofossils recovered. This scale was also utilised to generate summary histograms **fig. 55** and **fig. 56**.

8.1.2: Agricultural Economies in the First Millennium AD:

Tables 45 and **46** show the relative proportions of cereal grain, peat, seaweed and burnt vesicular material recovered from the five sites. In Shetland, (**table 45**) the addition of the carbonised material from Burland has enabled an analysis of changes in arable agriculture (particularly cereal species and land – use) to be made from the Mid-Late Iron Age / Pictish and Norse phases (see chapter 5). Thus a wider temporal analysis of agricultural changes may be proposed than would have been possible from the Iron Age / Norse material from Soterberg (chapter 6) and the probably Late Norse material from Setters (chapter 7). In mainland Scotland (**table 46**) environmental sampling was limited mainly to the Norse period at Geodha Smoo, with some data also from the pre-Norse (Pictish and prehistoric (Iron Age?) agricultural layers) at Marymas Green.

Four of the five sites produced evidence for hulled barley (*Hordeum vulgare* var. *vulgare*), and this is summarized in **fig. 50.** Hulled barley was recovered in the greatest concentration per litre of sampled sediment, from the Mid-Late Iron Age and Pictish phases at Burland. The presence of hulled barley at this site in subsequent Viking / Norse phases was greatly reduced, and from the Norse phases at the remaining sites studied its presence was never large. Barley grain of all species was completely absent from Setters, but the assemblage from this site was very small. When compared with **fig. 51(a)** the relationship between the presence of hulled barley and light sandy arable field indicator weeds at Burland is revealing, showing that these weeds underwent a significant increase in the Pictish phase. Whilst Iron Age grain may have been stored at Burland, and perhaps grown or processed elsewhere, by the Pictish period this appeared to have changed. The Pictish phases at Burland saw an arable intensification marked by an increase in sandy arable indicator weeds and the increased presence of seaweed and possible dung remains on site, suggesting the fertilisation of sandy soils probably in an attempt to increase local barley yield. This may also suggest a move away from a mainly storage role, toward a more active participation in on-site cereal processing occuring in the Late Iron Age, and this was reflected by the recovery of numerous rotary quernstones. The stratigraphic association of hearth place / flue and quernstone, together with the large amounts of peat, heather and cereal grain identified, strongly suggested that processing activities such as corn-drying and grinding were occuring (see **fig. 37** and chapter section 8.2.3). In **fig. 51(b)** Burland was removed in order to display sandy arable weed recovery more fully for the other sites, and this will be discussed further below.

Naked barley (*Hordeum vulgare* var. *nudum*) (see **fig. 52**) was also recovered in the largest amounts from the Pictish phase at Burland, although its use greatly decreased in the Norse phases. Soterberg also produced the most naked barley from the pre-Norse phases, although the overall numbers recovered were small. This is somewhat different from Marymas Green where, although a small presence was seen in the pre-Norse (Pictish) samples, there may have been an attempt to re-introduce this species during the Norse period. The earlier phases of the Norse midden saw a rise in naked barley, and it continued to be present into the last phase, although it is not known how long it took this midden to form or its precise dating within the Norse period. Naked barley was also present in the Early and Late Norse samples from Smoo, although in small trace amounts, which may reflect the survival of a relict crop, perhaps growing as a weed within fields of hulled barley.

Shetland Sites:	Burland:				Soterberg:		Setters:
Cultivated Species:	**Mid-Late Iron Age**	**Pictish**	**Viking / Norse**	**Late / Post Norse**	**Pre-Norse (Iron Age)**	**Norse**	**Late / Post Norse?**
Barley: Hulled	Abund.	Abund.	Occ.	Occ.	Present	Occ.	None
Barley: Naked	Occ.	Freq.	Present	None	Present	Present	None
Barley: Indet.	Freq.	Abund.	Occ.	Occ.	Occ.	Occ.	None
Barley: Chaff	Present	Present	None	None	None	None	None
Oat: Grain	Present	Present	Present	Present	Present	Present	Present
Oat: Chaff	None	None	None	None	None	None	None
cf. Wheat	Present	None	None	None	None	None	None
Flax	None	Present	None	None	None	None	None
Wild and Other Resources:							
Peat	Occ.	Freq.	Present	Occ.	Freq.	Freq.	Freq.
Heather Stems	Abund.	Abund.	Present	Present	Freq.	Freq.	Occ.
Seaweed	None	Freq.	Present	Present	Occ.	Occ.	Present
Burnt Vesicular (dung or other?)	Present	Present	None	None	None	None	None
Burnt Vesicular (coal or other?)	None	None	None	None	None	Present	Occ.
Fish Bone	None	Present	None	None	Present	Present	Present
Mammal or other bone	Present	Present	None	None	Freq.	Freq.	Present
Scale:							
None = Absent							
Present = 1-20 Fossils							
Occ. = 21-100 Fossils							
Freq. = 101-1000 Fossils							
Abund. = 1000+ Fossils							

Table 45: Summary of the Presence of Main Resource Groups Identified from the Shetland Study Sites.

Mainland Scottish Sites:	Marymas Green, Caithness:				Geodha Smoo, Sutherland:	
	Prehistoric Agriculture	Pre-Norse	Norse	Norse	Norse	Norse
Cultivated Species:	Date Unknown	Pictish	Earlier Midden (E-C)	Later Midden (B-A)	Early Midden (770-1000 AD)	Late Midden (890-1160AD
Barley: Hulled	None	None	Present	None	Present	Present
Barley: Naked	None	Present	Present	Present	Present	Present
Barley: Indet.	Present	Present	Freq.	Present	Present	Present
Barley: Chaff	None	None	Present	None	Present	None
Oat: Grain	Present	Occ.	Freq.	Occ.	Present	Present
Oat: Chaff	None	Present	Occ.	None	None	Present
cf. Wheat	None	None	None	None	Present	None
Wild and Other Resources:						
Peat	Present	Freq.	Freq.	Freq.	Freq.	Occ.
Heather Stems	Present	Freq.	Freq.	Occ.	Abund.	Occ.
Seaweed	Present	Present	Present	Occ.	Present	Present
Burnt Vesicular (dung or other?)	None	Present	Present	None	None	None
Burnt Vesicular (coal or other?)	None	None	None	None	None	None
Fish Bone	None	Occ.	Freq.	Freq.	Freq.	Freq.
Mammal or other bone	Present	Occ.	Freq.	Occ.	Freq.	Present
Scale:						
None = Absent						
Present = 1-20 Fossils						
Occ. = 21-100 Fossils						
Freq. = 101-1000 Fossils						
Abund. = 1000+ Fossils						

Table 46: Summary of the Presence of the Main Resource Groups Identified from the Mainland Scottish Study Sites.

Fig. 50: Comparison of the Presence of Hulled Barley by Phase Across the Investigated Sites:

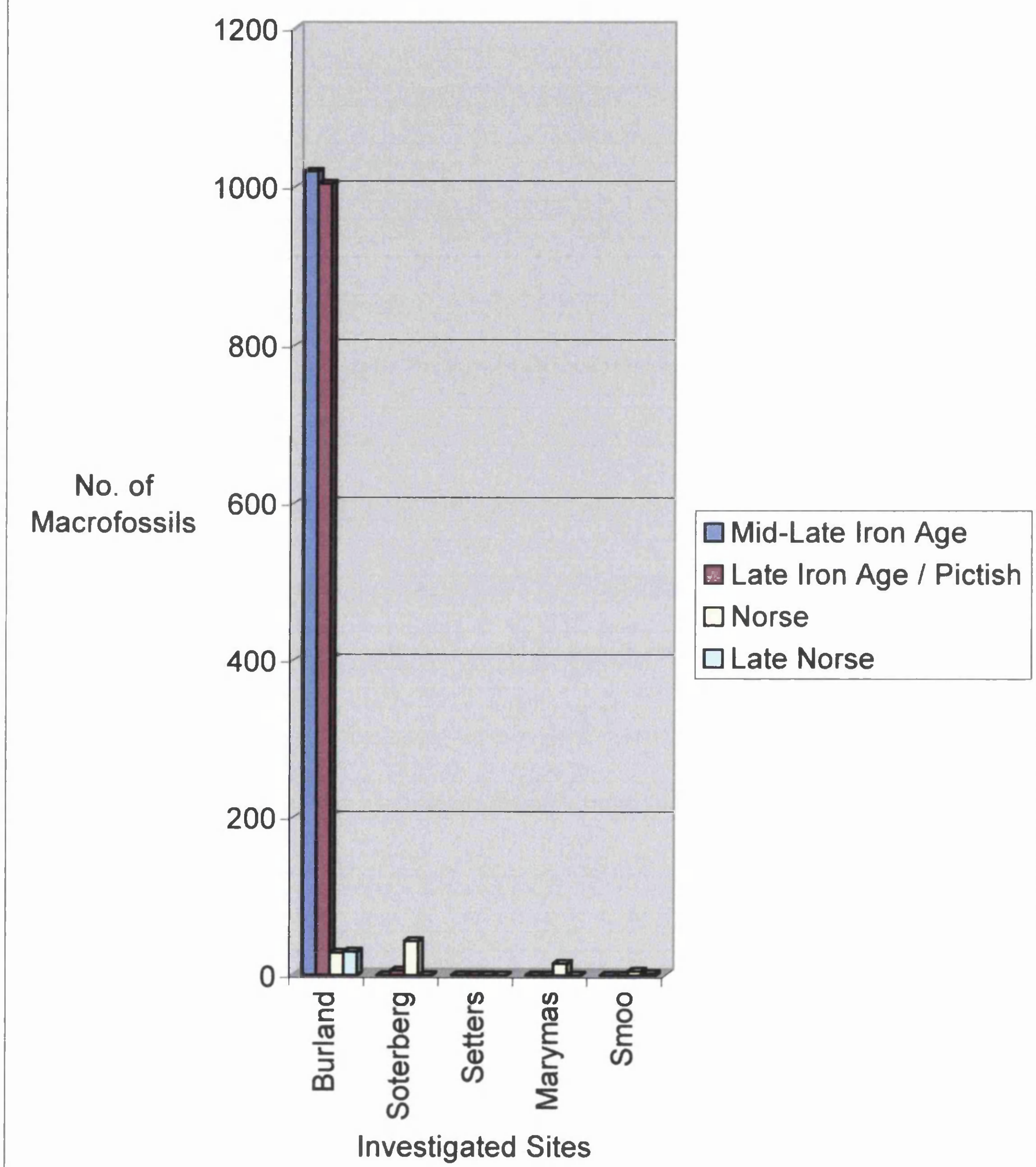


Fig. 51(a): Comparison of the Presence of Sandy Arable Indicators Across the Investigated Sites:

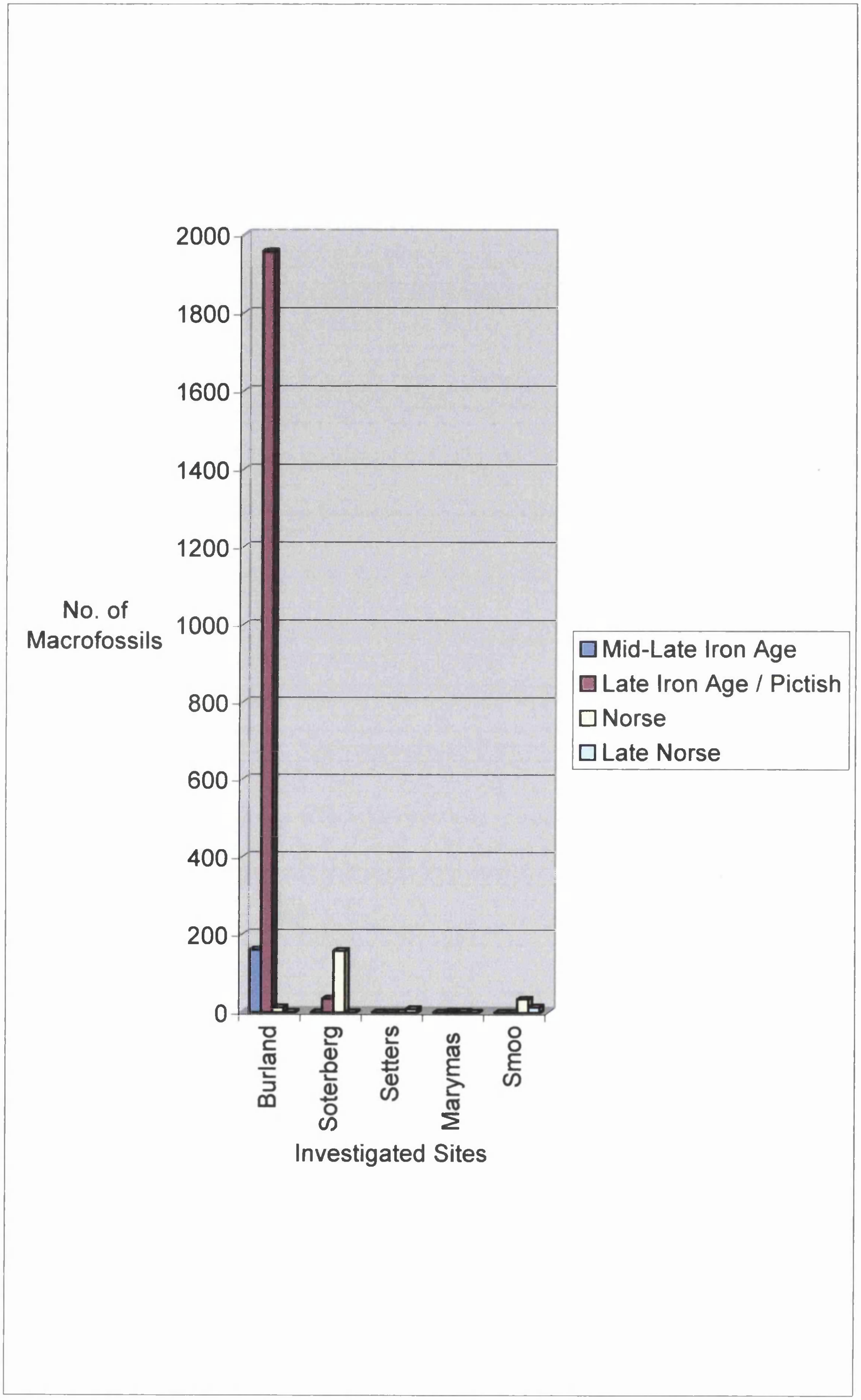


Fig. 51(b): Comparison of Sandy Arable Indicators (Burland Removed):

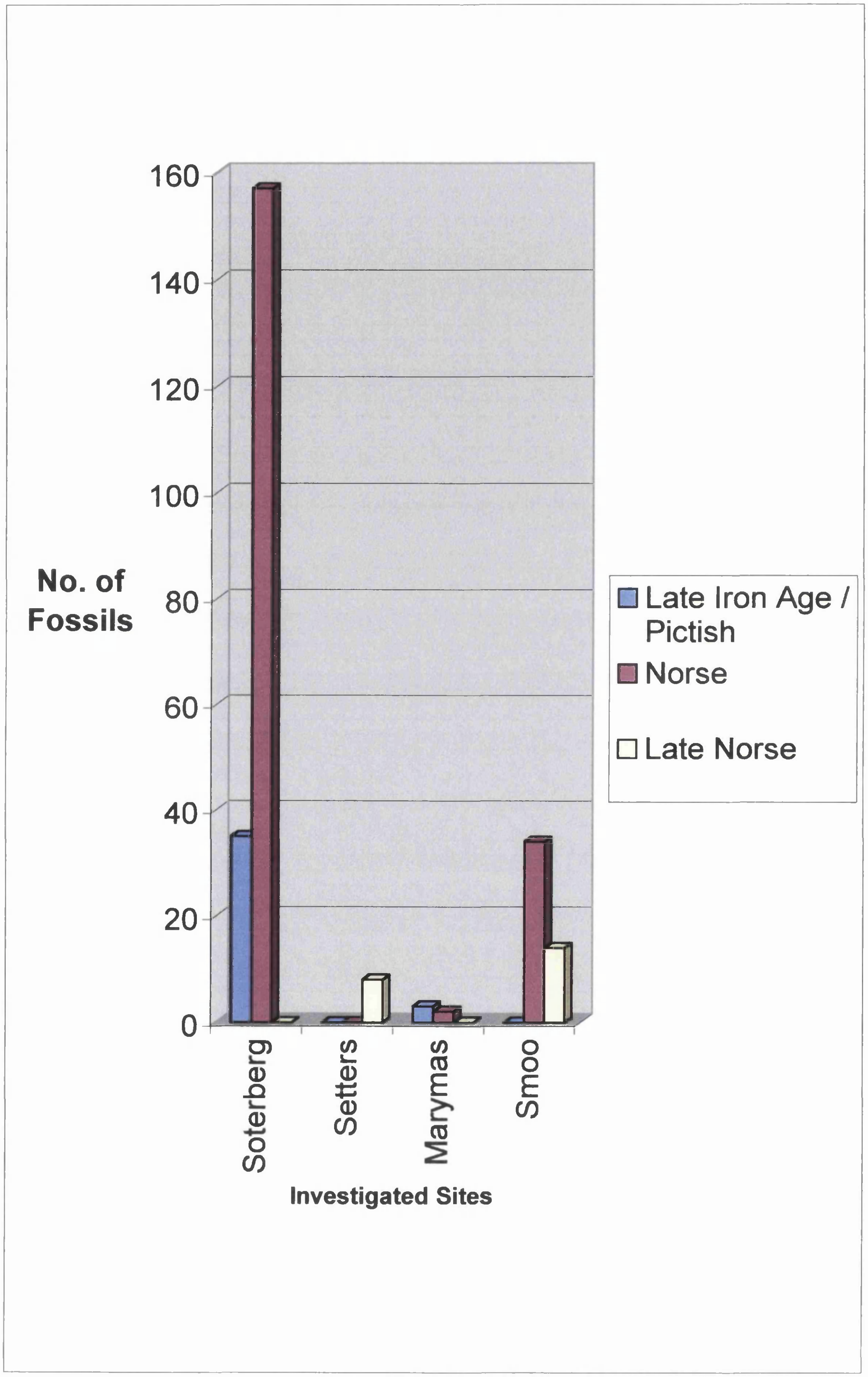
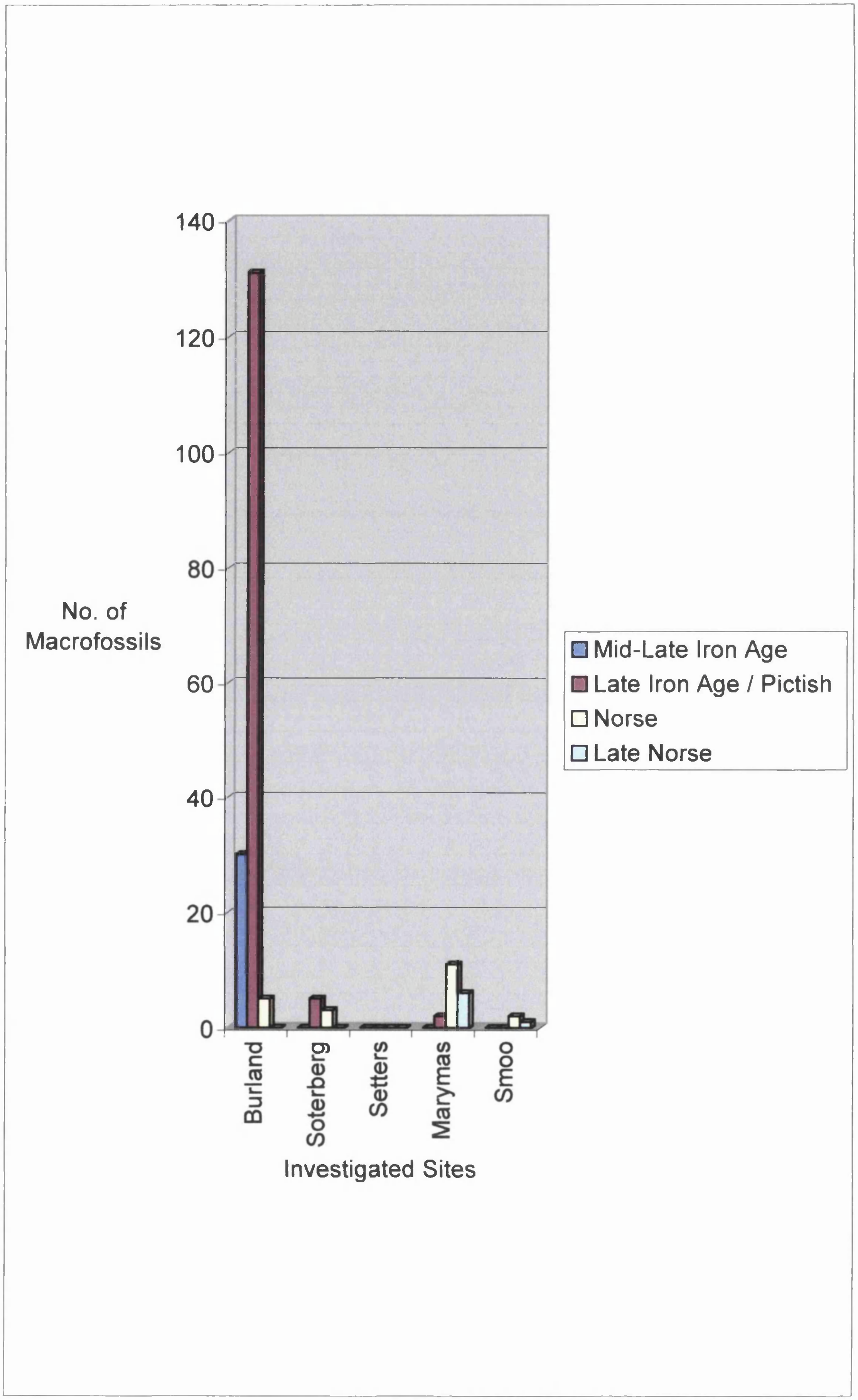


Fig. 52: Comparison of the Presence of Naked Barley by Phase Across the Investigated Sites:



Flax seeds were only recovered from the Pictish levels at Burland, and were not seen on any other of the studied sites. Flax is archaeobotanically a very rare find as a carbonised seed, due to the methods utilised in its processing (see chapter section 1.3.3). This plant requires good quality, usually fairly light and sandy arable ground for its cultivation (Bond and Hunter 1987). If this species was cultivated by the Pictish occupants of Burland it would have required both an investment in time and energy to grow and process, and would have taken up valuable space on arable land which could otherwise be used for barley cultivation (Bond 2002: 184). This will be further discussed in chapter section 8.2.3.

The number of oat grains recovered was similar on four of the five study sites (see **fig. 53**). Oat was the only cereal present at Setters, and given the lack of chaff, and presence of sandy arable indicator weeds, it may have come from more fertile areas of Unst, although it would have been equally at home on the rough marginal grasslands adjacent to the site. Oat was the most abundant cereal recorded from Soterberg and Smoo, and may have been grown for fodder. Both these sites could have utilised imported grain, as the weed suites suggested cereal grain was grown on more fertile light sandy soils than were immediately adjacent to the environs of these sites (see **fig. 51(b)**). Equally, more marginal areas may have been used for oat cultivation, with at least some of the Early Norse grain on Smoo probably originating from non-sandy arable land, although this group also included weeds of waste ground so it is difficult to be conclusive (see **fig. 54**). A slight rise in oat presence was visible in the Norse period remains from Burland, although in overall terms, oat cultivation appeared to be of very low importance to the occupants of this site.

The greatest change in oat presence was seen at Marymas Green, with a marked increase in the deposition of cultivated oat cereal grain and chaff occuring in the Norse midden. The overall trend towards a rise in oats seen at the study sites may reflect upon the increased requirement of fodder for animals. This could also suggest the expansion of agriculture onto areas more suited to oats than barley during the Norse period, with areas that were either too sandy for barley, or non-sandy arable ground being brought into cultivation (see **fig. 54**). Weed presence was very low from Marymas, with some species probably growing on waste / disturbed ground around the site. Therefore these species cannot readily be used to prove the ecological origins of the recovered grain.

Production of fodder and stalling / over-wintering of animals has implications for the whole agricultural economy, particularly requiring the adoption, or further intensification of a field management system, such as the infield, outfield, pasture system described by Fenton (1978). Certain elements of this, such as the infield, may already have been in place and undergoing intensification in the Iron Age for the cultivation of barley crops (e.g. Dockrill 2002, Simpson *et al* 1998). The precise timing of expansion into a wider agricultural system, although partly suggested by the removal of peat from upland areas for use in byres in the Late Iron Age (Guttmann 2001), requires further research in order to establish chronological patterns. However, in archaeobotanical terms the adoption of a manuring strategy may lead to visible depositional changes in the occurrence of re-cyclable plant material such as hay and dung indicators, and peat and seaweed fragments, around the settlement. The presence of indeterminate cereal stem fragments and mixed assemblages of cereals and low-growing weeds of cultivation could also indicate the reaping of cereal stalks for straw (e.g. Reynolds 1981) for use as byre fodder, and flooring / bedding for stalled animals. The occurence of these plant elements at the studied sites and how they can be related to arable / pastoral intensification will be further discussed in sections 8.1.3. and 8.2.

The research undertaken as part of this thesis has demonstrated the extent of the changes occuring in crop economics during the First Millennium AD, particularly with regard to new introductions and the farming strategies employed to maximise yields of economically important plants. The high recovery of hulled barley, particularly at Burland, during the Mid-Late Iron Age strongly suggested a central storage of grain, and the finding of wheat suggested strong trade links with southern regions of Britain. By the Late Iron Age / Pictish period this pattern had undergone a change with intensification of agriculture, taking in of new land for crops, and introduction of new species such as flax and attempts at growing relict species such as naked barley. This thesis has shown that metallworking played an integral part in the social control surrounding grain production and storage in the Mid-Late Iron Age. Perhaps the greatest reflection of change occuring in this relationship into the Late Iron Age / Pictish period is the multi-use of hearth activity areas for both metal production and cereal processing, with a far greater amount of weeds of cultivation found in the later deposits. The author would suggest that this implies movement away from the large scale storage economies and hierarchical power bases characteristic of the broch and immediate post-broch period and towards smaller scale family units with greater self reliance in the Pictish period. The structural evidence for single farmsteads, for instance at Buckquoy, Howe and at Burland also reflects this 'closing in' of society, probably with far greater independence from social ranking than had been seen in previous periods. Of course, whilst also growing crops for their own consumption the production of a tradeable surplus would have provided a useful form of wealth, particularly for exchange with southern neighbours for raw materials such as metal ore and charcoal. The implications of this will be further considered in 8.1.4.

8.1.3: Utilisation of Wild and Other Resources:

Tables 45 and **46** show the frequency of recovery of 'wild' or gathered plant remains and fish / animal bone, from the Shetland and mainland Scottish study sites. These two regional groupings will be discussed separately as the relative recovery of environmental material, such as burnt peat, seaweed, fish bone and marine shell varied greatly between the areas. In order to compare peat presence across the sites, a five-point frequency scale (see **table 45**) was used to standardise the data, and the results of this are presented in **fig. 55**.

On Shetland the evidence from the three sites indicated that peat was a major resource throughout the Pictish and Norse periods (see **fig. 55**). Burnt peat fragments were a regularly recovered feature at Burland, Trondra, being most frequently found in the Mid-Late Iron Age and Pictish levels. This may be as a result of the direct use of peat as fuel for domestic hearths, or as a form of charcoal for metalworking (see 8.1.4). The large quantities of heather stems recovered in these phases may be an indirect result of the burning of peat, or represent elements of structural remains, such as roofing or other features within the house. Peat may also have been used for flooring as suggested by Guttmann *et al* (2003) and this will be discussed in section 8.2. Peat and heather stems were also frequent occurences at Soterberg, and again relate to hearth features, with some of these deposits suggested as domestic processing / cooking areas by the presence of grain, others metalwork related from the recovery of slag. At Setters peat and coal-like material were recovered, suggesting that by the Post Norse period parts of Shetland were supplementing peat with alternative imported fuels (see chapter 7.5.6). Soterberg also produced occasional burnt coal-like residues from the upper deposits, and these may have originated from the later planticrub overlying the Norse house.

Seaweed recovery rose from zero in the Mid-Late Iron Age to extremely frequent in the Pictish phases at Burland. Possible burnt dung remains were present in both phases rising slightly in the Pictish. Seaweed continued to be present in the Norse phases at Burland and was also a frequent find at Soterberg and Setters. As discussed in section 8.1.2 this material may have resulted from intensification in arable agriculture in the Pictish period, with the fertilisation of light sandy base-rich arable fields in order to produce land viable for the production of barley crops for human consumption. Seaweed is a particularly good high nutrient fertiliser for very

Fig. 53: Comparison of the Presence of Oat Grains by Phase Across the Investigated Sites:

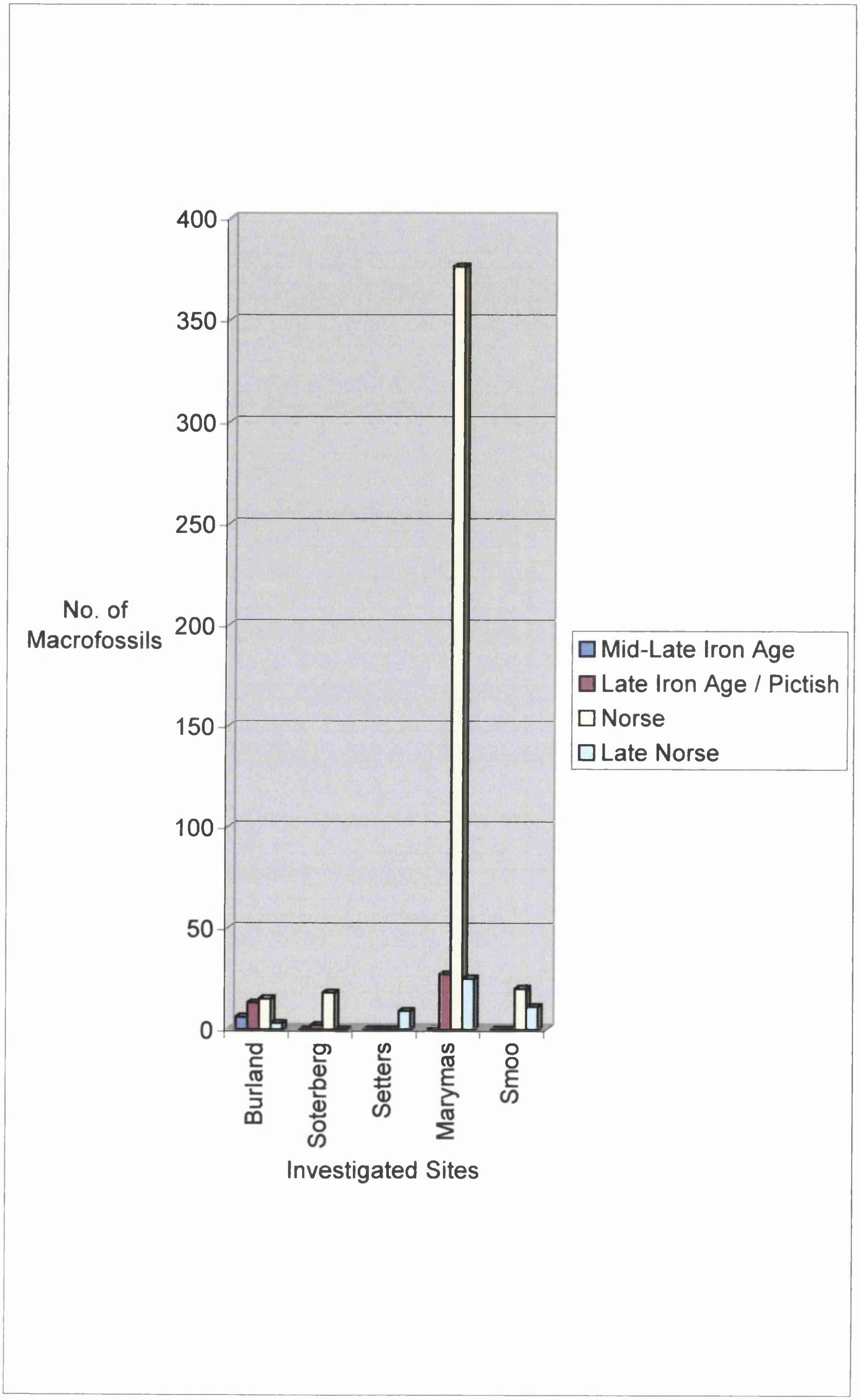


Fig. 54: Comparison of the Presence of Non-Sandy Arable Indicators Across the Investigated Sites:

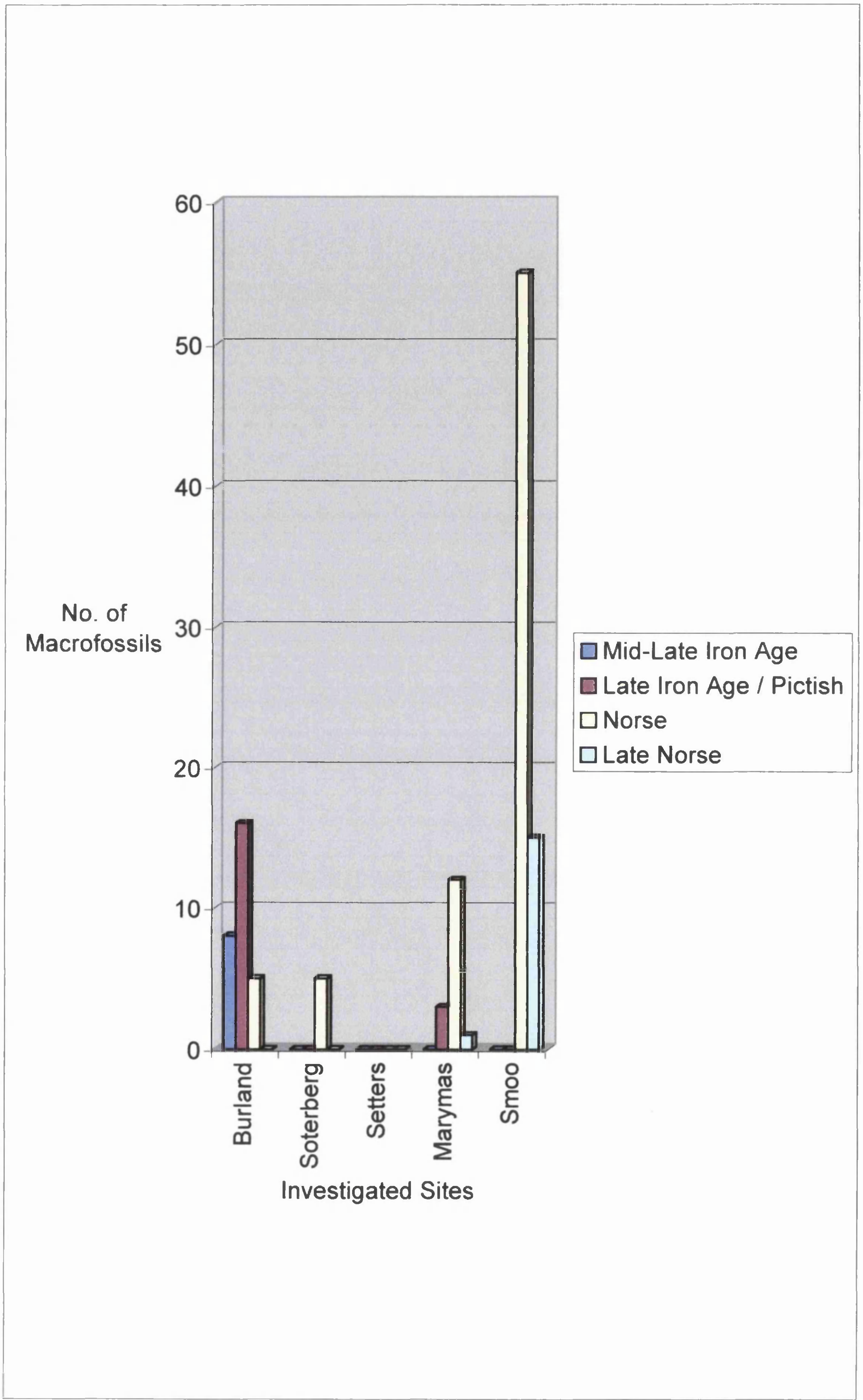
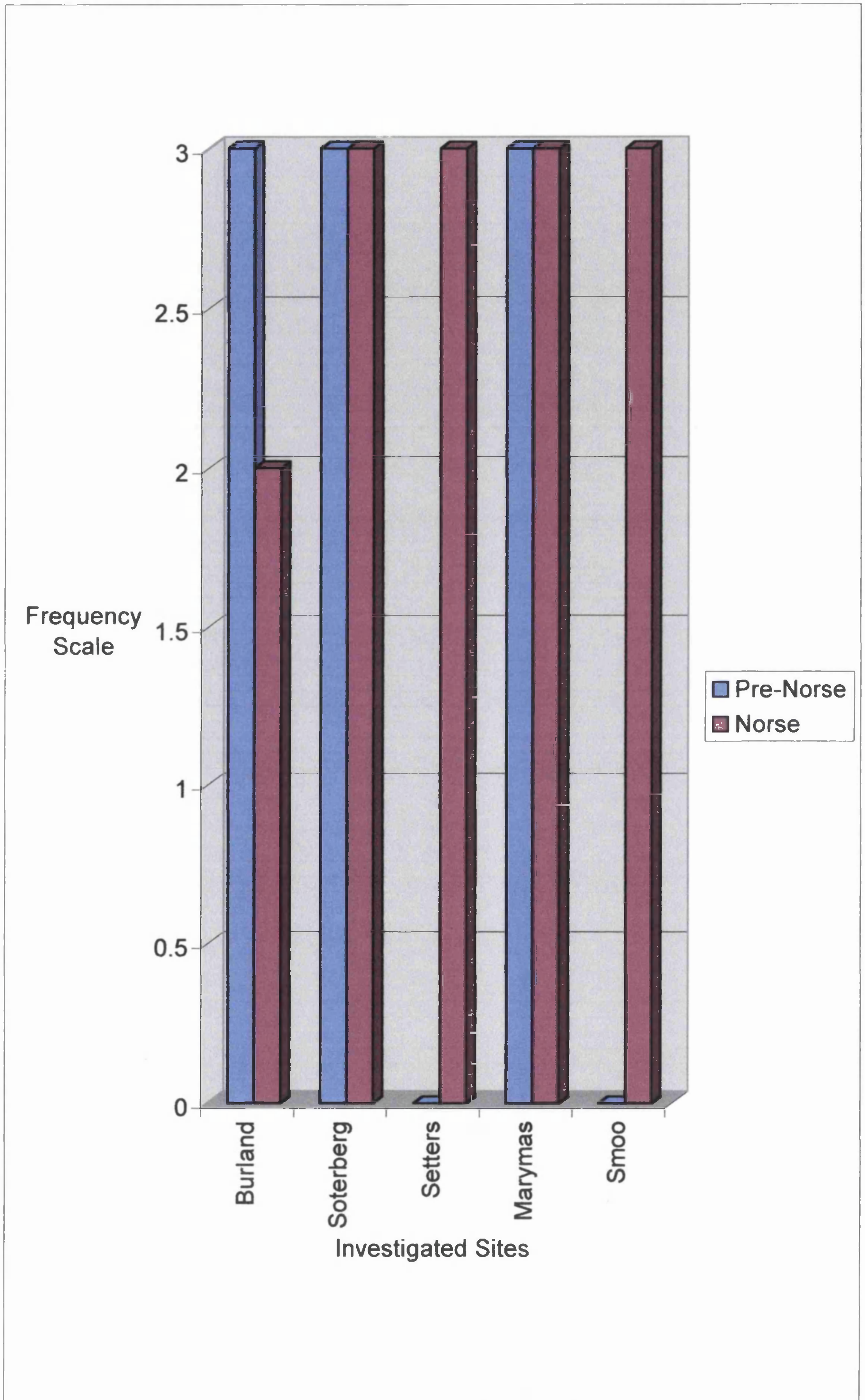


Fig. 55: Comparison of Peat Recovery based on a five-point frequency scale (see tables 45 and 46): (Note: Abundant category not present)



sandy soils, or marginal arable land (Fenton 1978, Baldwin 2000). The presence of large numbers of carbonised damp pasture and grassland indicator weeds (as well as a little pondweed) at Burland re-inforced the argument for manuring, as these may have originated from burnt animal dung or cut turf (e.g. Milles 1986: 120). Dry seaweed and dung could also be combined with waste from cereal processing activities and used as fuel, which may explain their presence on a predominantly metalworking site (see chapter sections 5.5.5 and section 8.1.4). The appearance of these materials on-site does probably not have a singular casual factor, but is linked in to the re-cycling of resources for many purposes. It should also be remembered that the Pictish Smithy at Burland was part of a larger settlement site, and as such would have used (and probably contributed to) midden material that was accumulated elsewhere around the farm.

Fish bone and mammal bone recovery were fairly negligible from the Shetland study sites, although Soterberg produced some very small burnt bone fragments which may represent cooking waste or fuel (see chapter 6.6.6). In contrast the Norse material from the mainland Scottish sites produced large quantities of fish bone and marine mollusc shell, probably as would be expected from sites classed as 'fish-middens'. Small amounts of peat and seaweed were also recovered from both Marymas Green and Smoo. Although when peat recovery was presented on a standardised frequency scale (see **fig. 55**) it demonstrated the dominant presence of this resource throughout the sampled material.

Seaweed and possible burnt dung were recovered in the pre-Norse phases at Marymas Green, and the appearance of seaweed in particular from early agricultural soils indicated the possible application of this material to arable fields. Pre-Norse contexts revealed evidence for animal husbandry in the form of cattle, sheep and pig bones. The presence of cattle in particular suggested that a regular supply of dung would have been available for use around the settlement. Interestingly, the presence of specimens belonging to both a neonatal and a juvenile cow, and the presence of pig, reflect similar economic recovery patterns to those seen at other Northern Isles sites (e.g. Bond 2002), although the recovery at Marymas was limited. Pastoral issues will be discussed further in section 8.2.3.

The largest change in deposition of environmental material from the mainland Scottish sites was seen in the later Norse midden phases at Marymas Green. Here a rapid increase in the presence of seaweed was concurrent with a drop in cereals and a large rise in fish bone. This formed an important indicator of economic change occuring at this site, probably in the Late Norse period. A high abundance of seaweed on the midden meant that this material had not been put to use on agricultural fields, although it had been burnt, perhaps to produce ashes for lye manufacture (e.g. Fenton 1978, C. Dickson 1999a). The concurrent drop in cereals and rise in fish bone suggested that arable agriculture in this area had probably largely been replaced by the requirements of the fishing trade. Indeed, the lack of weeds of cultivation and chaff throughout the midden could suggest that most of the cereal produce was traded from elsewhere. The production of cereal grain was probably heavily linked into the trade and exchange networks of the fishing industry, especially by the Late Norse period (J. H. Barrett 1995) and the results of research presented here reflect this.

The Smoo deposits were essentially dumped midden material, and as such contained a mixture of waste material which one might expect to have come from a nearby farm environment, such as cereal processing waste, animal bone and so forth. Changes were visible however between the Early Norse dated parts of the midden and the later Norse deposits, in quantities of peat, charcoal and cereal grain recovered. Chapter 4.5.4 suggested that the presence of peat, charcoal and slag in the early period at Smoo may reflect temporary fires, with brief stopovers by sailors who used fuel for heat and to assist boat repairs. Subsequent (although still fairly early) Norse deposits showed increases in cereal grain and in the use of wet-fen material for fuel (suggested by macrofossil finds). This may suggest a more regular Norse presence, probably involving occupation of this area by later periods. A brief analysis of the marine shell and fish bone from Smoo was carried out by Cerron-Carrasco (1996a and b). She concluded that most of the marine shell probably represented food remains, but some of the shellfish, such as limpet and periwinkle, could have been used as fishing bait. The fish bone analysed included inshore species such as saithe and pollack and deep-water fish, such as cod, ling and haddock. This bone lacked the cut-marks associated with stockfish production, and Cerron-Carrasco (1996b) concluded that fish were caught for local consumption, rather than preserving. Given the radiocarbon dating evidence from Smoo, which is mainly Early Norse, these data are concurrent with an economy seeking to support itself on a local scale, perhaps supplemented later by grain and other goods transported over short distances.

Identification and quantification of fragments of peat, burnt vesicular remains and seaweed is often overlooked during archaeobotanical analysis, usually due to a combination of large quantities being present and the samples being sorted by non-archaeobotanically trained technicians or students who do not recognise the diagnostic elements. The research undertaken for this thesis has demonstrated the importance of these catagories of remains in providing a full picture of wild resource use in the study areas, of particular value in regions with little natural woodland resources. Identification of peat, dung and seaweed has enabled the author to conclude that these elements formed valuable, collectable and recyclable resources throughout the Iron Age and Norse periods in Northern Britain. The thesis has shown that wild plants and their by-products (such as dung) were often used many times around the farm, and the interpretation of archaeological layers as flooring, byre material, midden material and so forth should be made with caution. In particular the presence of dung which may reflect middened byre material, but was also found carbonised on metallworking hearths, suggesting its use as not only fertiliser but also fuel.

8.1.4: Charcoal and Other Fuel Sources:

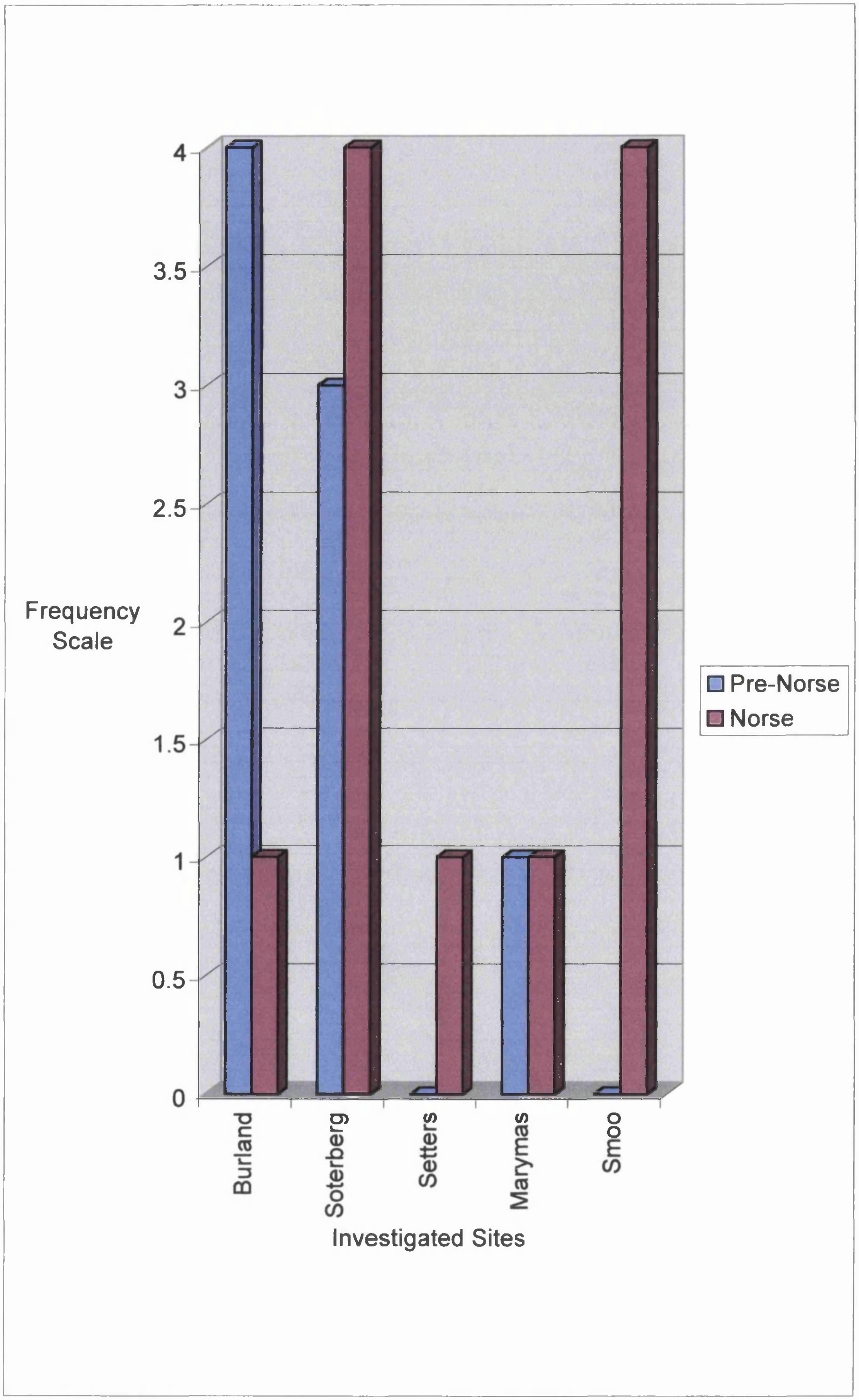
Charcoal recovered from the five study sites was divided into a five-point abundancy scale and is presented in **table 47**. This is presented in conjunction with metalworking waste for comparative purposes. This material has been split on a pre-Norse / Norse basis, based upon the available dating evidence, in order to present these data as simply as possible. Temporal divisions for the presentation of charcoal have not been as closely refined as those for the previous catagories of remains discussed in 8.1.2 and 8.1.3. This is mainly because the levels of recorded charcoal were overall quite low, and it is also probably better for discussion purposes to examine changes in woodland use across broader time periods. More closely defined discussions of species presence by phase is presented in the individual site chapters. Charcoal recovery was also presented in histogram form in **fig. 56**, based on **table 47**. Indeterminate wood was not included in these calculations.

The greatest amount and variety of coniferous type wood charcoal came from the Shetland sites, and most of this probably originated in the islands as driftwood. The presence of driftwood in the Northern Isles has been documented by J. Dickson (1992) and previously discussed in chapter 1.4.2.2. It is perhaps most surprising that more coniferous wood was not recovered from the mainland Scottish sites, given that both sites were adjacent to shores with strong tidal currents. The Scots pine recovered from Geodha Smoo could have been driftwood or growing further south from the site. Deciduous wood species such as *Quercus* (oak) may have been imported to Shetland. This species was certainly present in the pre-Norse phases at Burland, and the pre-Norse and Norse period at Soterberg, and on both these sites its presence may have been associated with metalworking activity.

Shetland and Mainland Scottish Sites:	**Burland:**		**Soterberg:**		**Setters:**	**Marymas Green:**		**Geodha Smoo:**	
Wood Charcoal Recovery:	**Pre-Norse**	**Norse**	**Pre-Norse**	**Norse**	**Norse**	**Pre-Norse**	**Norse (Late?)**	**Early Norse**	**Late Norse**
Larix (Larch)	None	None	Present	None	None	None	None	None	None
Picea (Spruce)	None	None	Present	Present	None	None	None	None	None
Larix / Picea (Larch / Spruce)	Present	None	None	None	None	None	None	None	None
Pinus sylvestris (Scots pine)	Occ.	Present	Present	Present	Present	None	None	Present	Present
Coniferous Type	Present	None	Present	Occ.	Present	None	None	Present	None
Ulmus (Elm)	None	None	None	None	None	None	None	Present	None
Quercus (Oak)	Present	None	Present	Present	None	None	None	Present	None
Betula (Birch)	None	None	Present	Present	None	Present	Present	Abund.	Occ.
Alnus (Alder)	Present	None	None	Present	None	None	Present	Freq.	Present
Corylus (Hazel)	Occ.	None	Present	Present	Present	None	Present	Freq.	None
Salix (Willow)	None	None	Present	Present	None	None	None	Occ.	Present
Prunus spinosa (Blackthorn)	None	None	Present	None	None	None	None	Present	None
Metalworking Waste:									
Slag	Abund.	Present	Present	Present	Occ.	Abund.	Occ.	Abund.	None
Scale: (Based on no. of fragments)									
None = Absent									
Present = 1-10									
Occ. = 11-25									
Freq. = 26-50									
Abund. = 50+									

Table 47: Summary of the Presence of Wood Charcoal and Industrial Waste on all Study Sites.

Fig. 56: Comparison of Charcoal Recovery (Identified Species Only) based on a five-point frequency scale (see table 47):



The most commonly recovered wood species from the sites came from open scrub woodland environments. In Shetland the island of Unst appeared to have offered greater opportunities for the growth of a variety of scrub (probably dwarf) species, including hazel, birch, alder, and willow, most likely in sheltered locations. The island of Trondra appeared to offer few of these species to the occupants of Burland, with mostly alder, hazel and (probably not local) oak used for fuel. By analogy with pollen evidence it is highly probable that the woodland resource was greatly reduced by the Iron Age, with fewer species and generally less wood available (Butler 1999). It is also possible that early metalworking activities used up most of the scarce resources that were available (e.g. C. Dickson 2000: 43), resulting in the utilisation of alternative fuels such as peat charcoal and dung. Certainly the presence of coniferous driftwood suggested that on Trondra at least, the inhabitants were fairly opportunistic – when wood was available it was used on metalworking hearths, when it was not alternative fuels were obtained. **Fig. 56** showed a drop in the occurrence of charcoal at Burland in the Norse period, compared to pre-Norse deposits. This probably reflects more on the activities taking place at the site than on actual woodland representation on Trondra (with most of the pre-Norse wood probably arriving as driftwood), and re-inforces the suggestion that the charcoal recovered from the pre-Norse was primarily targetted for metalworking.

At Marymas Green a supply of birch charcoal was found in the pre-Norse period together with slag remains. No other species were recovered at this time. Birch, together with oak both produce particularly good 'hard' charcoals for metalworking, as they do not readily crumble under pressure in the furnace (Tylecote 1986: 225). This suggested some degree of metalworking (maybe smithing) occuring at Marymas Green during the Pictish period, but it is impossible to say to what extent given the limited nature of the excavation – certainly nothing resembling a hearth place was discovered.

Alternative fuel stuffs such as peat and dung for domestic and metalworking purposes have already been discussed in section 8.1.3. Identification of burnt peat can be relatively straightforward provided the general characteristics, such as plant material, are present (see chapter 2.2.4.4). However, recognition of gross morphological features of other burnt products, such as vesicular and non-vesicular amorphous material, may be problematic, resulting in it being broadly catagorised as 'dung or other' and 'coal or other' by the author (discussed in section 2.2.4.4 and further below in 8.4.1). However, other more specific ecological indications can be gained from the identification of seeds. Division of the weed seeds into major ecological indicator categories has suggested the presence of damp pasture and grassland species in the Pictish period at Burland, which most likely originated in animal dung mixed with hay from the byre floor. These seeds most likely became carbonised when animal dung, along with straw and turf products such as flooring was burnt as fuel.

The collection of wetter fen-turf for use as fuel would be more likely to carbonise seeds of wetland species, and this was seen in the later Norse deposits at Geodha Smoo. Fuel cutting operations on drier heathy areas was suggested by heathland species present in the assemblages at Burland and in the early stages at Smoo, but these resources could also have been used for construction purposes. Turf may also have been cut from uncultivated land and used in combination with seaweed and animal dung in a plaggen system of agriculture (Simpson 1997, Davidson and Carter 1998, Guttmann 2001) and this will be discussed further in section 8.2.

In conclusion, this research has shown changes in the woodland resources in use for smelting / smithing and construction purposes occuring between the Late Iron Age / Pictish periods and the Norse period. The use of imported species was strongly suggested, particularly oak which probably came from the north west coast of Scotland, perhaps as far south as Argyll, and probably also Scots pine. This species may even have arrived as ready made charcoal in order to decrease the bulk of large timbers requiring transportation via sea routes. This north – south movement of raw materials was likely to have also included metal rich ores and indeed the transport of charcoal and metal ore may have occurred together. In return it may be possible to envisage trade in prestige metal objects, steatite and perhaps even salt during the Pictish period (although further research would be necessary to confirm the latter two items). Trade and exchange in these items would also have reinforced social relationships and placed the Northern Isles strongly within the larger dominance of the Pictish Kingdom. By the Norse period however the study sites show that this has completely changed, and trade movement has taken on a decided east – west flavour. In fact the use of wood charcoal appears to have completely vanished, although small amounts of slag and a little driftwood are recovered. The Norse dominance of this region and different trade interests (such as fishing produce) effectively destroyed the existing resource network and the social contacts and relationships that accompanied it.

8.2: Comparison of the Research to Other Economic and Environmental Studies in Northern Scotland and the Northern Isles:

8.2.1: Overview:

In this section the relationship between the study sites and other research that has been conducted in northern mainland Scotland and the Northern Isles on first millennium AD sites, will be discussed. The major themes raised in the introduction (chapter 1) will be used to cross reference the conclusions drawn from the study sites. The five study sites encompassed a broad temporal range, from the Mid-Late Iron Age to the Late / Post Norse period. Only one site, Burland, produced a continuous sequence broadly covering the whole of this period. Marymas Green produced evidence for early agriculture, 8th century occupation, and 12th- 14th century midden remains. Geodha Smoo produced radiocarbon dated evidence for

Early Norse contact, and possibly slightly later occupation. Soterberg was undated but excavation revealed extensive pre-Norse deposits with Iron Age pottery, and a subsequent Norse settlement. Setters has phasing problems but is most likely Late / Post Norse. Some of the sites therefore, for instance Geodha Smoo, provided a small closely dated window of events, whereas others such as Marymas Green, span broader time periods. A chronological comparison of the five study sites was provided in **table 48**.

The events recorded in the environmental data recovered from the study sites cover a period of significant economic change, from subsistence farming economies to settlements that were most likely involved in large scale long-distance trade and exchange networks, such as the stockfish industry. As previously listed in section 8.1.1, key elements in this change involved an intensification in agriculture and manuring practices, the expansion of a pastoral / dairying economy, and the development of the fishing industry. In the following sections the discussion has been divided by period to enable a closer analysis of the position the study sites hold amongst the current literature.

8.2.2: Mid-Late Iron Age:

The importance of barley as a stored resource, and hence 'bankable –wealth' during the 'broch period' of the Iron Age has been suggested by Dockrill based upon research at Old Scatness, Shetland (2002: 153). The storage of barley in a central location such as a broch may imply a power-base from where an elite managed agricultural practices in order to maintain high crop yields, in addition to controlling other activities such as metalworking (Dockrill 2002: 162). Bond (1994a) indicated that heavy manuring of barley fields could produce very high yields. Similarly C. Dickson's (1994) work at Howe, Orkney revealed evidence for a mixed arable and pastoral agriculture, growing hulled six-row and lesser amounts of naked barley into the Mid-Late Iron Age, with remains of burnt animal dung and

Table 48: Dating and Phasing Chronology for the Five Study Sites: (approximate dates are given as dotted lines):

Date:	Period:	Study Sites:
1000BC	Late Bronze Age	
700BC	Early Iron Age	Marymas; Burland P1
300BC		
200BC		
	Middle Iron Age	
AD0		
AD200	Mid-Late Iron Age	Burland P2; Burland P3
AD400	Late Iron Age / Pictish	
AD600	Late Iron Age / (Pictish / Norse Interface)	Marymas; Burland P4; Soterberg T2x
AD800	Viking / Early Norse	Burland P5
AD1000		Smoo
AD1100	Late Norse	Soterberg T1,2,3; Marymas; Setters
AD1500	Post Norse / Post Medieval Crofting	
AD1700	Highland Clearances	Burland P6
AD1800	Industrial	Soterberg Planticrub
AD1900	Industrial	
AD2000	Computer / Technological	

straw probably indicating manuring practices. Both naked and hulled barley species were seen by Boardman (1998: 158), throughout the Iron Age phases at St. Boniface Kirk, Papa Westray. In addition extremely large amounts of naked barley have been found in the Late Iron Age / Pictish structures excavated at Minehowe, Orkney, although hulled barley was also present (Alldritt, forthcoming). Research of this nature had not been carried out on Trondra, Shetland until the excavations at Burland. Analysis of the Mid-Late Iron Age phases suggested the presence of large quantities of hulled six-row barley, with lesser amounts of naked barley present. The remains from Burland therefore fit the general pattern of cereal species recovery seen at other sites in Orkney and Shetland with Mid-Late Iron Age phases. It would appear from the current literature that naked barley continued to be grown into the middle to later Iron Age in the Northern Isles, but by the Pictish period in some areas had largely been overtaken by oat cultivation (see below 8.2.3).

The Mid-Late Iron Age phases at Burland may represent ancilliary or 'extra-mural' style buildings for the nearby broch of Burland, or may slightly post-date the broch's use, although radiocarbon dating would be needed to confirm the exact sequence of events. In chapter section 1.2.2. the difficulty of providing a chronology for the Iron Age, traditionally reliant upon separating post-broch and extra-mural style structures based upon building typology and finds was highlighted (e.g. Hunter 2002: 129, 1997: 249). Of particular difficulty are the structures of the Late Iron Age, with a confusion of wheelhouses, figure of eight and other amorphous features. In this respect it is essential to reflect upon Armit's (2002: 15) comment regarding social and cultural variations in the importance of these structures on local and regional scales. At Burland the archaeological evidence certainly suggested that the excavated structures were involved in metalworking, and other activities such as cooking probably also occured here. The dominance of hulled barley, mostly clean grain, in the early Burland assemblage indicated that this settlement might have maintained a wide sphere of influence on the island of Trondra, and acted as a central grain store for the island's farmers. Trade routes via the sea with other localities should not be forgotten (e.g. Ballin Smith 2002: 174), and some of the grain at Burland, for instance the wheat (which is only present in this phase) was most likely traded from further south. Trace quantities of wheat were also found at Freswick Links, Caithness (Huntley 1995a) although this was thought to reflect Norse trading contacts. Research undertaken for this thesis has demonstrated that movement of both raw resources and processed cereal grain was occuring in parts of Northern Britain prior to Norse arrival.

The use of plaggen soils in the Middle or Late Iron Age has been suggested at Old Scatness from the work of Simpson *et al* (1998), and further developed by Guttmann (2001) and Guttmann *et al* (2003). The plaggen system of agriculture involves the use of organic manures, such as animal manure mixed with hay from byre floors. In this respect the flow chart for movement of resources around a Norse farm produced by Buckland *et al* (1993) could be adopted for the Mid-Late Iron Age, although it would be important to add in both metalworking and charcoal / wood resources to this picture. The burnt animal dung found at Howe, by C. Dickson (1994) could suggest the stalling of animals indoors. This has also been suggested as a possible reason for compacted organic floor material that had accumulated at Scalloway (Sharples 1998). Guttmann *et al* (2003) proposed a 'proto-plaggen' system for the Late Iron Age, whereby flooring was re-used as fertiliser, together with animal manure and domestic waste. Early agricultural soils sampled at Marymas Green produced evidence for manuring with midden material, including seaweed, and although not radiocarbon dated, these layers are pre-Norse deposits. At Burland very small amounts of dung and straw were recovered from the Mid-Late Iron Age phases so it is difficult to conclude that these practices were occuring on this site early in this period. However, by the Late Iron Age / Pictish phase large increases were seen in possible manuring materials, and this will be discussed below.

8.2.3: Late Iron Age / Pictish Period:

Oat crops appear to become more important during the later Iron Age / Pictish period at a number of sites in the Northern Isles. This was seen at Howe (C. Dickson 1994), Scalloway (Holden and Boardman 1998) and Pool (Bond 1994a), and has also been proposed for Old Scatness (Bond 2002: 183). Oats were present in the Pictish phases at Burland and Marymas Green, together with some possible straw fragments, although in small amounts only. The presence of this crop may suggest an increased requirement for fodder for animals, in addition to suggesting that land not as suitable for barley was being brought into cultivated (Bond 2002: 183). Low-growing weeds of cultivation, present in abundance at Burland, also indicated that cereal crops were harvested low on the straw, perhaps as a necessity to produce sufficient fodder for over-wintering of animals. Oats may have been grown in the outfield part of a settlement, and might only have been manured with dung if there was spare (Dickson and Dickson 2000: 233).

Hulled barley continued to be the main crop in evidence at Burland, although naked barley also increased at this time, and this could indicate an attempt to re-introduce this species as a viable cereal crop. The continued abundance of hulled barley into the Pictish period and the rise in sandy arable weeds, suggests the use of manuring regimes to keep yields high on Trondra. Species of damp pasture, remains of seaweed and possible dung, and evidence for straw increased during this period and may reflect agricultural intensification and management of the infield. The presence of these macrofossils could be linked to the manuring practices discussed in section 8.2.2, in addition to the optimization of resources discussed in section 1.5.1. with these elements probably re-cycled in a number of locations around the settlement (e.g. Buckland *et al* 1993). This shift in agricultural practice may reflect changes in the wider political and economic power base, with movement away from the storage economics of the Mid-Late Iron Age (see section

8.2.2) toward a more locally based agricultural system, based upon intensive infield manuring to maximise barley production.

Flax may also have been introduced to Trondra at this period, although traditionally associated with Norse agricultural intensification (e.g. Bond and Hunter 1987, Bond 1998b), more recent studies have revealed its presence in Pictish dated layers, for instance, at Howe (C. Dickson 1994) and Scalloway (Holden and Boardman 1998). Flax seeds are rich in protein and this plant could have been used to supplement animal or human diets, in addition to its more traditional uses for oil and fibre (Bond and Hunter 1987, Bell and C. Dickson 1989). The presence of flax could suggest the need to expand onto new arable land, and the intensification in production of manures that this would imply. However, recovery of flax from Pictish contexts could also suggest Early Norse trading contact (e.g. Dickson and Dickson 2000) and the beginings of early east – west trading patterns, although flax has been found in earlier Iron Age deposits, such as at Warebeth broch (Bell and C. Dickson 1989). The amounts recorded from Burland were very small, so it is difficult to assess the impact of this species, but when compared to other published sites, recovery of carbonised flax from archaeobotanical samples is generally quite low (see chapter sections 1.3.3. and 8.1.2).

Animal husbandry practices, such as stalling of animals in byres would have produced a ready supply of manure for the infield (e.g. Guttmann 2003), and intensification in arable manuring practices may in turn reflect an economy involved in increased production of pastoral products. The recognition of a high mortality rate in young calves in the Late Iron Age / Early Norse period has suggested an intensification in dairying practice at this time (Bond 1998b, J. H. Barrett *et al* 2000). Although McCormick (1992) has indicated that the culling of very young cattle would prevent lactation in the herd stock, and Halstead (1998) further argued that the importance of cattle as a meat source in prehistory should not be ignored. The dairying debate has not yet been resolved amongst animal bone specialists (Richarson pers. comm.) and Bond (2002: 181) concluded that the simplest explanation for the high numbers of young calves on settlement sites in the Northern and Western Isles was that they were a by-product of milk production. Elements of this form of pastoral management may have been in place earlier in the Iron Age (Bond 2002: 179). However, it would appear that expansion in production and subsequent trade or tax payments in dairy produce (such as butter) are associated with later Norse developments (J. H. Barrett *et al* 2000: 23). High recovery of pig bone was seen in the Late Iron Age at Pool (Bond 1994a), Howe (C. Smith 1994) and Scalloway (O'Sullivan 1998). This animal would have represented a fast-return meat product, which could have been fed on scraps from around a farmstead. However, it would be difficult to attribute the rise in pig bone recovery to increasing social status in the Late Iron Age without further research (Bond 2002: 181).

Together with intensification in arable agriculture, an increase in metalworking activity was seen in the Pictish phases at Burland. Multi-purpose usage of the Pictish activity area was indicated by the presence of rotary quernstones, and this suggested that domestic activities such as cereal grinding, in addition to metalworking, were occuring around the hearthplaces. Corn drying activities were suggested by the presence of hearth places / flues together with an adjacent quernstone and dense concentrations of carbonised barley, heather and peat (having parallels with features at St. Boniface Kirk (Lowe 1998: 117)). Similar evidence from excavations at Howe indicated a number of domestic and craftworking activities were taking place within a central space during the later phases (Ballin Smith 1994: 77). Smithing of iron produces two important residues – slag and hammerscale (McDonnell 1998: 154), both of which were in abundance in the hearth deposits at Burland. Further specialist analysis of these deposits is required before proof of smelting at the site can be ascertained, and indeed to confirm whether the building was used as a full time smithy or for occasional metalworking (e.g. McDonnell 1998: 158). Certainly the evidence from the plant remains and artefactual recovery suggested a number of activities taking place within the Late Iron Age building, although metalworking debris and fuel ash remains dominated the excavated archaeological assemblage. McDonnell (1998: 160) has suggested that the presence of ironworking in 'villages' close to the core of a settlement (such as at Howe and Old Scatness), indicates the high social status of the smith. Indeed, the items of portable wealth produced by the smithy were probably strongly linked to gift exchange or trade, and the centralisation of economic resources during the Mid-Late Iron Age (e.g. Dockrill 1998, Dockrill 2002: 160-161).

The identification of fuel resources is an important area of study in Northern Isles archaeology (McDonnell 1998, Church and Peters *in press*, Peters *et al* in press). Research from the study sites presented in this thesis has shown the overall importance of peat as a fuel during the Late Iron Age and Norse periods (e.g. **fig. 55**). However, alternative sources of fuel were also identified by these studies, utilising comparative data from the ethnographic sources discussed in section 1.5 (e.g. Fenton 1978, Firth 1974). Dung recovered from Burland had been burnt, and it was suggested (chapter 5 and chapter 8.1.3) that this was probably as a further supplementary fuel to charcoal for use in metalworking hearths. This differs from C. Dickson's (1994: 127) interpretation of the dung from Howe, which she proposed would have been too valuable a part of the agricultural system to have been used anywhere else other than on arable crops. However, Howe produced over 1000 grammes of willow charcoal from the smelting hearths, whereas at Burland the occupants did not have the luxury of such resources. Indeed, although coniferous charcoal was used when available, the overall picture is one of peat being used as the main source of metalworking fuel at Burland. Wood and peat were probably supplemented to a certain extent with material such as dung, cereal processing waste and seaweed, taken from middens or hearth sweepings elsewhere on the farm. Peat was also the main fuel recovered from hearth areas associated with grain drying.

8.2.4: Early Norse / Norse Period:

Early Norse settlement appears to have focused on prime locations near the sea, with coastal access to resources and communications a neccesity, but fertile land for agriculture and pasture for grazing animals was also important (Small 1969, Crawford 1987, Bigelow 1992). Re-use of settlement mounds by Viking and Late Norse populations has been documented by Batey (2002), and has in part contributed to the 'farm mound' phenomenon that is visible in parts of Orkney and Shetland (Davidson *et al* 1983, Bertelson and Lamb 1993). Pictish multicellular buildings at Old Scatness were also infilled with Norse midden material (Dockrill 1998). The partially excavated Viking / Norse house at Burland was located adjacent to the Pictish smithy and this location may have been chosen as a means of assuming control over Pictish metalworking activities, in addition to controling farmland that had proven viable throughout the Late Iron Age. Radiocarbon dating of these features will enable a closer distinction between periods of use to be made. Early Norse settlers seem to have continued crop regimes that had been successful for millennia, with the only major change appearing to be an intensification in the cultivation of flax in Orkney and Shetland (Bond 1998b).

The lack of early Norse sites on the north mainland coast of Scotland means that studies of the interactions between Pictish and Norse populations are not as advanced as in Orkney and Shetland (Batey 1991). Huntley (1995a) undertook an important study on the Late Pictish to Norse deposits from Freswick Links, Caithness, and found no significant changes in the presence of six-row hulled barley and oats over this time scale. Geodha Smoo provided an important radiocarbon dated sequence of events which cover the Early Norse period in Sutherland, but a recognisably distinct Pictish element could not be identified in these features. The publication of work from nearby Sangobeg may prove more enlightening for the interface period (Miller and Ramsay forthcoming). However, Smoo did indicate that early contact may have been initially in the form of brief stopovers, followed later by use of local peat and heathland resources and the probable supplementation of locally grown produce with transported cereal crops. J. H. Barrett *et al* (2000) have suggested that market trade was well established in the Viking Age, but that long range trade in staple goods such as cereals (perhaps including wheat) and fish probably did not develop fully until later periods (see 8.2.5 below). The research presented in this thesis suggests elements of this early trade occuring in the Mid-Late Iron Age, although reinforcement of social relationships may have been a greater incentive to movement of goods than strictly market forces. However, as in modern times, conspicuous consumption of prestige goods could be considered a high motivating factor in shipping overseas.

8.2.5: Late / Post Norse Period:

On both Early and Late Norse period sites six-row hulled barley and oats are the predominant cereals recorded, for instance at Pool, Sanday (Bond 1998b), Beachview, Birsay (Nye 1996) and The Biggings, Papa Stour (C. Dickson 1999a). The relative proportions of barley and oats found varies with individual sites, and there does not appear to be an overall pattern of dominance of one particular cereal covering a wide area of Norse influence. At Marymas Green, the later Norse midden deposits produced quantities of oats significantly exceeding any other type of cereal, and this may have been a product of an expansion of agriculture, including the use of manure on poor quality land.

At Burland recovered amounts of oats were small throughout all phases, but recovery of oats per litre of sample sediment could be seen to increase during the Norse period. It seems that in general the amount of land used to grow oats had already increased in some areas in the pre-Norse, and this was maintained into the Late Norse period (Dickson and Dickson 2000: 175). At Brough Road, Birsay (Donaldson and Nye 1989), Barvas Machair, Lewis (unpublished results in Dickson and Dickson 2000: 172), and Soterberg, Unst (although a small assemblage) greater quantities of hulled barley than oats were recorded. These cereals may have been traded, but the continued presence of oats in Late Norse deposits may also indicate the expansion of local agriculture onto poorer soils as a result of increased settlement pressure (e.g. Small 1969, Bigelow 1992). Increases in oat production in some areas may be related to the necessity to produce larger amounts of animal fodder for a pastoral economy reliant upon dairying (e.g. J. H. Barrett *et al* 2000).

In the Late Norse period in Caithness, J. H. Barrett (1995) has demonstrated the role of dried stockfish as a major economic export from northern Scotland, and suggested that fishing activity began to intensify at some time in the 11th – 12th centuries. The evidence from Marymas Green (dated 12th – 14th century from artefacts) may reflect these patterns, particularly as the large-scale deposition of seaweed in the midden suggested a move away from labour-intensive manuring practices towards increased fishing activity at this site. The seaweed had been collected, burnt and middened, but not applied to arable fields, which could indicate that the arable labour force was now involved in fishing. However it is important to re-iterate the interpretative warnings discussed in section 1.5.1, particularly regarding the 'traditional folk view' that Shetlanders (and indeed other coastal inhabitants) are fishermen who farm (e.g. Bigelow 1992: 18, Irvine and I. Morrison 1987, B. Smith 2000). The relationship between fishing and farming has undergone fundamental change in the past 500 years, and one should beware of projecting historic 'traditions' into the prehistoric past. More research is necessary if a fuller understanding of the relationship between long distance trade in cereal grain and stockfish during the Late Norse period is to be gained. In the case of wheat grain, the presence of trace amounts in Norse dated deposits seen at Smoo and other sites (e.g. J. H. Barrett *et al* 2000) should not be overlooked, although its trading origins and pathways may have been fundamentally different to that seen in earlier Iron Age periods.

8.3: Were the aims and objectives of the study achieved?

8.3.1: Aims:

The aims of the research were presented in chapter 2.1.2. In the course of this study a series of three excavations were identified with the potential to produce suitable environmental assemblages, and enabled the author to take a 'hands-on' approach to sampling and processing the material (Aims 1 and 2). In two of the case studies, namely Marymas Green and Burland, Trondra, large assemblages of environmental material were collected and these proved very successful. In the third site, at Soterberg, Unst, the samples were less productive and fewer conclusive outcomes could be drawn from the investigations.

A further two sites were identified which had already been excavated and samples taken (Aim 3). These samples produced two very different assemblages of environmental material. The first samples were from GUARD's excavations at Geodha Smoo, which produced a set of contextually secure, dated midden samples, which proved to be very rich in environmental remains. Investigations at this site proved a valuable addition to the otherwise sparse database concerning Early Norse activities in northwestern Sutherland. The same cannot be said for Shetland from the data obtained from Setters, where few environmental remains were recovered and where there had been considerable conflict amongst the archaeologists concerning the excavation methods used and the dating of the site. This site has been included in the thesis as it was undertaken as part of the research and probably represents Late Norse / Post Norse activities on Unst.

All environmental material obtained from the study sites was identified to the best of the author's ability (Aim 4). Plant macrofossils were identified to species were possible. Charcoal was also identified and analysed. Other environmental material, such as fish bone, marine shells and mammal bone, were counted, weighed and archived. In the case of material identified by other specialists, this has been stated in the text. All environmental material taken from GUARD sites has been archived within this organisation, and is available for use by other researchers subject to GUARD's authorisation. The data from GUARD's sites have also been written up for incorporation into their records. By contractual obligation the environmental material obtained from EASE from Burland, will be returned to that organisation, and subsequent results submitted as a report for future publication.

A comparison of two different processing methods was carried out (Aim 5). This was undertaken with varying degrees of success (see chapter sections 3.5.7, 5.5.7, and 6.6.3). The overall conclusions gained from comparing flotation and laboratory processing methodologies suggested that (as previously indicated by de Moulins (1996) study) thorough residue sorting, preferably by experienced workers, could have a great deal of influence upon the recovery of the 'heavier' portion of environmental samples. Certain categories of friable burnt material, such as peat charcoal, may readily be lost during bulk flotation, but this would require further experimental work to be proven conclusively.

8.3.2: Objectives:

The geographical and chronological objectives of the research were achieved with a good deal of success, but in many ways this was one of the most difficult elements of the research. Identifying a series of excavations in the North of Scotland and Northern Isles which would be completed within the time frame imposed by PhD research, and which also encompassed the latter part of the first millennium AD proved initially to be a very difficult task. The original aim of concentrating research only in Orkney and Shetland was broadened at an early stage to include Caithness and Sutherland, as these latter areas had been the subjects of very few investigations until the work of J. H. Barrett (1992, 1995) and Morris *et al* (1995).

The five overall objectives of the research (as described in chapter 2.1.5) have been achieved with varying degrees of success for Caithness, Sutherland and Shetland. The mainland Scottish sites produced good environmental assemblages, complete with archaeological phasing / datable material upon which to draw conclusions. Burland on the isle of Trondra, Shetland, produced the biggest assemblage of environmental material and finds, and subsequently the most enlightening data from which to consider the research objectives. Further work is required in the north of Shetland if similar conclusions are to be drawn for the other islands, such as Unst.

Contextual analysis of environmental data (objective one) is reliant upon the varying skill of field archaeologists in obtaining the initial data set (i.e. the samples) and recording the necessary stratigraphic variations in sediment deposition from which conclusions can be drawn. This was achieved with a great deal of success at Burland, Marymas Green and Geodha Smoo, and the archaeological phasing / palaeoenvironmental data integration reflect this.

Stratigraphic analysis of material from Burland has revealed agricultural intensification occurring in the Late Iron Age / Pictish phases at this site (objective 2), possibly involving the use of seaweed and / or dung. The production of fodder for animals was suggested by identification of hay and damp pasture indicator plants from this site. Prehistoric (undated) agricultural layers from Marymas Green also hinted at the utilisation of seaweed on arable fields in Caithness. Changes from arable subsistence to an economy largely reliant upon precurement of fish for long distance trade were seen during the Norse period in Caithness and Sutherland (objective 5). The research sites revealed changes in crop regimes occuring during both the Pictish and Late Norse periods, with the rise in the presence of oats perhaps indicating an increased need for fodder for animals (see section 8.1). The beginnings of a pastoral dairying economy were suggested in the

Late Iron Age / Pictish period, but trade and exchange in these products did probably not undergo expansion until the Late Norse.

The research sites produced large amounts of burnt peat, heather stems, and burnt vesicular material some pieces of which may have been dung, whilst others were peat charcoal or burnt coal fragments. Far fewer remains of wood charcoal were found. However identification of these material categories enabled a thorough comparative analysis to be made of the importance of wild resources (objective 3) and the limited woodland resource available during the Pictish / Norse period. This was succesful in showing that although wood charcoal was preferred for metalworking to the extent that woodland resources including driftwood would have been re-used many times, the largest fuel supplies recovered came from peat (probably as charcoal) and possibly also dung mixed with cereal waste (see section 8.1). Metalworking and the control of raw resources necessary for smithing / smelting formed an important indicator of social status, and within the Late Iron Age / Pictish building at Burland, these activities were being carried out in the same spaces used for cereal processing.

8.4: Future Avenues of Research:

8.4.1: Archaeobotanical Considerations:

Experimental carbonisation of plant and other organic material, such as peat, fen turf, dung and wood has proven very useful to archaeobotanical studies in the past (Dickson and Dickson 2000). However, this has been reliant mainly upon gross morphology and comparisons between modern burnt material and carbonised material recovered from archaeological assemblages. As has been seen during the course of this research, the broad definition of carbonised vesicular material leave many questions unanswered concerning the exact composition of such matter. A more thorough analytical approach, perhaps involving the building of a reference collection comparable to the soil thin sections assembled by Guttmann (2001) would be extremely useful in indicating whether a 'check-list' of identifiable characteristics could be produced. A multi-disciplinary scientific approach to this particular problem of identification is probably better than a singular archaeobotanical attack.

The identification of oat species is also an important area of archaeobotanical work in northern Scotland, which requires further research. The separation of 'common / cultivated' and 'wild' species by means of chaff is currently the only way of identifying the presence of different types of oat on a site. This does not help researchers in the Northern Isles who may be dealing with black / bristle oat, and variations in the terminology used in different publications confuse the issue (see sections 1.3.2.6 and 2.2.4.3.1). The area of oat identification requires at the least a discussion equivalent to Hillman *et al* (1996 for 1995) for wheat, to ensure that there is some degree of consistency in terminology. Future advances in identification proceedure applied to oat species may require genetic intervention to determine whether a viable set of identification characteristics can be made for carbonised material.

8.4.2: Future Archaeological Investigations:

During the course of research a number of sites with potentially first millenium AD preservation were highlighted in the Orkney islands and these may be suitable for future investigations. Coastal survey work by EASE has revealed two possibly Late Iron Age / Norse period sites on Stronsay, characterised by midden and structural remains. These sites are subject to damage by coastal erosion, and their survival may be greatly reduced in coming years. The first site at Navsy was briefly investigated by EASE in 1994, and produced a very deep coastal section containing structural remains and other anthropogenic deposits (H. Moore pers. comm.). The potential for environmental preservation at this site was considered quite high and the fish and shell midden remains may be of Viking or Late Norse date. The second site was at Rothiesholm, and consisted of very extensive Late Iron Age / Viking / Norse settlement and farm mound-type material in clearly stratified deposits (H. Moore pers. comm.). These sites could be the target of future research, perhaps initially involving the collection of a sequence of column samples, followed by excavation of the structural features before coastal erosion completely removes the deposits.

In the Shetland Isles many of the more remote areas remain unsurveyed and use of local knowledge would greatly improve the chance of new settlement landscapes being discovered. On a recent (2002) hillwalk in the Burwick area of Mainland, accompanied by Mr. T. Isbister of Burland, the author and members of EASE archaeology were introduced to a series of unsurveyed archaeological features not in the SMR. These included prehistoric ring ditches, enclosures, stone circles and unidentifiable features, none previously investigated probably due to their remoteness from the nearest road. The island of Yell may also yield many new Iron Age and Norse dated sites, with this island probably receiving the least attention in terms of survey and excavation, apart from work at the Late Iron Age site at Bayanne House (H. Moore pers. comm.). In addition the author would propose a re-assessment of the Norse settlement survey undertaken by Hansen (1995a and b) on Unst, and suggest a more thorough excavation of the site at Soterberg than was undertaken in 1997. This programme of work could fit within the Shetland Amenity Trust's 'Viking Unst' project design, and it may be possible to consolidate the site as an open attraction for the public.

In recent years the excavation of the important multiperiod site at Old Scatness has, to some extent, eclipsed investigations and discoveries elsewhere in Shetland, with a large part of the Shetland Amenity Trust's resources being diverted to the southern tip of Shetland. As the phases of new excavation at Old Scatness are reduced and the site begins consolidation, perhaps a wider picture of research and excavation encompassing the northern Mainland and outlying islands may be looked to in the future.

8.5: Summing Up:

Previous research on Shetland has shown possible agricultural intensification occuring in the Mid-Late Iron Age with the use of manures to artificially enhance agricultural soils (e.g. Simpson *et al*, Guttmann 2001), and the accumulation and storage of large amounts of processed grain in central places (Dockrill 2002: 162, Bond 2002: 182). Research undertaken as part of this thesis has shown cultivation and storage of hulled barley from the Mid-Late Iron Age period in Shetland. At Burland, close analysis of plant macrofossil and contextual evidence suggested that this settlement may have acted as a central storage place for large amounts of 'clean' grain on Trondra at this time, based around a 'post' or 'extra-mural' - broch period economy. Later Iron Age / Pictish deposits examined from Burland suggested agricultural management practices were occuring, probably involving manuring of the infield with seaweed and dung in order to maintain a high yield of hulled barley. Re-cycling of plant and other agricultural by-products around the farm was indicated, and many of the hearths and activity spaces within the Pictish smithy had multi-purpose uses, including cereal drying.

Metalworking held an important economic position within the Pictish power base, to the extent that on Trondra at least valuable manures such as seaweed and dung were also being burnt as fuel in smithing hearths. This in part may reflect upon the lack of woodland resources, with the most dominant fuel source used on all types of hearth being peat. Increases in metalworking production and intensification in arable agriculture during the Pictish period suggested an economy based around a local power-base, reliant upon fairly short distance trade and exchanges in high value 'portable' goods (such as gift exchanges involving metal (e.g. McDonnell 1994: 228, 1998: 160)) to maintain social relationships. Increased use of fertilisers to maintain the infield suggested the necessity for local nucleated settlement units to be largely self-reliant and produce a surplus both for times of hardship and for reciprocal exhanges in a client / patron economic system. Movement and exchange in raw materials such as wood charcoal and metal ores was also indicated by this research, in particular the use of sea routes for transporting goods from north west Scotland to the Northern Isles, perhaps with the finished metal products, steatite and salt moving southwards. Orkney and Shetland were undoubtably an integral part of a much wider Pictish Kingdom, with the necessary social reinforcement this implies, however, the arrival of the Norse has been demonstrated by this research to have effectively cut off relationships between the Northern Isles and parts of Mainland Scotland in particular with regard to their more southerly exchange links.

Evidence for the Pictish / Norse interface in the northern Scottish mainland remains scarce and requires further excavation and research. Early Norse deposits from Geodha Smoo suggest contact, perhaps as early as AD 770, with parts of Sutherland, although it is difficult to ascertain whether these represent brief stopovers or early trading contacts with local settlement. Certainly between approximately AD 820 - 1000 at Smoo it could be suggested that transportation of cereal grain (perhaps only over short distances) was taking place.

In the Late Norse period the increases in fish bone and oat cereal grain deposition at Marymas Green reflected other work in Caithness and Orkney (e.g. J. H. Barrett *et al* 2000). J. H. Barrett (1995) demonstrated that Caithness held an important position in the stockfish market economy of the Late Norse, and this thesis has suggested that cereal trade probably formed an integral part of this. In Shetland, archaeobotanical evidence from the research sites at Soterberg and Setters, Unst, hinted at an expansion onto poorer agricultural lands in the Late Norse. This was perhaps brought about by increased settlement pressure, although is likely also to reflect pastoral expansion and the necessity to produce surplus goods. Late Norse economics were dominated by inter-regional trade in low value high bulk staples e.g. dried fish, cereal grain and butter. This move towards a market exchange system is in contrast to the subsistence based economies characteristic of the Iron Age, although intensification in arable production and the beginings of a dairying economy are seen in the pre-Norse period. The locally based, chiefly power systems of the Late Iron Age were largely replaced by centralised state authority by the Late Norse period (e.g. J. H. Barrett *et al* 2000). Further excavation of Norse settlement in Shetland is required if assumptions concerning building typology, introductions and economics are to be tested.

Research undertaken as part of this thesis has demonstrated the long-term pattern of economic change occuring during the first millennium AD. This began with the subsistence based economies characteristic of the Mid-Late Iron Age, based around local power units - such as extra-mural and 'post' broch settlements – although as the thesis has shown the chronology of these settlements requires further definition. During the Late Iron Age / Pictish period a movement toward intensification of agriculture and metalworking practices was shown and exchanges with southern British neighbours demonstrated. With the arrival of Norse settlers, economic expansion in an east – west direction (culminating in the development of the long distance market trading patterns associated with the Late Norse period) effectively removed traces of earlier north – south societal and trade links. Further research, in particular for the Early Norse period, will enable a degree of 'fine-tuning' to the geographical and chronological sequence of these events to be realised.

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