Feeding the troops: Local grain supply on the northern frontier

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DECLARATION

I hereby declare that this thesis is composed of work carried out by myself unless otherwise acknowledged and cited and that the thesis is of my own composition. The research was carried out in the period 8th October 1998 to 30th September 1999 on a full time basis. This thesis has not wholly or in part been presented for any other degree.

Keith Baird Miller.

For Jacquie, Katie and Elanor

ABSRACT

The regular and reliable supply of food products must have been a matter of constant concern to the Roman army both when on campaign and when in garrison in occupied territory. Whilst much of this was meat, dairy products, wine, oil and vegetables the vast bulk consisted of grain. As most of the Roman army in Britain was stationed in the north of the country this is thought to have placed a considerable burden on an area hitherto considered relatively impoverished. However, the deployment of troops and the occupation of the forts north of the Tyne-Solway isthmus varied considerably through time. This variation in the numbers of soldiers deployed during the intermittent and often brief periods of occupation must have influenced the magnitude of the grain requirements at any one time.

The nature of the late Iron Age economy and the local capacity to provide an adequate supply of grain has been much debated in recent years not least because of the generally poor survival of organic remains in northern soils. It has therefore, been generally assumed that the adverse climate meant the army was forced to obtain its grain supply by importing it from more fertile regions further south. However, extensive tracts of ploughing and field systems in the aerial photographic record and the ubiquity of quern stones recovered from excavations indicate that grain was an important part of the native economy. Furthermore, it seems likely that local supply was organised wherever possible in view of the high cost, low carrying capacity and relative slowness of overland transport in the ancient world. Greater awareness of the need for environmental sampling over the last twenty years has provided a corpus of new information to be scrutinised.

The analyses of a number of charred and waterlogged seed assemblages from a range of indigenous native sites in the area between Hadrian's Wall and the Scottish Highlands, contemporary with the Roman occupation, are compared with assemblages from military sites to ascertain if local supply was possible. The predominance of barley at all of the sites examined suggests that this requirement was easily obtainable. Moreover it is contended that as well as feeding animals more barley was eaten by soldiers than hitherto acknowledged. It is also shown that wheat growing was more prevalent than previously supposed. Wheat was grown in the more favourable areas, in eastern districts where conditions of temperature and precipitation were more conducive. Emmer is the predominant wheat species in the north and occurs in proportionately greater quantity at northern forts implying a local source of supply. Spelt the most numerous wheat species found at Roman forts is only a minor crop on indigenous native settlements therefore, it is suggested that some supply from further south would have been necessary to fully meet the grain requirement of the army in all periods of occupation. Bread wheat the most often attested wheat species in the literary sources is recovered in such insignificant quantity in the first and second centuries AD that its importance is overestimated and it only becomes important in the later Roman Period.

The siting of Roman forts is significant, though they are placed primarily for tactical reasons, concerning the control of movement along natural corridors, it seems to be no accident that they were also situated in more fertile regions. This indicates perhaps a deliberate concern to ensure that control was maintained over land that had the ability or potential to sustain Roman garrisons. The Roman impact on the northern part of Britain was limited, operating within a framework of continuity and gradual development. The evidence currently available indicates no discernible disruption or major change. Where changes did take place, they do so within a longer timescale and are thus difficult to attribute to the Roman presence. This is probably a consequence of the short duration and intermittent nature of the occupation north of the Tyne-Solway isthmus.

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Acknowledgement

In a work of synthesis such as this it is inevitable that there are a great number of colleagues whose research contributed to this thesis. I particularly wish to thank Dr. Jennifer Miller, Dr. Susan Ramsay and Dr. Ian Banks, University of Glasgow and Jacquie Huntley, University of Durham for kindly allowing access to their unpublished work. I am also indebted to the Trades House of Glasgow who amidst the generally negative funding climate provided much needed financial support. I am extremely grateful to my supervisor Dr. W.S. Hanson whose advice and encouragement influenced and stimulated this research, though any errors of interpretation and flaws in logic or reasoning are my own. Above all I am grateful to my wife Jacqueline who has been supportive throughout and to my children Katie and Elanor for their forbearance when the work meant that their father was less than attentive to their concerns of the moment.

1.

INTRODUCTION

1.1 Background

In a paper published in 1991, Hanson and Breeze produced a review and critique of the current state of knowledge concerning the Roman Period north of the Tyne-Solway isthmus and highlighted the limitations in the database, while at the same time suggesting some lines of further research. Among the areas deemed to require further elucidation were the relatively poorly understood relationship between the occupying Roman forces and the indigenous population and the extent to which these forces had an impact on agriculture and the environment. The research objectives of this thesis were stimulated by reflections on these issues and, given the probability of a more extensive suite of evidence now being available, another consideration of these themes seemed overdue.

There is a long tradition within the field of Roman studies in Britain that the Roman presence was the cause of, or stimulus to, various changes within contemporary indigenous society. However this is not so easy to demonstrate in the north where the quality and quantity of the evidence is invariably poorer, due to the often adverse burial conditions and a comparative lack of investigation in the most suitable areas. This was caused by the preoccupation hitherto with site based studies, in particular, of the more visible remains and military installations. Environmental sampling has not always been carried out until comparatively recently and the earlier studies that exist may not measure up to modern rigorous scientific standards. Thus the incidence of cereals, for example, at Roman military sites in Scotland is not extensive and quantities are often small and of uncertain value. For these reasons the precise nature of the relationship between the occupying forces and the indigenous populations remains a matter of debate, and recent perspectives consequently tend to minimise the scale of the impact of Roman upon native (Hanson and Breeze 1991; Hanson 1997; Armit and Ralston 1997; Armit 1998).

Within the approximately 400 years in which the Romans administered the province of *Britannia,* the time span of the Roman occupation of Scotland is rather short, amounting to no more than forty years, perhaps extending to eighty years if all the other minor incursions and periods of temporary control of parts of the southern uplands are taken into account (Hanson 1997, 198). The brief tenure of the Roman military over Scotland and its apparent failure to consolidate the gains with civil rule are likely to have a particular and marked effect on the archaeological record. It is, therefore, unsurprising that the evidence for the impact of Roman activity on the indigenous communities is often conflicting and difficult to read. The peripheral location of northern Britain on the margin of empire and the fact that the majority of the proposed study area was only intermittently and briefly included within it led to a particular set of circumstances. These would probably have profoundly affected the way the native people viewed their world and the nature of their interactions with the occupying forces.

The Roman occupation of Scotland was essentially military in character and all of the known sites are associated with the army, though not all sites are military in nature. The local population, therefore, came into contact with the invaders after the belligerent phase of conquest primarily with the army, through its demand for supplies and recreation. Setting aside the requirement for recreation which is a separate issue, the army would require the provision of a large and extensive range of goods (see Breeze 1984, 268). The principle military requirement, however, was food for men and animals. The issue, which has been the subject of considerable debate, has been to assess the effect of the Roman Military presence on the agricultural economy of the native population through the demand for supplies of all kinds. Two opposing views have been advanced. There are students of the Roman period who believe that the army would ship in supplies of all kinds as a matter of course and that that local supply would be unnecessary. Basing their case on the abundant evidence for movement of foodstuffs throughout the empire. Manning (1975) however, in the specific case of North Wales, has argued that high overland transport costs meant the Roman army obtained much of its grain supply locally. Furthermore, Manning argued that this had the effect of stimulating local agriculture. Conversely, Higham (1989; 1992) has argued that the base to create a surplus was not available due to more marginal environmental conditions or the absence of a sophisticated socio-economic structure, and the army, therefore, impoverished the agricultural economy in the north. One question, therefore, becomes central to the theme of the impact of the Roman army on the peoples of a frontier zone such as Scotland — to what extent, if any, could the Roman army be supplied with its grain requirement from local sources ? For a positive answer it would need to be demonstrated that arable agriculture was intensive and widespread within a suitable radius of the majority of Roman forts. This study will, therefore attempt to demonstrate whether or not local supply was possible and if the local population adapted or changed their farming practices to meet the challenge of the army's demands.

Earlier assessments tended to place an over emphasis on the few extant ancient literary sources, which are not often founded upon first hand knowledge. And even Caesar, (*De Bello Gallico 5.14*) who invaded Britain on two occasions in the middle part of the first century BC, resorts to sweeping generalisations in keeping with his audiences expected view of primitive barbarians. These accounts are in any case part of a literary genre based on rhetoric, with very different purposes to the rigorous forensic studies expected today.

Stuart Piggott (1958), was one of the first to attempt a modern overview of native economies in northern Britain, based on archaeological evidence. He characterised them as mainly concerned with animal husbandry and involving an element of limited nomadism as pasture became exhausted. This view was partly founded on an apparent lack of the evidence for grain storage pits, field systems and a scarcity in the north of the carbonised grain assemblages of prehistoric date found in south-eastern Britain. Even comparatively recently Van der Veen (1988) specifically noted that there were small numbers of bread wheat grains recovered due to the low numbers of Roman period grain assemblages then available. Underpinning this earlier opinion was the more general supposition that the climatic and soil conditions in the north of the country made the area unsuitable for arable agriculture. This view drew upon a comparison with modern environmental conditions where soils are mostly developed upon acid rock substrata, are generally thin and impoverished, and subject to a higher average rainfall. Most, though not all, of modern British cereal production takes place in the more fertile lowlands of south-eastern England and there is a prevalence of hill farming and animal husbandry on the extensive tracts of rough pasture found in northern Britain.

Environmental determinism has often been used in the past to explain variation in settlement pattern and economy, but subsequent work has modified this view considerably prompting a re-assessment of the role of arable farming in the north. There is a growing realisation that arable farming played a bigger role than was once thought and new interpretative frameworks have attempted to integrate cultural perspectives into the hard science of palaeoethnobotany (Butler 1995). Recent aerial survey and pollen diagrams indicate extensive agricultural exploitation and evidence for late prehistoric field systems, ploughing, cord rig cultivation, quern stones; and cereal remains has been recovered in many areas of southern Scotland and northern England (e.g. Boyd 1988; Topping 1989; van der Veen 1992; Huntley and Stallibrass 1995). The picturesque and over-simplified view of prehistoric farming in north Britain involving semi-nomadic pastoralism painted by Stuart Piggott no longer finds favour. Scottish soils are of low inherent fertility, but there are large tracts of productive soils among the moorland and peat bog. These are found mainly across the central belt and along the southern and eastern fringes of the country coinciding almost exactly with the dispositions favoured by the Romans for their network of forts and indicating perhaps a concern to ensure that control was maintained over land that had the ability or potential to sustain Roman garrisons. Bearing this in mind it would seem that a new assessment of the potential for local supply to the army would be timely.

1.2 Aims and Purpose of this Study.

There are different ways of approaching these issues, but the approach taken here will be to advance a series of questions relating to local supply and examine the evidence from botanical remains to see how far it might be possible to provide answers. It is the aim of the present study to analyse and interpret previously collected archaeobotanical data from the area north of the Tyne-Solway isthmus to the edge of the Highlands, in order to improve our understanding of the nature of the agricultural regime in this region and to assess to what extent local supply was a realistic option for the Roman Army.

As noted above, we are largely ignorant of the nature and wealth of the agricultural base in northern Britain in the later Iron Age and Roman period because until recently direct evidence for systems of food production have been seldom available (Cunliffe 1991, 400). The lack of evidence hitherto has been an obstacle to a comprehensive assessment of the agricultural potential in this area. However, in recent years the collection and analysis of environmental data has become routine during excavations creating the opportunity to examine the specialist reports appended to many of the subsequent published accounts to evaluate the quality and extent of the evidence. The issue has been examined over a longer time scale for the north east of England (van der Veen 1992) and for Wales (Caseldine 1990) and a wider survey of the available data for the north of England has been compiled by Huntley and Stallibrass (1995), but coverage of northern England west of the Pennines and Scotland is in general patchy and incomplete. To date there has been no thorough attempt to synthesise this data and, therefore, it is proposed to take a regional approach and draw together all of the disparate strands from individual sites to assess the capacity of the native agricultural regimes to produce grain in sufficient quantity to satisfy the demands of the Roman army. This research will attempt to compare samples from native settlement sites with those from Roman military sites in the same areas; as well as comparing between Roman and native sites more generally where contemporanity can be established. Then an assessment of the impact of Roman supply considerations on the agricultural regime might be made.

It is meaningless in a Roman context to confine the locality of this investigation to the modern geo-political unit which constitutes Scotland. The region chosen for this dissertation is, therefore, defined by the presence of Roman military sites north of the Tyne-Solway isthmus and, since there are no known permanent sites north of the Highland boundary fault, it forms the northern extent of the study area. (Figure 1.1)

The data used in this study are botanical remains, particularly carbonised and waterlogged seed assemblages from previously published, recently published and forthcoming excavations in national and regional academic journals pertaining to the study area. Carbonised seeds give a close indication of usage by people and, though they indicate only a particular moment in time, in almost all cases are representative of their harvested cereal crops and associated weeds of cultivation (van der Veen 1992, 4). For this form of preservation to occur plant remains have to come into contact with fire; this can be accidental but invariably relates to human activities such as cooking, parching, grain drying and sterilisation of storage facilities. Therefore, carbonised seeds form the ideal type of data to study what the indigenous population grew as their staple crop in any given area and what the Roman garrisons were potentially being supplied with.

Settlement and artefactual evidence which can provide indications of cereal cultivation, storage and processing (such as querns, field systems, drying ovens) will also be scrutinised and integrated with the macrofossil and palynological evidence to examine to what extent, if any, the Roman army was supplied with its grain from local sources, and whether the native population were able to produce a sufficient surplus to both fulfil their fiscal obligations and supply the army.

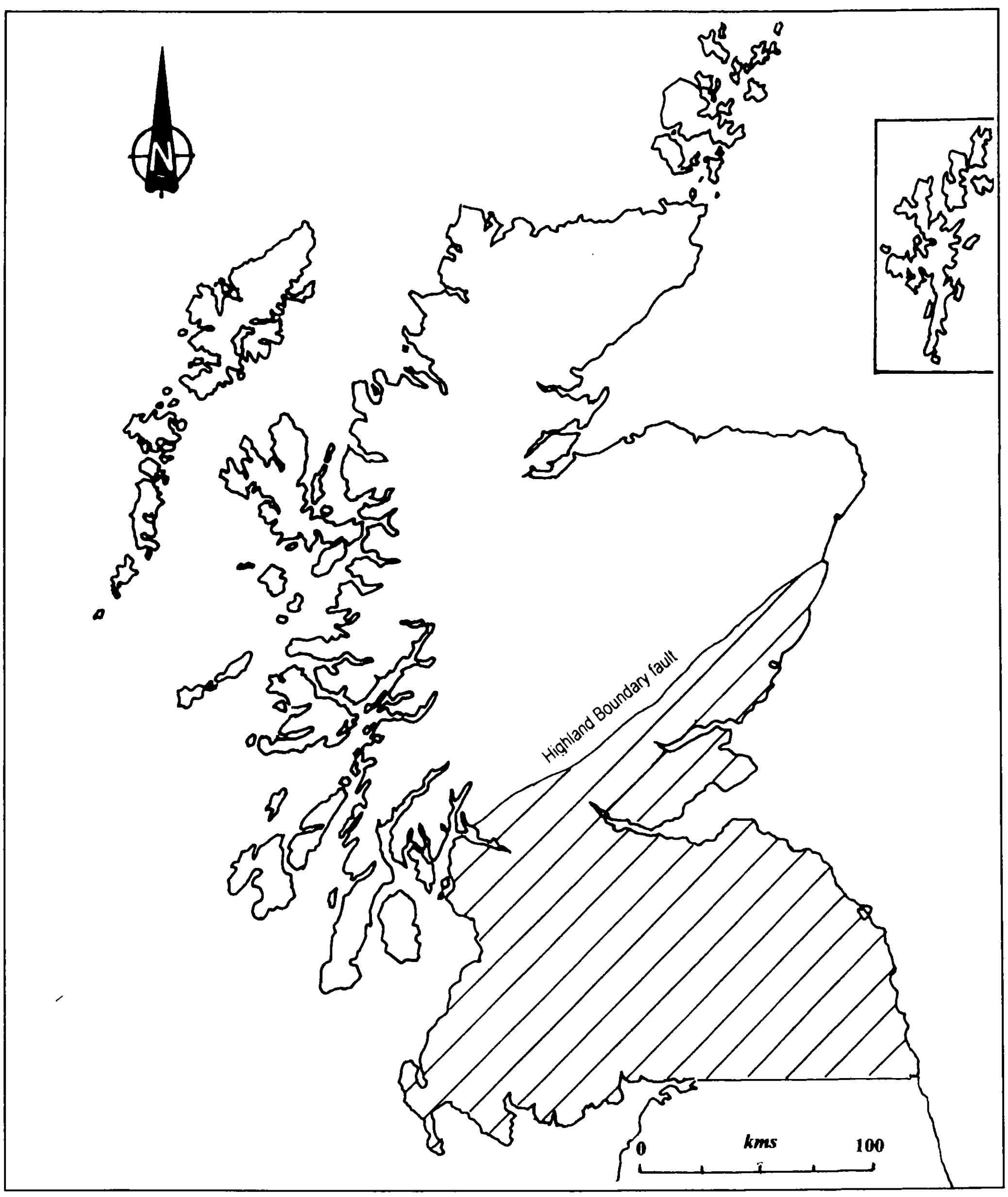

Figure 1.1: Location of the study area.

1.3 The Structure of the Thesis.

The structure of this thesis is as follows: In chapter 2 the physical and environmental background to the region is described, while chapter 3 outlines the cultural and historical context. Chapter 4 discusses the materials and analytical methods used and chapters 5 and 6 present the results from the individual sites. A general discussion and summary of the results is given in chapter 7 and some conclusions drawn.

2

ENVIRONMENTAL BACKGROUND TO THE STUDY AREA.

2.1 THE MODERN BASIS FOR AGRICULTURE.

2.1.1 Topography/ Relief

The area of study is naturally divided into three regions of distinctive topography and varying fertility (Figure 2.1). These comprise The Midland Valley, the Southern uplands and the lowland coastal plain of Northumberland. The Midland Valley forms a major corridor of relatively low lying land across the region, although it is traversed by several chains of hills. These interruptions consist of low lines of volcanic hills like the Sidlaws, Ochils, Campsie fells and isolated volcanic residuals, the Lomond hills and Cleish hills. The central lowlands are also interrupted by the extensive drainage systems of the Forth and Clyde rivers. Along with the Tay these three rivers form major inlets on the east and west coasts with considerable modifying effects on the climate. North of the Tay between the Highland Boundary Fault and the North sea lies a region of wide lowlands and rounded hills largely drained by the Tay and its tributaries which has formed a major strategic route northwards for all invading armies from the Romans to the Hanoverians. Sheltered by the Highlands this area forms a region of drier warmer climate favourable for arable agriculture. The Fife peninsula is bounded on the north and south respectively by the Tay and Forth rivers. Its rolling countryside with a fringe of lowland, normally of high fertility, forms one of the more agriculturally productive regions. South of the Forth the Lothian plain on the east and the Ayrshire coast on the west form highly productive areas.

The terrain of the Southern uplands consists largely of moorland plateau traversed by rolling valleys and broken by outcrops of bare rock. Only a few summits, however, exceed 762m in elevation. Though much covered by drift deposits and hummocky ground Southern uplands landforms are generally smooth with extensive tracts of rolling country. In the west along the Galloway coast several parallel river valleys (Annan, Nith, Dee, Cree) drain into the Solway Firth, where they broaden out to form the fertile Solway lowlands. The Tweed basin in the east is the major drainage system and route of access to

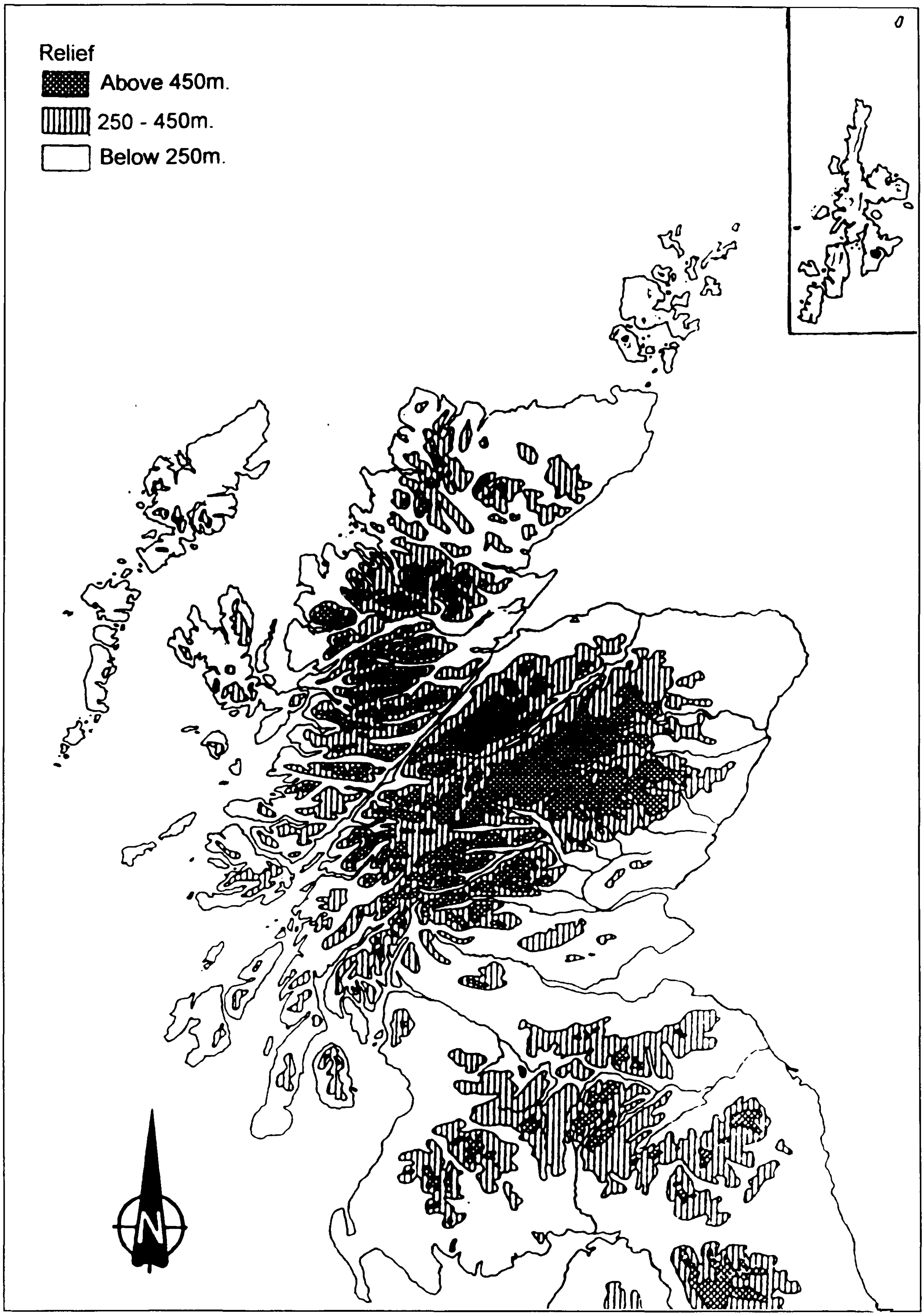

Figure 2.1: Scotland and northern England, Relief from (McNeill and MacQueen 1996).

this area, promoting pastoral activity in its upper reaches and arable cropping further down.

Adjoining the Southern uplands region along the border with England are the Cheviot hills which advance into Northumberland merging into the northern Pennines. This junction is pierced by the Tyne Solway gap a major east-west route of communication, in the past as it is today, through the essentially north-south orientation of the topography in these parts. East of this central spine is the coastal plain, a narrow strip of land less than 200m OD., some 20km wide in northern Northumberland and fringed by sandy beaches.

The region studied is part of the upland zone of Britain and is often perceived as a mainly marginal area for arable agriculture. Nevertheless, in Scotland particularly, it contains most of the better quality land, as defined by the land capability classification for agriculture (Bibby et al. 1982), of that which is available. There is a great diversity of landforms and range of relief giving rise to a variety of soil types and current land use patterns. Relief is not generally an obstacle to agriculture since there are few insuperable topographic obstacles to surmount in the region. The influence of the range of relief is felt indirectly through the modification of local climatic conditions. Sharper regional and local contrasts in climate than would otherwise be the case are the result. The disposition of landforms and the altitude effects the amount of rainfall and temperature regimes experienced which are also an important factor in determining soil type. Climate varies considerably at a local scale due to differences in exposure to wind and rain and the aspect of hill slopes with respect to insolation, brought about by the highly variable topography. This gives rise to a steep lapse rate (the rate of temperature change with height). Small differences in aspect and exposure, therefore equate to large climatic contrasts and a rapid shortening of the growing season with increasing altitude.

2.1.2 Geology

The underlying rocks of the area under study exhibit a wide variety of structure and form, the product of a long and complex geological history. Prolonged denudation and weathering, influenced by the lithology and structure of the rocks, has produced long term geomorphological effects on the countryside (Bown, Shipley and Bibby 1982, 2). This produces a great diversity of landscape, and physical features. Tectonic movements along four major dislocations of the earth's crust means that the Scottish landscape consists of five major geological units (Ballantyne and Dawson 1997, 23, Figure 2.2) The study area consists of the two southernmost of these physiographic units, The Midland Valley lying south of the Highland Boundary Fault, which separates it from the Grampian Highlands, and the Southern Uplands, separated from the Midland Valley by the Southern Uplands Fault. The remainder of the region under study comprises the greater part of Northumberland in northern England. Each of these divisions has a broadly characteristic rock assemblage, sedimentary rocks of Carboniferous or Devonian age in the Midland Valley and shales and greywackes of Silurian or Ordovician age in the Southern Uplands (Craig 1991). Northern Northumberland consists of Carboniferous limestones , sandstones and shales that form the well known formerly economically important millstone grits (Jarvis *et al.* 1984). There are particular west-east distinctions in the geological pattern which have important implications for agriculture. For example the distribution of the Old Red Sandstone of Devonian age along the eastern fringes and the Midland valley. This in combination with essentially west-east climatic patterns gives rise to friable well drained soils, which warm up earlier in the spring than the heavier clay soils.

The landscape has also been sculpted and modified by the effects of glaciation and exhibits an abundance of features typifying its glacial history. This glacial history has significant importance because the form, composition and distribution of the many different soil parent materials and much of the variety in localised topography resulted from glacial and periglacial action during more recent times. Much of the ground is therefore overlain by glacial tills (diamicton). Isostatic uplift associated with the withdrawal of the ice has since the last major glaciation, 10,000 years ago, produced the widespread phenomenon of raised beaches. Thus introducing sands to improve the drainage characteristics and enhance the land use potential of some heavier glacial tills. (As for example in the 'Golden Fringe' of the East Neuk of Fife). Another kind of legacy of agricultural importance are the rich estuarine muds which clothe the fringes of the major river estuaries around the Tay, Forth, Clyde and Solway, which emerged above sea-level approximately 4000 years ago.

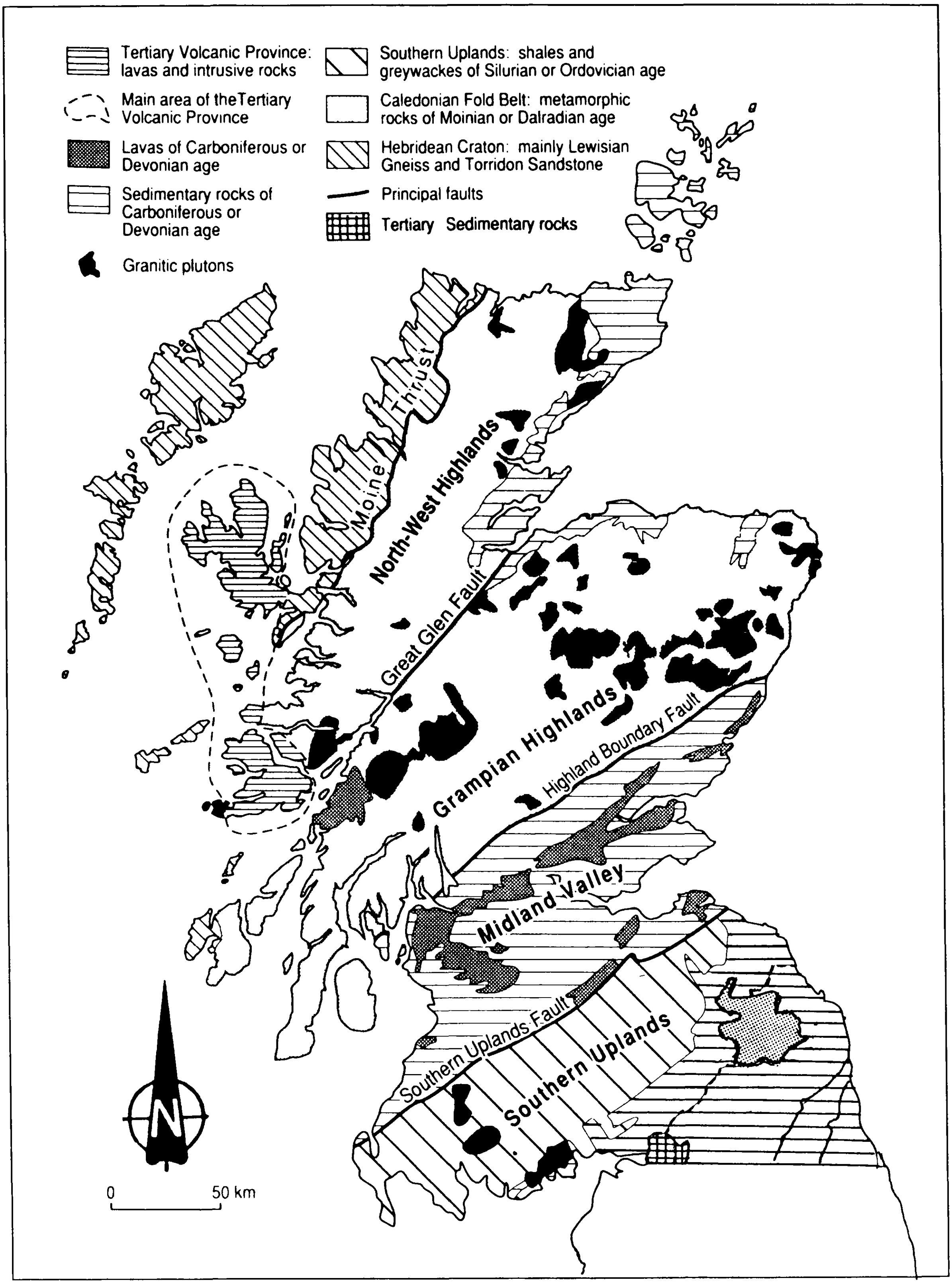

Figure 2.2: The structural provinces of Scotland and northern England, showing the distribution of major rock types. Geological boundaries based on Craig (1991) and Ballantyne and Dawson (1997).

2.1.3 Soils

There is a close relationship between the rocks, the geomorphic history of the major physiographic features and the landforms and soils which they produce. A distinctive feature of the regions soils are their youth, having been formed over the last 10,000 years since the last de-glaciation. The prevalence of drift deposits leads to a highly variegated soil pattern and a hummocky and uneven landscape in lowland Scotland and northern England. Soils are mainly derived from glacial till which in turn are largely the products of acid parent rocks. The prevalence of high rainfall in many areas leading to leaching, especially in well drained soils with acid parent rocks, leads to a low level of inherent fertility and limited land use potential of much of the region. The vast majority of regional soils are subject to leaching caused by the high rainfall in much of the region and many of them have impeded drainage, therefore, the characteristic soil types are peat soils, peaty podzols and peaty gleys forming Land Capability for Agriculture (LCA) classes 3_2-5 (Davidson and Carter, 1997 47). There are, however, some areas, predominantly in the east, where better drained highly productive soils exist, (LCA classes 1-3_1) these sandier soils tend to dry out faster and warm up more quickly in spring . Often the choice of farming system will be limited, or at least indicated by particular soil conditions, a situation which, of course, was more prevalent in the past. (Figure 2.3)

Soils are not solely the product of parent material, relief and climate; the activities of human communities for at least the last 5,000 years and their effect on the nature of the vegetation cover have also substantially influenced the present day soil conditions. Hence the arable lowlands of the region now contain essentially anthropogenic soils. Consequently, it is very difficult to assess how these present day soils relate to those prevailing in the late Iron Age and Roman period. However, since soil type is in part dictated by parent material, the land use potential in the past need not have been significantly different from today. The evidence of cord rig and settlement in upland areas indicates that large tracts of upland were cultivated in the past. These soils are uneconomical or difficult to cultivate today due to a move away from subsistence farming and the complete mechanisation of farming practices (Halliday, 1986; Topping, 1989; Gates 1999).

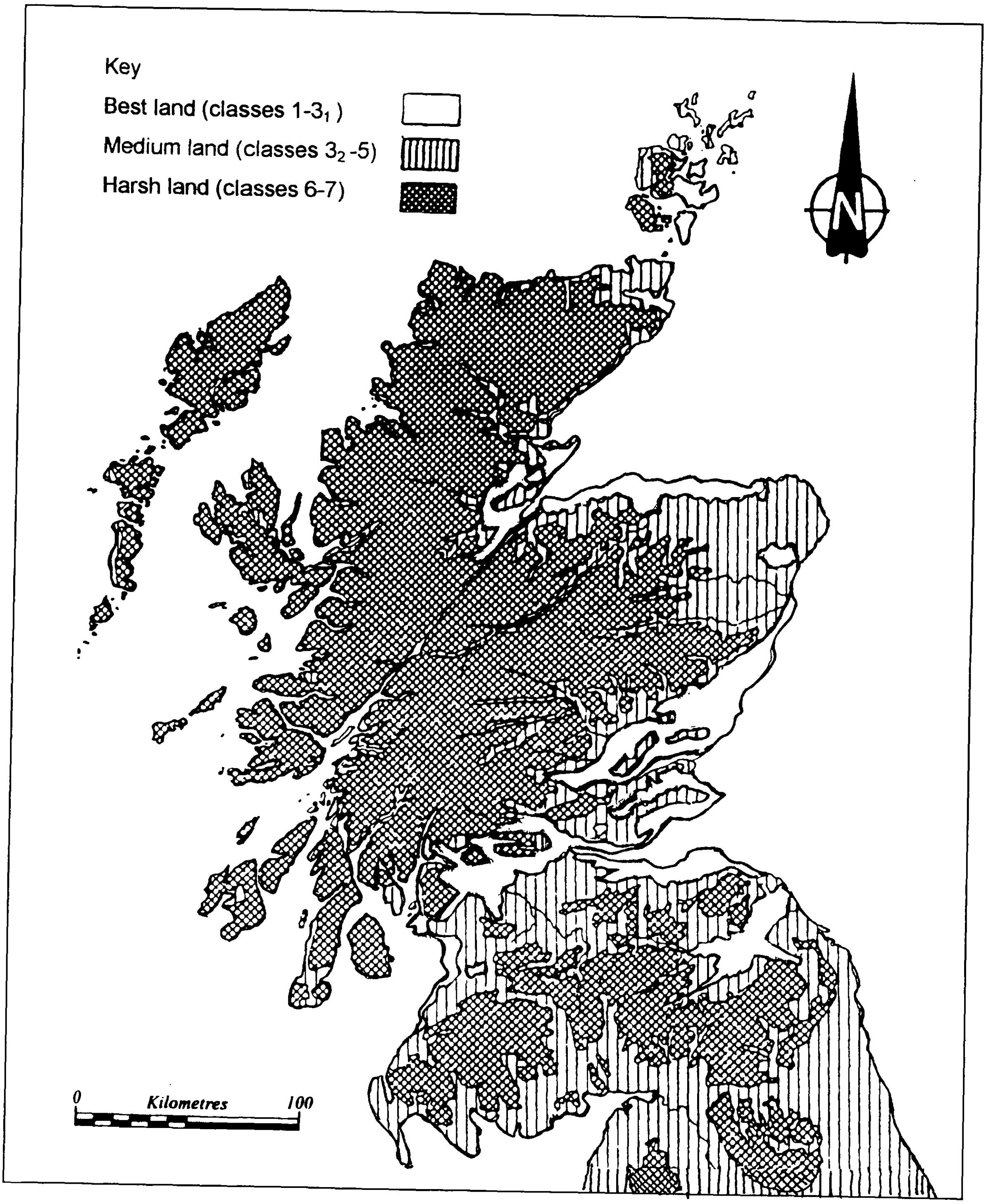

Figure 2.3: Simplified distribution of land capability classes for agriculture from (McNeill and MacQueen 1996).

2.1.4 Climate

Climate is the most important physical factor affecting agriculture in the region and sets the ultimate limits to all forms of agricultural production. On a broad classification of the world's major climatic zones, Britain lies in the cool temperate zone. Temperate winters and cool summers are, therefore, the outstanding climatic features. In a British classification of the climate, which integrates temperature, air movement, incoming and outgoing radiation and moisture movement data, Shirlaw (1971 20) divided the country up into six broad climatic regions (Figure 2.4). The study area falls into three categories, the west is described as having mild wet winters and cool wet summers, while the central strip experiences cold wet winters and cool wet summers, in keeping with its generally greater elevation, and the east enjoys much dryer conditions in the cold winter and cool summer (Shirlaw, 1971 20). However, the climate is chiefly dominated by maritime influences, the sea is in intimate contact with the land along the deeply indented coastline. Winds are predominantly westerlies bringing weather in off the Atlantic. This means that the ocean has a marked effect on the regional climate. The proximity of the warm waters of North Atlantic Drift considerably ameliorates the effect of a comparatively northern latitude making winters relatively mild. A further consequence of the nearness of the deep ocean, for agriculture in particular, is that in summer the heat-sink effect depresses growing season temperatures, making crop ripening more marginal than in countries with more continental regimes (McNeill and MacQueen, 1996 16).

Climatically there are considerable differences between the east and the west of the region, reflecting the balance between the oceanic west and the more continentally influenced east. Climatic conditions when combined with the regional topography and the nature of the underlying geology favours the East for agriculture. Cultivation can take place at higher altitude in the east, farther from the heat sink effect, than in the oceanic west and as a consequence cereals ripen at much higher altitudes here. Precipitation which is marked by regional variations, ranges from about 2500mm annually over the Southern uplands to about 635mm in certain eastern areas. The prevailing westerly winds mean that rainfall increases with height and for any given height from west to east. The uplands compel air to rise and lose much of its moisture as precipitation over the heights, therefore

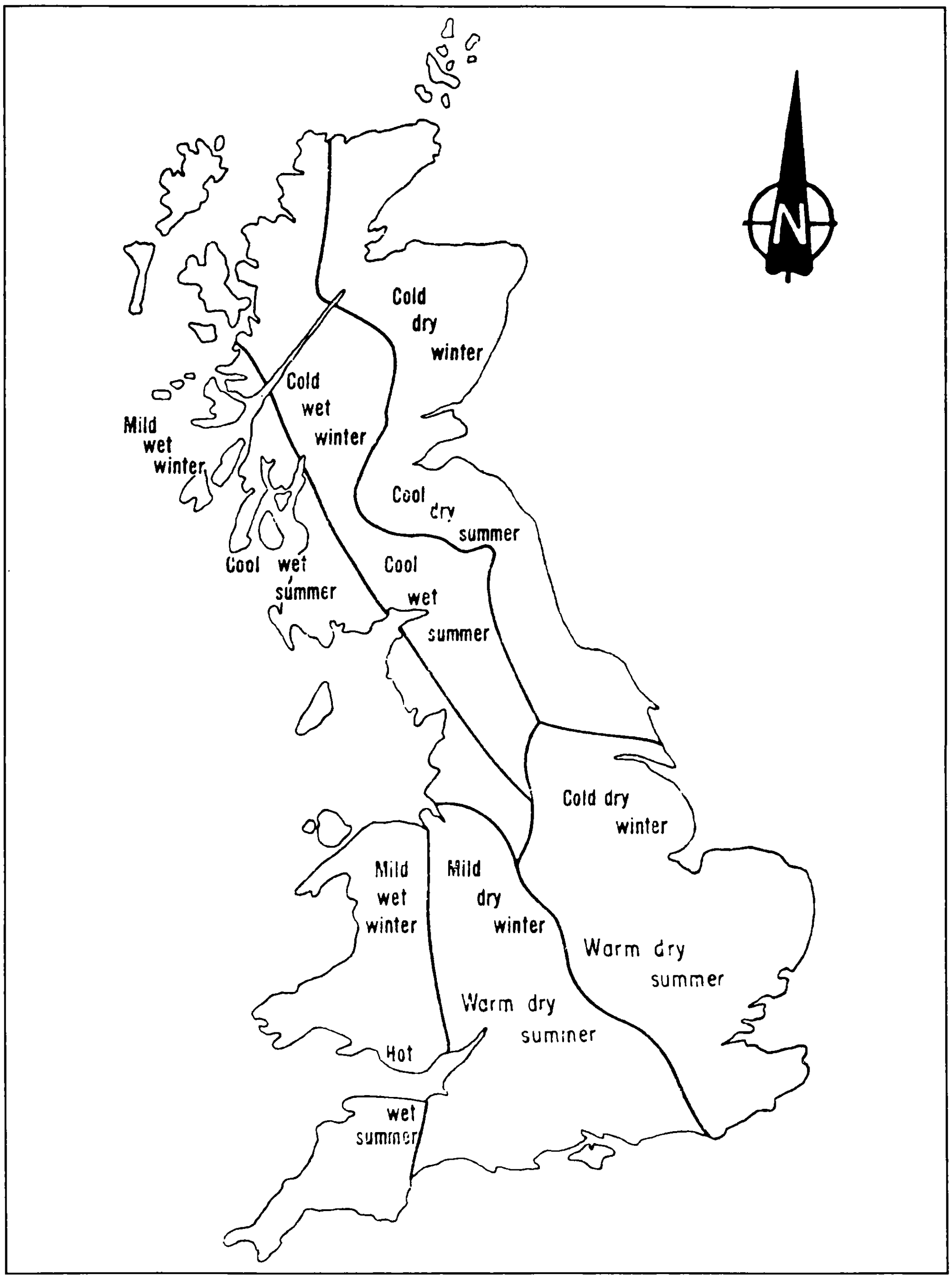

Figure 2.4: Broad climatic regions of Great Britain from (Shirlaw 1971).

there is a considerable rain shadow effect which permits dryer conditions in the eastern lowlands, with clearer skies and warmer temperatures. (figure 2.5)

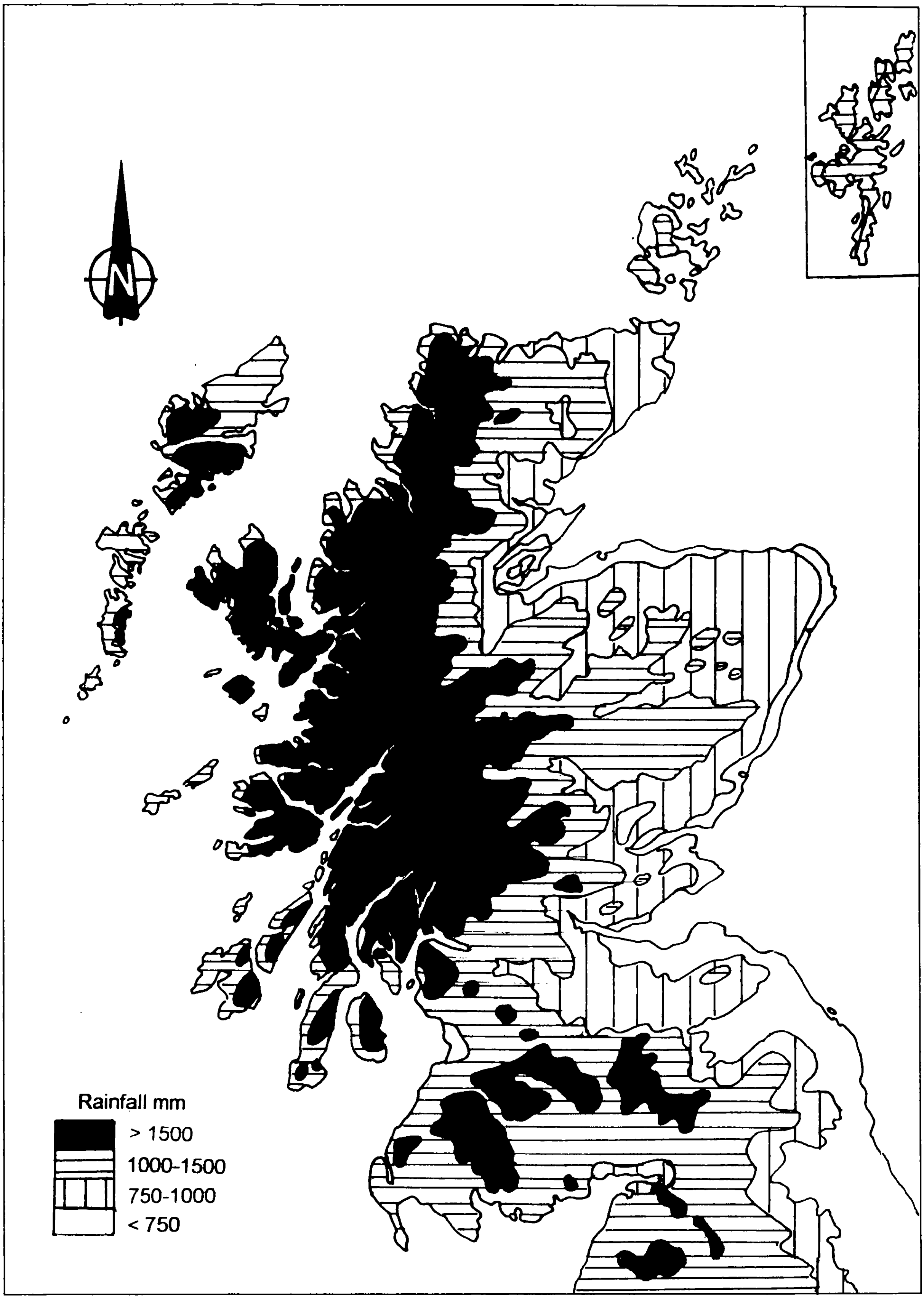

Figure 2.5: Average annual rainfall after (Coppock 1976).

Assessment of climatic conditions is based on accumulated temperature and potential water deficit. The amount of rainfall, while important with respect to agricultural potential, merely indicates the water input to the soil. Loss by transpiration of vegetation and evaporation must also be considered so that the water available for plant growth can be estimated. Therefore, potential soil moisture deficit (PSMD), expressing the balance between inputs and losses from the system, is more relevant. PSMD values indicate that the well drained soils of the east are more at risk of drought than the water retaining soils of the west in the summer months. This has self evident implications for the production of cropmarks and the consequent favourability of eastern areas for aerial prospection means that the settlement evidence is generally more extensive here.

The range of temperature across the region from east to west is demonstrated by the average temperature of the east and west coasts in the coldest and warmest months respectively. The January temperature of the eastern coastal region is 3.9° C, and the average January temperature of the western coastal region is 3.1° C; corresponding July averages are 13.8° C and 15° C. Traditionally minimum and maximum temperature values for January and July have been used for evaluating where crops may be able to grow. However, these are not often used today, but they remain useful parameters for discussing broad natural vegetation blocks. Plant growth tends to increase with temperature and a useful indicator of this is accumulated temperature, which is measured in day degrees (Birse and Dry, 1970). This integrates the number of days on which the mean soil temperature exceeds a given base temperature, usually taken as 5.6° C, which represents the approximate threshold at which plant growth begins in many indigenous species and the number of degrees above this minimum (Coppock, 1976 16). (figure 2.6) The flatter oceanic annual temperature curve in the west seriously reduces the amount of heat (accumulated day degrees) available above the threshold temperature needed for crops to grow. A small change in conditions can, therefore, be critical, whether due to local altitude or climatic variation through time. So a small vertical change, for example, can seriously curtail agriculture. The warm lowlands have an annual average of 1375 day ° C, while the cooler uplands , above 400m, have 825-1100 day ° C, with only 150 day ° C on the mountain tops.

For cereals though, it has been demonstrated that leaf expansion continues down to 0°C, although slowly, and that the accumulated temperature above this threshold for the early half of the year, January to June, was of the most relevance for cereal growth (Biscoe and Gallagher, 1978). This is expressed as growing day degrees (GDD). The Northumberland coast is the warmest with 1350 day ° C in an average year. Accumulated temperatures are lower in the Cheviot Hills, where totals are less than 1050 day ° C above 300m O.D.

These figures refer to present day conditions and their validity for the late prehistoric and Roman period is difficult to assess. However, some information is available with which to construct broad trends. A synthesis of the nature of the Holocene climate in north-western Europe as a whole was attempted by Lamb (1977) utilising an array of proxy data (such as peat stratigraphy, pollen analysis, oxygen isotopes, dendrochronology, varves, post-glacial vegetation mapping and ice-sheet stratigraphy). From this research the broad pattern of climatic change for the British Isles was reconstructed (Lamb, 1981). Thus the traditional view, still sometimes found in the archaeological literature, gained common currency. This model held that the climate at the beginning of the first millennium BC was warm and dry followed by a sharp decline in temperature and an increase in precipitation between 1000 and 750 BC. The estimated drop in overall mean temperature was 2° C with profound effects on the length of the growing season. Between 400-150 BC there was an amelioration and by the first century AD the climate was generally considered to be very similar to that prevailing today. From the late Roman period (250-400 AD) the climate was slightly warmer again followed by a decline in the post Roman period. This view has been challenged in recent years with the development of new ideas and techniques (such as climate modelling; Anderson *et al.* 1988) and the refinement in resolution and accuracy of the various methodologies. Present evidence indicates a generally improving climate from 10,000 years ago, since which time conditions have remained more or less constant at the macro-scale. Only minor perturbations of this general trend, involving intermittent and periodic changes of a lesser nature, have disturbed the overall stability of the pattern (Whittington and Edwards, 1997). Thus analysis of deuterium isotopes in pine stumps from the Cairngorms (Dubois and Ferguson, 1985) for example, have recognised some wetter periods between 2880 and 2330 cal BC and again around 360 cal AD. Seasonal temperatures in Britain over the last 22,000 years have been reconstructed using beetle remains (Atkinson *et al.* 1987) and a close correlation between summer and winter temperatures at 2000 BP. and present day temperatures indicates a broadly similar temperature regime then as now.

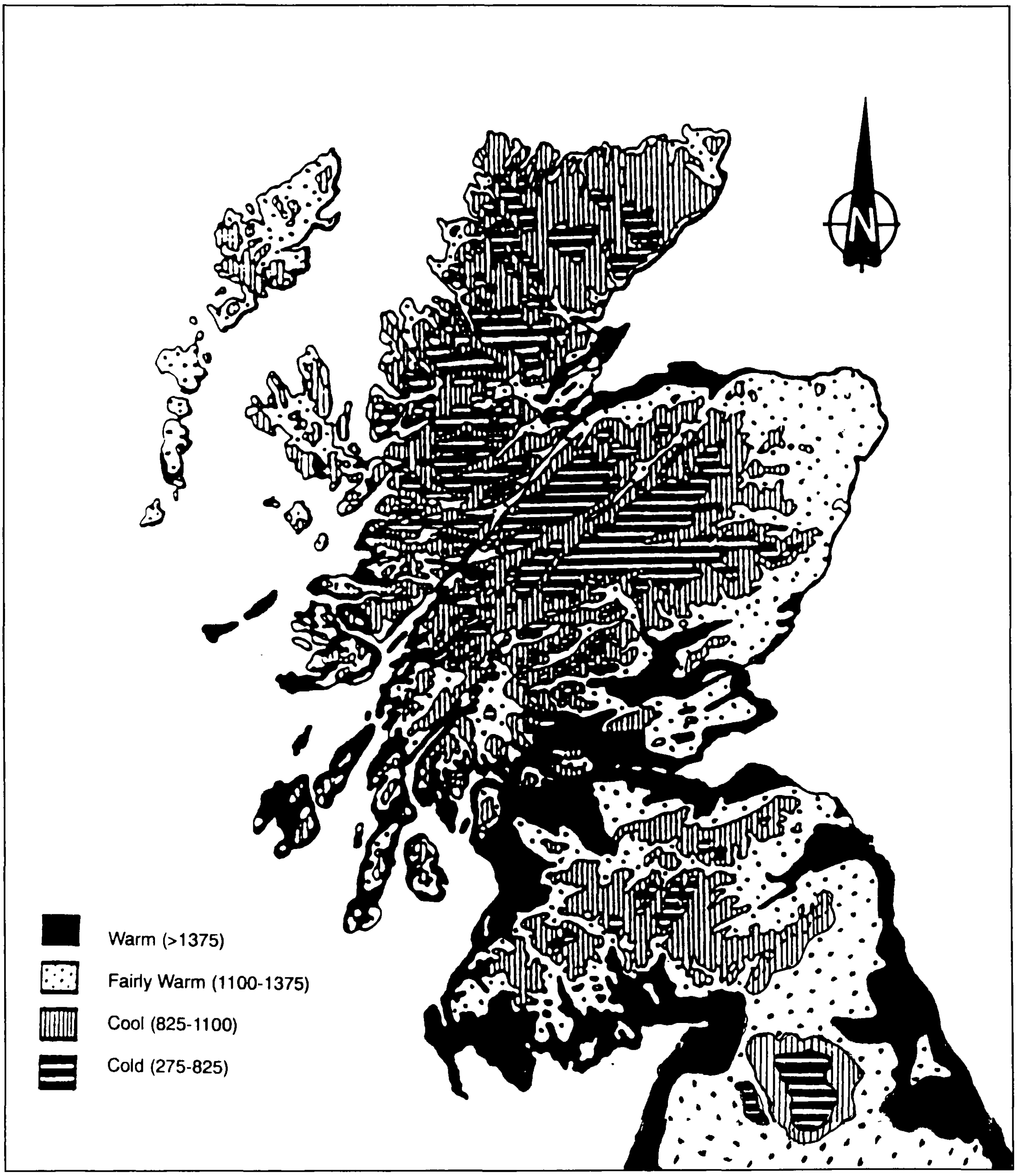

Figure 2.6: Accumulated temperature in day degrees Celsius after (McNeill and MacQueen 1996).

2.2 VEGETATIONAL HISTORY.

A considerable number of dated regional pollen diagrams are now available for the area north of Hadrian's Wall which record the vegetational history of the later prehistoric and Roman periods. Thus the picture of woodland clearance and agricultural exploitation is becoming progressively clearer. (see Tipping 1994 and 1997 for a comprehensive list of pollen diagrams). It is evident that forest clearance and manipulation of the environment by human communities probably began as early as the Mesolithic and intensified in the Neolithic on a sporadic basis. By the Bronze Age and early Iron Age this increased in intensity in some localised areas (Turner, 1965, 1975; Davies & Turner, 1979; Barber, 1981; Dickson *et al.* 1984; Innes & Shennan, 1991; Tipping 1992, 1994, 1995; Whittington & Edwards, 1993; Dumayne & Barber, 1994). However, over much of the study area large areas of countryside appear to have undergone substantial and rapid phases of forest clearance from c. 500 cal BC onwards (Davies & Turner, 1979; Turner, 1979, 1981, 1983; Boyd, 1984; Dickson & Dickson, 1988; Tipping 1992, 1995, 1997; van der Veen, 1992; Dumayne, 1993; Dickson, 1993; Ramsay, 1995; Dumayne-Peaty, 1998). Simultaneous clearance is difficult to demonstrate due to the imprecision of the available radiocarbon dates (Dumayne *et al.* 1995) and the lack of overlap in the pollen catchments between sites. Large individual site recruitment zones in most areas were systematically cleared, often rapidly (Tipping, 1997), sometimes leading to severe soil erosion (Tipping 1992). From the limited data available to her, Turner postulated a progressive clearance beginning in the south of the study area and moving north at a significantly later date (1979, 1981). However, clearance was of regional significance, the spread of radiocarbon date ranges from pollen cores currently available for sites in the north and south of the region show that clearance was haphazard and site specific. However, due perhaps to the smaller database available for the area north of the Forth-Clyde Isthmus, clearance appears to be substantial, but less widespread. The significance of this is unclear, but the link with the different and seemingly more conservative settlement pattern shown by field and aerial survey (Macinnes, 1982) may point to a more fragmented and sparse population.

Of significant interest has been the question of how far clearance had proceeded before the Roman arrival. Sites close to Hadrian's Wall appear to have been cleared slightly later than others north and south of the wall. It was argued by Davies & Turner

(1979) that clearance at the site of Fellend Moss near Hadrian's Wall was a Roman period phenomenon, a view endorsed by Barber (1981) at Bolton fell Moss. This view has most recently been re-stated by Dumayne in a suite of papers (Dumayne, 1992, 1993a, 1993b, 1994; Barber *et al.* 1994; Dumayne & Barber, 1994; Dumayne *et al.* 1995). Though this view has not gone uncontested (Hanson 1996; Tipping 1994 and 1997). The general trend demonstrated at the overwhelming majority of sites, though, is clearance of late Iron Age date. It should be remembered, however, that the most rapid and dramatic clearances were not necessarily sustained, and regeneration may have taken place where occupation was not continuous. Pollen profiles from Bloak Moss (Turner, 1965, 1970 and 1975) also indicate that in some areas clearance did not take place till later in the Roman period (c. AD 415). Similarly, local pollen evidence from on-site sampling of buried ground surfaces sealed beneath the ramparts of Roman forts or roads indicates a cleared landscape at the time of the Roman arrival (Boyd 1984; Butler 1989; Dickson forthcoming). Though the often poor survival of pollen and spores in these situations and the uncertainty of the extent of the catchment area require a cautious approach to this site specific data.

Archaeological evidence in support of a late Iron Age clearance comes in the form of prehistoric plough (ard) marks regularly discovered preserved beneath the ramparts of Roman forts. These occur mainly along Hadrian's Wall, but are also found elsewhere, such as at Cramond in Lothian (Goodburn 1978). The vast quantities of turf used for fort ramparts and to build the Antonine wall are also indicative of a cleared landscape. The ubiquity of temporary camps among the standing monuments in the landscape, some of them very large, is further evidence for extensive areas of open country at the time of the Roman campaigns. It is unlikely that time would be wasted in clearing land for short-term stopovers expected to be constructed quickly at the end of a days march.

It is usually assumed that forest clearance is associated with increased agricultural activity. However, the causes of this phenomenon can be difficult to assess. The part played by climate and pedogenic change, as against, or in combination with, human impact must be taken into account. Many of the data sets are not collected primarily to address anthropogenic questions, and the part played by human populations in the process is not specifically looked for. Different types of land-use following woodland clearance are recognised by identifying characteristic pollen groups (taxa) (Behre, 1981). A pastoral base to agriculture is most often asserted for this region, based on the presence of pollen of herb families of open pasture (*Plantago, Urtica, Rumex, Ranunculus*). However, these indicator species, for example (*Plantago lanceolata)* a key indicator, are not found exclusively in grassland habitats. The most obvious palynologically diagnostic feature of clearance for arable agriculture is the presence of cereal pollen in the spectra. Regional pollen diagrams derived from large lakes and mires, though, tend to under-estimate cereal cultivation due to the distance of the pollen core from the nearest source of cereal type pollen with its well attested fall off characteristics (Vuorela, 1973). For this reason the absence of cereal type pollen cannot necessarily be taken to indicate the absence of cereals. These problems not withstanding, the palynological data record both pastoral and arable herb indicator pollen types at the vast majority of sites, with cereal type pollen also found at many of them, indicating clearance for expansion in agriculture. The balance between pastoral and arable practices is impossible to discern from pollen data, but physical constraints operated then as now to make the uplands more suitable for grazing animals than growing crops. The corpus of information on field systems continues to grow through aerial survey, but anything other than broad indications, on size and form, of what they might have been used for is lacking. Dating is also a major problem, so few have been excavated, and assigning them to a late Iron Age horizon on morphological grounds only tentative. That a mixed farming regime was likely to be employed is not in doubt, since food was produced essentially for domestic use.

Population expansion, entailing more building, fuel needs and food production, and hence a requirement for more cleared land, is a convenient underlying cause for forest removal. Indeed population expansion is implied by the extensive settlement pattern indicated by aerial photography. However, again a lack of secure dating poses a major difficulty. More land under cultivation need not mean more people, but may reflect a need to create larger surpluses for exchange, obligation, ritual purposes or to supply the Roman Army

Traditionally it was thought that the Romans were responsible for initiating or accelerating forest clearance in the north of Britain, a view long ago dismissed with the improvement in the quantity of pollen diagrams and the prevalence of radiocarbon dated horizons within them. Dumayne (1994) has interestingly strongly re-asserted the primacy of the Roman army among other causes of forest clearance particularly with reference to the site of Fozy Moss some 200 m north of Hadrian's Wall. The interpretation given is that construction of the wall, its forts, barrack blocks and metal-working activity by the soldiers produced an increased demand for timber. Dumayne's arguments have been criticised by Hanson (1996 and 1997) on the basis of three criteria. Firstly previous research (Hanson 1978) indicated that Dumayne had overestimated the timber requirements for construction of the military installations, particularly given the limited use of timber on Hadrian's Wall sites. Secondly, the lack of precision of conventional radiocarbon dating generally and of the Fozy Moss diagram specifically does not allow correlations between palynologically and historically attested events (Pilcher, 1991; Dumayne *et al.* 1995), and thirdly, because the vegetational changes indicated were long term phenomena and were, therefore, more likely to reflect agricultural expansion than short term military activity. Further criticism has come from Tipping (1994 and 1997) on the grounds that changes in the herb taxa identified at Fozy Moss are entirely in keeping with those identified at sites which were cleared elsewhere in the late Iron Age. Therefore, clearance for an expansion in agriculture is more likely at Fozy Moss.

How much woodland was cleared, when and where has been the subject of some debate in recent years (Hanson 1996 and 1997; Dumayne-Peaty 1998a, 1998b). The pollen evidence indicates a general trend of extensive clearance throughout the study area in the late Iron Age, but in some areas a substantial amount of woodland still stood by the time of the arrival of the Romans (Dumayne 1994). While at other sites woodland was regenerating after short-term clearance (Dumayne-Peaty 1998b). On-site pollen evidence from ditch fills and turves from forts in central Scotland indicates an open landscape of heath, pasture and some tree cover (Boyd 1984; Knights *et al.* 1983; Newell 1983). The presence of macro-plant remains in the form of twigs, leaves, fruits and small diameter roundwood recovered from excavations at Roman fort sites indicates that woodland was still an integral part of the landscape since these are unlikely to have been imported (Hanson 1996 and 1997). The common assumption that supplies were obtained locally wherever possible (Manning 1975) would suggest that sufficient large timber was available. However, in many places primary mixed oak woodland had been substantially reduced. This is supported by the occasional use of timber which was not ideal for building purposes, such as alder and ash, to construct Roman forts. The above discussion indicates that clearance was not simultaneous or general across the region and of varying intensity and duration. However, extensive clearance had taken place by the late Iron Age, and by the end of the Roman period areas which had still retained substantial woodland cover were cleared also. The reasons for this are associated with an expansion of settlement and its concomitant growth in agriculture.

3.

CULTURAL BACKGROUND.

3.1 INDIGENOUS SOCIETY.

3.1.1 The Database.

The topographic diversity of the Scottish landscape, with its contrasts between upland and lowland and east and west, lends itself to geographic determinism and regionalist divisions of the data. The apparent regional differences in the settlement pattern with their discrete monument types further reinforce this trend. With this in mind and believing in the diffusionist paradigm in vogue at the time, in which all innovation came from the south, Piggott, S. (1956 and 1966) attempted to relate the observed settlement evidence for the Scottish Iron Age with that better known and investigated in southern Britain. He adapted the then current model used to interpret southern British Iron Age society and applied it to explain the Scottish evidence. A regional scheme of four provinces was postulated, the North Eastern, the Tyne-Forth, the Solway-Clyde and the Atlantic. This scheme took into account the topographic diversity of the Scottish landscape and formalised the broad regional differences discerned in the settlement pattern with their distinctive forms of architecture, brochs, duns, souterrains and crannogs. The brochs indeed tend to be found in the north and west, with a few outliers elsewhere, while the souterrains tend to concentrate in the area of the north and east, again with some exceptions. Crannogs are generally situated in western central and south-west Scotland. These are quite distinctive, and relatively visible, forms of settlement pattern and have generally speaking discrete patterns of distribution. (Figure 3.1) However, the scheme is breaking down and has long been challenged because there is some overlap in settlement forms between areas and the more extensive use of aerial photography and field survey is able to identify the, previously invisible, more ephemeral settlement traces. These techniques have highlighted the more extensive and complex nature of the settlement pattern and the numerous unenclosed or insubstantially enclosed sites thus identified have changed the research emphasis away from the single site approach towards a more regional, landscape perspective. These divisions though, are still often used because they are deeply ingrained in the literature and sometimes prove useful in discussing the evidence. However, they also serve to highlight the regionalism of study effort in the Scottish Iron Age. The research coverage of the study

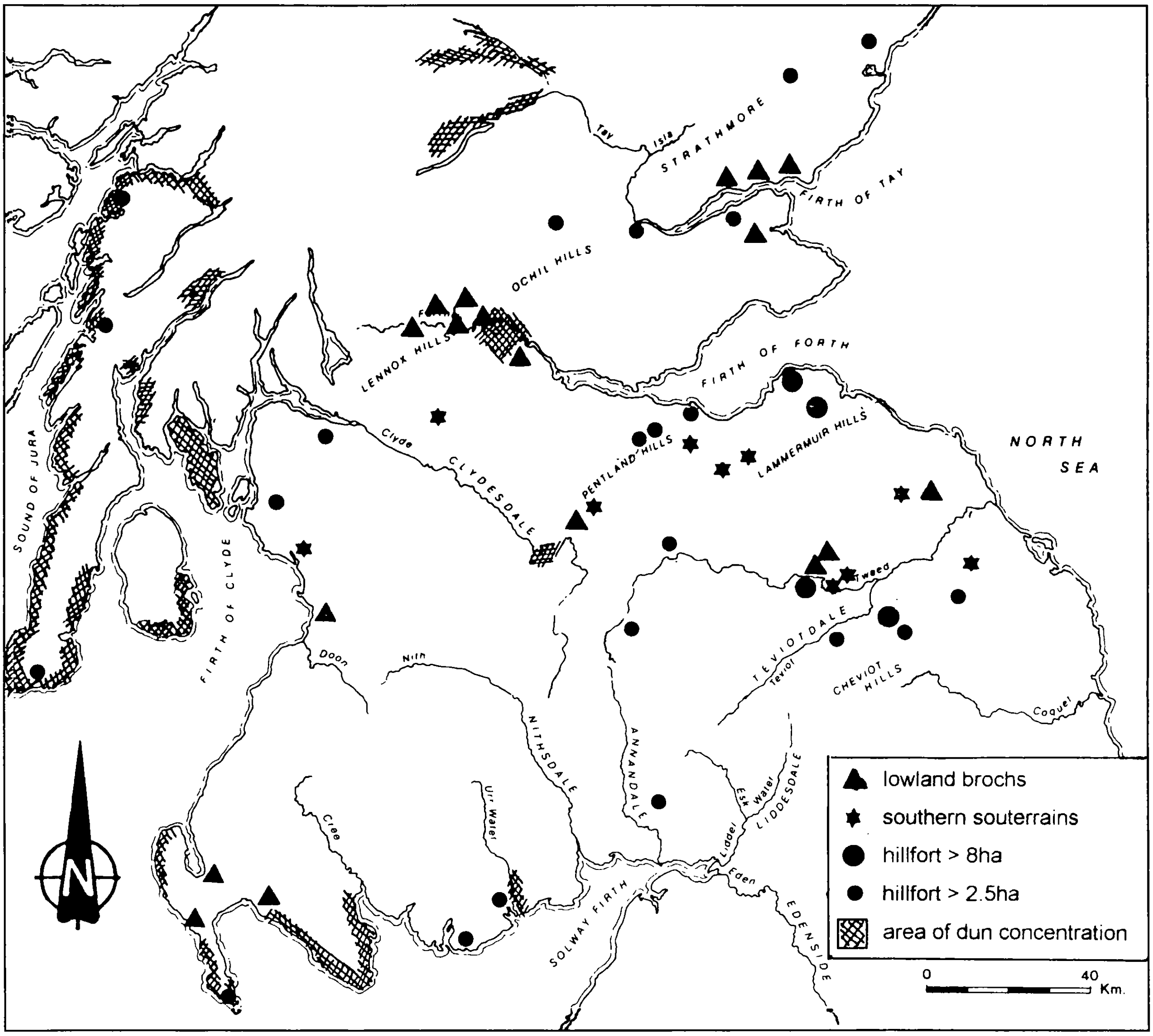

Figure 3.1: Distribution of large hillforts, brochs, duns and souterrains.

area in the late prehistoric and Roman period is uneven, Atlantic Scotland dominates with its fine site preservation, relative abundance of distinctive pottery, and monumental dwelling forms. The researchers working in the Iron Age have also favoured the north-western seaboard. Research on the settlement pattern and economy in southern, central and eastern Scotland, including the south-west and some of the north-west, has been piecemeal in contrast to the major efforts undertaken over many years in Northumberland pioneered by the late George Jobey. There was a burst of activity in south-east Scotland in the early 1980's (Harding 1982; Rideout *et al.* 1992) but in general a lack of publication of excavation results, in particular of the environmental studies carried out, hampers synthetic treatments of the evidence.

When the material evidence is considered, there is sometimes difficulty encountered for the Iron Age period because the data is invariably both qualitatively and quantitatively poorer than that recovered from southern Britain. Pottery forms are often crude and, therefore, undiagnostic and the absence of pottery on many excavated sites, such as at Ironshill, Angus (Pollock 1997) may indicate that some areas were aceramic. In consequence native pottery, has little value over much of the area under consideration as a cultural or chronological indicator. Burial conditions in the predominantly acid soils mitigate against bone survival and human burials are rare. Settlement evidence in the north, however, tends to be much richer because of the better preservation in upland areas. Settlement data in consequence are the largest set of archaeological evidence available for study. The comparative paucity of artefactual evidence means that material culture has played a subordinate role to that of settlement evidence in interpretations of the late pre-Roman Iron Age. The chronology of the period remains weakly established, there are few radiocarbon dates and the majority of those available pertain to sites in the Atlantic west. Although the aerial photographic record indicates an extensively populated landscape in many areas, lack of excavation makes it difficult to relate these remains to any given period. Chronological precision is generally not available in prehistoric contexts and carbon-14 derived date ranges are often wide. Radiocarbon dating results are expressed as a probability that a site was occupied within the given range, but even at the 98% confidence limit there is still a chance that occupation fell outside these limits. This contrasts markedly with the close dating available from Roman military sites. Date becomes important in a study such as this, when contemporaneity with the Roman occupation is a prerequisite for assessing the impact of the Roman military on indigenous society. Therefore, archaeologists have tended to fall back on comparing settlement morphology, often equating similarity of form with chronological contemporaneity. Caution must also be exercised when deducing settlement function and economy between sites from the form of the remains. The presence of Roman artefacts on native settlements not surprisingly, have been a traditional chronological indicator for these sites in the past, particularly before the advent of carbon-14 dating. The dangers inherent in this approach are illustrated by the excavation of Milton Loch Crannog, Kirkcudbright by Piggott, C. M. (1953) assigned to the second century AD on metalwork evidence. Subsequent radiocarbon dating of structural timbers showed that occupation was of two periods, the first around the mid 1st millennium BC and the second in the last centuries BC and the first centuries AD (Guido 1974, 54 ; Crone 1993, 246). A further cautionary note is sounded because the prevalence of Roman finds on elite native sites indicates that their availability was not even, but was limited to certain social groups whose power and identity were defined by control of these objects (Macinnes 1989). Conversely an absence of Roman finds does not necessarily indicate a pre-Roman or post-Roman period of occupation since many social, political, religious, economic and taphonomic factors determined the uptake and later presence in the archaeological record of these artefacts on sites.

3.1.2 Settlement pattern.

Aerial prospection indicates that the settlement pattern is more extensive and complex than previously imagined. The scheme devised by C.M. Piggott (1948) from her excavation of Hownam Rings, Roxburghshire defined a developmental sequence from palisaded settlement through several phases of circumvallation of increasing complexity to a final phase of unenclosed settlement. Though hampered by a lack of precise dating which compressed the chronology, this series has been widely accepted. The excavation at the small hillfort at Broxmouth, East Lothian highlights the difficulty in this broad brush approach, here phases of multivallation alternate with phases of single ditches culminating in an open settlement phase (Hill 1982). Such frequent changes in the scale and nature of defences challenges such a simple model of development as the so-called Hownam sequence. The complexity of many sites may indicate a difficult to disentangle palimpsest of occupation, rather than succeeding elaboration of fortification. While there is a general trend from palisaded settlement to unenclosed settlement, this takes place over a much longer period of time and the sequence is different in detail in different places. Once it was generally believed that the move away from visibly defensive forms was a direct consequence of the *Pax Romana* (Jobey 1966). However, the level of control required to facilitate this makes it probably an anachronistic concept. Moreover, the time required to carry out such a policy against a largely dispersed community was not available within the brief and intermittent occupation of the area. The archaeological evidence increasingly indicates that the move to open settlement occurred before the arrival of the Romans. At Burnswark, a hillfort in Dumfriesshire, Jobey (1978) demonstrated that although occupation in the form of timber-built roundhouses continued into the mid 2^{nd} century AD, the defensive enclosures were already redundant. Excavation at Broxmouth, East Lothian by Hill (1982, 171-75) revealed three sunken stone built houses exhibiting several phases of reconstruction utilising stone robbed from the earlier defences. These structures were overlain by soil and tumbled building remains which contained Samian sherds indicating an occupation probably, though not necessarily entirely, before the Roman period. A number of sites on the Lothian plain, such as St. Germains (Watkins 1982; Alexander and Watkins 1998) and Dryburn Bridge (Triscott 1982), show the later unenclosed settlement expanding to overlie the infilled or demolished earlier defences. Small finds at St. Germains indicated that the last phase was still current when the Romans arrived. Radiocarbon dates, where available, support an early to mid 1st millennium BC date for the floruit of unenclosed settlements, for example the settlement of ring ditched houses at Douglasmuir, Angus (Kendrick 1982).

The settlement pattern across the study area is not a cultural continuum and it can be demonstrated that defended sites did exist in some areas. The Dunion, Roxburghshire, appears to have continued in use and perhaps expanded in the pre-Roman Iron Age (Rideout 1992), but the defensive structures are slight, exploiting natural features of the landscape to create the impression of strength. Traprain Law, the c.17ha large hillfort in East Lothian, has generated intense though intermittent study because of its conspiciousness. Unfortunately the major excavation efforts between 1912 and 1923 which recovered a rich and varied material assemblage (Burley 1956), did not record the context of the recovered artefacts, but merely their general level in the stratigraphic sequence. Consequently, though the site shows an almost continuous occupation throughout the Roman period, it has been impossible to link these with the series of defensive structures. In consequence, and with the appreciation of the more symbolic role of boundaries (Bowden and McOmish 1987), Hill (1987, 88) postulated that this apparently high status site was not a settlement but was used mainly for ceremonial purposes in the early first millennium AD. This idea has become somewhat of an orthodoxy in recent overviews of this period (Breeze 1996, 114; Hingley 1992, 37; Armit 1997, 102-3; Armit and Ralston 1997, 180). However, more recent work, involving analysis of the distribution of the finds from the western plateau at Traprain Law has identified a fairly even spread of features reminiscent of domestic activity in the late pre-Roman Iron Age and Roman Period (Erdrich *et al.* forthcoming). The presence of hearths, quernstones, whetstones and spindle whorls points to a primarily domestic occupation of the site. Though as Erdrich *et al.* point out, it may be unreasonable to divorce cosmological ideas and practices from everyday life in this period. Demonstrably defended sites generally are a rarity in the settlement pattern of the late pre-Roman Iron Age and the Roman Period and the numerous enclosed but undefended settlements overlying hillforts in the Tyne-Forth province demonstrate that this form had substantially gone out of use (Jobey 1974a, 22).

Many other conspicuous settlement types generally believed to have elite status due to their monumentality and elaborate architectural construction can be demonstrated to have been occupied in the Roman period. As stated above many of these have limited regional distributions. Brochs, the characteristic settlement form of the Atlantic west, are found in the lowlands in restricted numbers. They are distributed mainly in the Forth and Tweed valleys and the Lothians. Dating evidence usually comes in the form of Roman material and indicates occupation in the first and second centuries AD. Carbon-14 dates are rare but those obtained for two brochs in Stirlingshire at Leckie, (Mackie 1982, 62-64) and Buchlyvie (Main 1978, 1979, 50 and 1998) support this, though the statistical ranges are wide, encompassing the late pre-Roman Iron Age and the later Roman period. In some cases brochs can be shown to post-date earlier defensive structures for example at Hurly Hawkin, Angus, where the inner rampart of the double defences of the promontory fort was levelled to facilitate construction of the broch (Taylor 1982, 223) and at Torwoodlee, Selkirkshire where the broch ditch was cut through the partially silted ditch of the pre-Roman hillfort and the broch wall overlay the hillfort rampart (Piggott, S. 1951, 102). While acknowledging the obvious defensive qualities of broch structures to low level threats, this aspect is no longer generally regarded as paramount. The old diffusionist explanations involving an influx of people from the north or the import of broch building experts to explain the apparently anomalous existence of an exotic building tradition in the lowlands no longer finds favour. Macinnes (1984b, 238-9) has argued, that the broch form is a local development, utilising analogy drawn from anthropological models of the adoption of architectural innovation within stable social groups and from an analysis of the comparison between the internal arrangements in lowland brochs and substantial timber houses. Thus recognising that the use of space in the seemingly exotic broch is comparable with that in existing structural forms. Broch construction is paralleled with the continued erection of substantial houses in many areas in the early centuries AD (Macinnes 1984b) when the trend is generally towards smaller house structures from the end of the first millennium BC. North of the Forth substantial houses are still in use at Newmill, Perthshire (Watkins 1980) and Scotstarvit, Fife (Bersu 1948). While south of the Forth, Dryburn Bridge, East Lothian (Triscott 1982, 120) and Rispain Camp, Galloway (Haggarty and Haggarty 1983) provide examples. In some cases continuity can be demonstrated from earlier timber structures, as at Buchlyvie (Main 1978, 1979, 1984 and 1998) and Torwoodlee (Piggott, S. 1951). Indeed, at Buchlyvie the broch hearth is superimposed upon that of the previous wooden structure, showing a perpetuation of focus for both dwellings. Brochs emerge as a conspicuous settlement form at the same time as farmsteads and duns are also being constructed in dry stone in the lowlands in many places. Brochs in the north are usually associated with patches of the most viable land in an otherwise relatively barren landscape and the lowland brochs are also sited on eminences near to productive tracts of land perhaps indicating a similar desire to control the most productive land. Such is the case at Buchlyvie (Main 1978, 1979 and 1998) situated on the fertile alluvial deposits of the Carse lands of the Forth valley. Lowland brochs, such as Buchlyvie (Main 1998) and Leckie (Mackie 1982), have furnished high quality Roman objects suggesting that the inhabitants were an important part of the indigenous native elite. They should, therefore, perhaps be seen as an alternative means by which wealthier elements of indigenous society could display their status and legitimate tenure and control of tracts of the most fertile land available in Scotland.

A settlement form related morphologically to brochs are the small dry stone constructed forts known as duns. These circular or oval settlement enclosures, averaging 375 sq. m in area, are rather more numerous than brochs in the lowlands. Most are found in Argyll where their distribution overlaps with brochs. Further clusters have been identified in Stirlingshire, Ayrshire and Dumfriesshire. Dating relies predominantly on artefactual evidence, mainly Roman material, for ascertaining occupation contemporary with the Roman incursions. However, a comparative lack of excavation means they provide such material less frequently. Pottery glass and metalwork in moderate quantity have been recovered from Castlehill Wood, Stirlingshire (Feachem 1957) and Castle Hill Ayrshire (Smith 1919). Whilst a considerably smaller assemblage was unearthed at Keir Hill, Stirlingshire (McLaren 1958). The defensive qualities of their construction and topographic setting are generally believed to be less important than was once the case and their architectural sophistication and monumental construction are probably a manifestation of conspicuous material display by the indigenous elite.

Crannogs the artificial islands, wholly or partially man-made, which abound in the lochs and estuaries of the western lowlands have the potential to tell us much about the local agricultural economy due to the excellent preservation of organic material in the prevailing waterlogged conditions at many sites. Most comprise a single building of circular plan and of some architectural sophistication placed upon an artificial island of elaborate timber construction. The survey of Roman material on native sites by Robertson showed that a wide range of quality items of Roman manufacture were available to crannog dwellers, for example at Hyndford, Lanarkshire and Buiston, Lochlee and Loch Spouts in Ayrshire (Robertson 1970, Table 3). Radiocarbon dates, where available, indicate that crannogs have a long history of intermittent occupation from the later Bronze Age to the early historic period, with some reoccupation thereafter (Barber and Crone 1993, 520-33). The architectural sophistication displayed by crannogs suggests their elite status, and their access to Roman imports has long been seen as a reflection of this. Many crannogs were associated with arable agricultural activities, as the waterlogged chaff from Oakbank crannog indicates (Miller *et al.* 1998, 807). Ard ploughs have also been recovered on some occasions as at Milton Loch 1 (Piggott, C.

M. 1953) and Oakbank (Dixon 1984). The siting of crannogs reflects the importance of agricultural activity on the adjacent land. They are invariably placed close to shore, where suitable bottom conditions off-shore prevail, adjacent to patches of viable productive land (Morrison 1985, 74-80).

Souterrains, the enigmatic stone lined underground passageways associated with unenclosed settlements often of timber-built round houses, are found densely spread in Angus and south Perthshire. Though the densest concentrations are north of the Forth, there are outliers in Lothian and the Borders. Smaller examples are known outwith the study area in the northern isles and north-west Scotland, but the largest and most impressive structures are recorded in the eastern lowlands. Souterrains are generally considered to be underground storage places for agricultural produce (Watkins 1980a, 197-8 *contra* Wainwright 1963, 16-19). Dating evidence is rare, but they appear to have been, as far as can be discerned, a first to third century tradition, though some have their origin in the late Iron Age. At Hurly Hawkin, Angus the souterrain succeeded a broch which was in turn built within and partly overlying the ditch of an earlier promontory fort (Taylor 1982, 215), and at Castlelaw in Lothian the souterrain was constructed utilising the ditch of an earlier hillfort (Piggott and Piggott 1952). Roman artefacts are not infrequently recovered from souterrains, for example at Carlungie, Hurly Hawkin and Pitcur in Angus, and Castlelaw in Lothian (Robertson 1970, table 4). A number of souterrains incorporate the dressed and carved stones robbed from Roman forts in their structure, indicating construction after the various Roman withdrawals. Amongst Roman stones included in the fabric of the souterrain at Chrichton Mains is the carved Pegasus emblem of *Legio II Augusta* (RCAHMS 1929, 53-4). These stones probably came from the bathhouse of the nearby Flavian auxiliary fort at Elginhaugh (Hanson forthcoming). Post-Roman construction in the mid-second century is suggested at Shirva where the passageway lined with grave slabs and other commemorative stones was inserted into the ditch of the Antonine Wall (Keppie 1998, 133). Also at Newstead I, stones robbed from the fort were re-used in the structure. There is considerable diversity among unenclosed souterrain settlement. A large single souterrain associated with a single substantial house at Newmill (Watkins 1980a) may have had authority over a communal storage facility where control of distribution was a mode of maintaining elite status. Whereas a large complex souterrain dominated a smaller settlement at Carlungie (Wainright 1963) suggesting a shared storage facility. Smaller individual souterrains were attached to smaller houses at Dalladies (Watkins 1980b) implying domestic storage places for each household. The acceptance of a storage function for souterrains and the abundance of querns on such sites suggested to Macinnes (1984a, 241) that a systematic exploitation of the arable land in this region was taking place. The storage capacity of the eastern lowland souterrains and their location in the most fertile regions of Scotland perhaps indicates the generation of a considerable agricultural surplus. This is difficult to relate to the Roman army, but there may be considerable potential as a source for local supply.

These presumed higher status sites apart, the predominant settlement form over much of the study area in the Roman period was the small rectilinear or curvilinear non-defensive enclosed settlement, sometimes terraced into the hillside, comprising from 1-5 small round houses with accompanying sunken yards. In the eastern lowland hills the enclosures are normally stone walled with stone-built houses. This form is found throughout the borders and Northumberland as for example at Crock Cleuch, Roxburghshire (Steer and Keeney 1947) and Haystack Hill (Jobey 1964). Further west in Dumfriesshire the tradition of timber building is maintained. Here small earth and stone embanked enclosures containing circular timber-built houses are the most representative settlement type (RCAHMS 1997). A typical example is the multi-phase site at Boonies, Westerkirk excavated by Jobey (1974b), where the houses were confined to the rear of the enclosure leaving a slightly sunken yard. The enclosure contained one house in its first phase expanding to five later. Dating by carbon-14 indicates occupation in the first to second centuries AD.

On the freer draining and agriculturally more productive land of the major river valleys and the coastal lowlands, sub-rectangular enclosures containing one or more houses often of timber construction are typical, as at Doubstead, Northumberland (Jobey 1982b) and Enclosure A on the terrace above the river Nith at Carronbridge, Dumfriesshire (Johnson 1994). Square and rectilinear enclosures are also to be found clustering to the south and west of Traprain Law. These cropmark sites have been tentatively identified as belonging to the Roman period on morphological comparison with a few carbon-14 dated examples from Northumberland (Maxwell 1970). An example at Brixwold (Dalhousie Mains), Midlothian was recently excavated and radiocarbon dates suggest that the second phase of activity at the site fell within the Roman Period (Crone and O'Sullivan 1997). Unfortunately extensive plough damage made it impossible to ascertain the domestic arrangements within the enclosure.

The area north of the Forth displays many of the settlement characteristics of further south, and non-defended sites are also found, particularly in the lowlands of Angus (Macinnes 1982,61). There are generally fewer hillforts beyond the Forth-Clyde isthmus and, as in the south, these had been largely abandoned by the early centuries AD. Large hilltop enclosures such as the Brown Caterthun (Feachem 1966), and vitrified forts such as Finavon (Mackie 1976), both in Angus, had been abandoned for some considerable time. But whereas enclosed settlement predominates to the south, open settlement, that is sites not defined by any enclosing boundary, are the most representative form further north (Macinnes 1982, 68-9) for example Dalnagar (Stewart 1962) and Kilphedir, Sutherland (Fairhurst and Taylor 1974). Houses are either timber-built or stone based. In Fife in the later pre-Roman Iron Age settlement is comparable in size to that north of the Tay, but in character resembles that to the south of the Forth, indicating that the river was more of an avenue of communication than a barrier between tribal areas (Hanson and Maxwell 1986, 10). By contrast the predominance of open settlement north of the Tay and the apparent longevity and lack of change in the settlement pattern probably indicates that the Tay was a cultural divide at the time of the Roman incursions (Macinnes 1982, 70-2).

3.1.3 Subsistence and land use.

Iron Age economic strategies probably varied widely due to differences in soils, topography, climate and the patterns of preferred or inherited exploitation from the later Bronze Age. It is generally accepted that the Iron Age subsistence economy was based on mixed farming (Macinnes 1984a, 189-96). Indeed such a strategy would seem necessary, to maximise the return from the land, supplemented with hunting and fishing where possible. The relative proportions of arable to pastoral are difficult to discern from the limited evidence available, but it would be expected that upland farms would be more suited to stock rearing while lowland farms concentrated on arable cultivation. The major pastoral element seen in upland areas is manifested as major cross dykes and linear dyke features usually interpreted as stock control measures. Pit alignments such as those at Priestfield, Angus (Macinnes 1982) and Castlesteads, Midlothian (Armit and Ralston 1997; Halliday 1982) suggest land divisions for controlling animals. Bone is the most direct evidence for animal husbandry, but the more acid soils in the north and west tend to militate against its survival. Where bone does survive, such as at Broxmouth, East Lothian (Barnetson 1982), it indicates predominantly cattle and sheep as the major domestic species, with some pigs and goats. The inherent bias due to the paucity of the available sample tends to indicate meat production though the presence of spindle whorls on many sites, including Traprain Law, and butter residues on food vessels such as, at Oakbank Crannog, suggests wool production and dairy produce were also important. Archaeological evidence for arable farming in the late pre-Roman Iron Age and Roman Period is increasing. Aerial photography has identified extensive field systems apparently associated with settlements, for example at Castlesteads, (Halliday 1982) and at Chesters near Drem, (Macinnes 1984a) both in Lothian, where a series of long fields are defined by pit alignments enclosing substantial tracts of arable land. Patches of cord rig, surviving at altitudes above levels of later cultivation, indicate that arable farming must have been fairly extensive (Halliday 1982 and 1986; Topping 1989; Gates 1999). However, obtaining precise dates for these is problematic, and rigs are known to have been used into the Early Medieval period (Carter 1994). That the uplands were being extensively cultivated implies that the lowlands were utilised to capacity, particularly on reasonably drained lower-lying areas where subsequent use has obliterated archaeologically-recoverable traces. Storage facilities such as four posters and pits are rare but souterrains are densely found in some areas such as Angus (cf. Maxwell 1983). Their storage capacity may indicate the scale of agricultural production. Querns are frequently found on Iron Age sites (though perhaps not exclusively used for cereal grinding). Rotary querns appear early and disseminate widely throughout Scotland, perhaps indicating that processing of cereal was of considerable importance (Armit and Ralston 1997, 190). However, they can only be linked with cereal consumption rather than crop growing in the absence of corroborating evidence of processing activities (van der Veen 1992, 16). Lastly, agricultural implements such as iron plough shares, hoes, mattocks and spades have been recovered from Traprain Law (Burley 1956), and from the large votive deposits at Blackford Mill and Eckford (Piggott, S. 1953). The cropmark evidence indicating a considerable density of settlements in many areas such as East Lothian north-east Fife and Angus leaves little doubt that lowland settlement was based on a mixed economy in which arable agriculture played a central role. The economy was much more complex, we are not dealing with a simple subsistence economy for there is evidence of production of fine metal-work which would suggest the presence of specialist craft workers. A surplus must be generated to maintain these individuals who were non-productive, in agricultural terms.

3.1.4 Socio-political Structure.

It seems likely that we are dealing with tribal groupings, though how cohesive and distinctive these may have been and what potential they had for corporate action is debated (Hingley 1992, 34 and 42). There is a comparative lack of literary references for the northern part of Britain (Mann and Penman 1990), but the two Classical sources that are extant give indications of tribal names. These are the *Geography* of Ptolemy and Tacitus' account of the invasion of north Britain led by his father-in-law Agricola. Both of these primary sources suffer from being second hand, neither author visited Britain, and there is considerable debate about what sources were used. Ptolemy writing in the mid-second century based his work on that of Marinus of Tyre , now lost, and may have had access to information brought back from the Roman campaigns in the first century (Hanson 1987, 23-5; Rivet and Smith 1979, 114-16). The list of names and their latitudes and longitudes which Ptolemy provides are difficult to place because the map derived from his co-ordinates is displaced at right angles to the rest of Britain. This leaves a considerable potential for error when correcting for this distortion (Mann and Breeze 1987). The account of Tacitus suffers from an extreme paucity of geographical references, which is not surprising when the audience it was composed for is considered. The majority of these upper class Romans did not know where Britain was and probably did not care either. Ancient historians were not engaged in the rigorous, forensic investigations which modern historians employ, marshalling all of the available evidence to support their argument. They were composing a literary genre, the aims of which were artistic, political, moral and rhetorical in inspiration (Hanson 1987, 15-23).

There is difficulty in defining the territories associated with the named tribal groupings. Coin evidence, used to link tribal names to areas of influence through analysis of the distribution patterns and mapping of their circulation areas, is absent in the north. Tribal groups are also difficult to define on archaeological evidence. There are regional differences discernible in the settlement pattern. The distinctive settlement forms of brochs, duns, souterrains and crannogs may imply distinctive social groups with a common political identity, or at least territorially conscious groups attempting to signify their distinctiveness from their neighbours (Armit 1997, 78), But this may be an overly simplistic view since these dwellings display many characteristics in size, architectural sophistication and complex spatial organisation in keeping with broader indigenous traditions seen in substantial timber houses (Macinnes 1984b, 239). The predominance of open settlements north of the Forth in contrast to the preponderance of enclosed settlements to the south has been defined as a regional contrast in social organisation with cultural implications (Macinnes 1984b, 241; Maxwell 1985). This probably reflects a difference in the basic organisation of society and provides a strong hint that there was a cultural divide somewhere between the two firths of Forth and Tay (Macinnes 1982, 70-2). While it is apparent that variations in the settlement pattern exist, they cannot be linked with any confidence to any of the named tribal groups. A hierarchical model for social organisation is generally assumed because there is evidence of a settlement ranking and some limited indications of political centralisation. Hierarchies probably operated at several levels, from the local scale of the household to the kinship group, tribe and then the territorial group. Large hillforts such as Traprain Law, East Lothian and Eildon Hill North, Roxburghshire, which were demonstrably occupied in the late pre-Roman Iron Age and Roman Period, would suggest some settlement hierarchy. That these functioned perhaps as central places is suggested at Traprain Law, where small rectilinear settlements cluster around the Law (Maxwell 1970), and at Eildon Hill North, Roxburghshire (Owen 1992), where a hierarchical pattern of settlement may be indicated by the c. 150 settlements within a 25 km radius of the fort (Jones 1990). Substantial houses with associated souterrains surrounded by smaller houses, as at Newmill (Watkins 1980a), point to the power of individual households to control agricultural production at the local scale. A strong familial structure is discerned largely on the settlement evidence. The vast majority of settlement sites are small of less than 0.5ha and consist of 1-5 houses whether enclosed or open and are generally regarded as homesteads for family groups. A typical example is Carronbridge, Dumfries, an enclosure with one or two houses in the interior dated from the second century BC to the second century AD (Johnson 1994). There are some indications in the settlement evidence of higher status individuals. The distinctive settlement forms of hillforts, brochs, duns, souterrain settlements and crannogs are generally considered to be elite residences because of their architectural sophistication and monumental nature. Evaluation of their wealth relative to other types of site in the Roman period is currently only possible with respect to their receipt of Roman material. Despite biases in the data due to differential deposition, survival and access to the material, it seems that Roman material was only available on architecturally distinctive sites (Macinnes 1984b, 241-2). This phenomenon is most marked in the first and early second centuries AD. Political centralisation may be manifest in the obvious enormity of the task of mobilising labour and co-ordinating the effort required to construct a large hillfort. The ability to gather together a disparate collection of tribes to challenge the Roman army at Mons Graupius is also an indication, however temporary, of some coercive power by individuals or groups. Corroborating evidence in the form of wealthy burials and as previously mentioned coins, are absent, but there are indications in the literary evidence of named individuals of elite status for example. Cartimandua was queen of the large tribal confederation, the Brigantes, with her tribal capital at Stanwick, Yorkshire, which is thought to have controlled northern England and perhaps some of southern Scotland. She is recognised in Roman sources because she was a client queen (Tacitus *Annals* 12.36 and 40 and *Histories* 3.45) There is also Calgacus the war leader who led the temporary tribal confederacy brought together to oppose the Agricolan invasion of the first century (Tacitus *Agricola* 29-32). Material culture evidence in the form of elaborate metalwork indicates a hierarchical social structure. Some famous pieces such as the Torrs chamfrain (pony mask) from

Kirkcudbrightshire, the armlets from Castle Newe, Aberdeenshire and the Stichill collar from Roxburghshire. There were undoubtedly wealthy individuals who were able to afford to commission this work. The idea of Iron Age societies being ruled by warrior elites finds less favour among Iron Age scholars today and the current view stresses the small scale nature of warfare involving raiding and a strong element of display and symbolism (Armit 1997, 49). This is borne out by the token nature of defensive structures on many hillforts and the preponderance of open settlement and undefended enclosures across the majority of the landscape. Symbolism and display are reflected in the artefactual record. Elaborate horse harness features highly in metalwork hoards, while weapons, except in Northumberland, are a relatively small component (Hunter 1997). The Deskford carnyx (war trumpet) from Banffshire perhaps typifies the ritual nature of these combats. The settlement pattern seems to indicate that stable and relatively peaceful conditions prevailed on the eve of the Roman invasion (Armit and Ralston 1997; Armit 1997).

3.2. HISTORICAL OUTLINE OF THE CONQUEST.

In order to place the Roman presence in the north in context it is necessary to outline the historical background to the Roman occupation. The Civil War that marked the transition from the Julio-Claudian dynasty to the Flavian came at the end of a decade of retrenchment caused by the Boudican revolt of AD 60, which almost caused the loss of the province by Rome (Suetonius *Nero* 18). Thereafter, with the establishment of the Flavian Dynasty, we see a return to a more aggressive approach and a renewed advance. The large tribal confederation, known as the Brigantes, in Northern England was conquered by Petillius Cerialis, governor AD 71 -74 and control was established over Wales by Julius Frontinus, governor AD 74 -78 (Frere 1987). The mopping up was left to Julius Agricola in the first years of his governorship AD 78 -79 (Tacitus *Agricola* 18-21).

As Hanson and Breeze (1991) note, "The political history of Roman Scotland is reasonably understood and provides a vital framework for more detailed study". The periods of Roman occupation are well defined and relatively brief. The extant literary sources record that there were three major invasions by the Roman army which led to the occupation of some territory north of the Tyne-Solway isthmus, though there were also a number of other military contacts, mainly punitive in nature, with less discernible results.

Initial contact may have been made in the early 70's AD during the governorship of Petillius Cerialis as part of the conquest of the Brigantes (Hanson 1987). However, the first invasion and serious attempt at conquest took place under the command of Julius Agricola between AD 79/80 and 83/84 (Tacitus *Agricola* 18-40). Agricola's unknown successor then carried on the process of re-ordering the new conquests for the efficient collection of taxes and exploitation of resources, by extending the network of forts and connecting roads, as well as building the legionary fortress at Inchtuthil as a forward base for a campaign to complete the conquest of the island (figure 3.2) Circumstances elsewhere in the empire, however, necessitated a withdrawal to the southern uplands by AD 87, as the coin evidence indicates (Hobley 1989), and by c. AD 105 the frontier had been withdrawn to the Tyne-Solway Isthmus. Archaeological evidence in the form of pottery from several forts in southern Scotland indicates that they remained in occupation longer than their northern counterparts and many have two late first century phases of construction supporting a gradual withdrawal (Hanson and Breeze 1991). With the establishment of Hadrian's Wall in the AD 120's outpost forts, as bases for long range patrolling, were sited on the fringes of the Scottish lowlands (Breeze and Dobson 1987). This was the extent of the occupation until a limited re-conquest began in early AD 139 initiated by the need of the new Emperor Antoninus Pius for a relatively easy victory to consolidate his position on the throne. The aim of the conquest of the lowlands was substantially complete and consolidation underway by AD 142, with the construction of a linear barrier, the Antonine Wall, and its attendant forts and fortlets. The Antonine Wall was sited across the Forth-Clyde isthmus. An extensive network of forts was built behind it and a line of forts screening off Fife in front, in support of it (figure 3.3) Occupation continued, the current orthodoxy maintains, until the mid AD 160's according to the Samian evidence (Hartley 1972), although there is still some debate on this chronology in some quarters. Mann (1988) asserting the primacy of the extant literary sources, favouring a later date AD 195 and Hodgson (1995) arguing convincingly for an even more short-lived occupation and gradual run down before abandonment of the wall by AD 158.

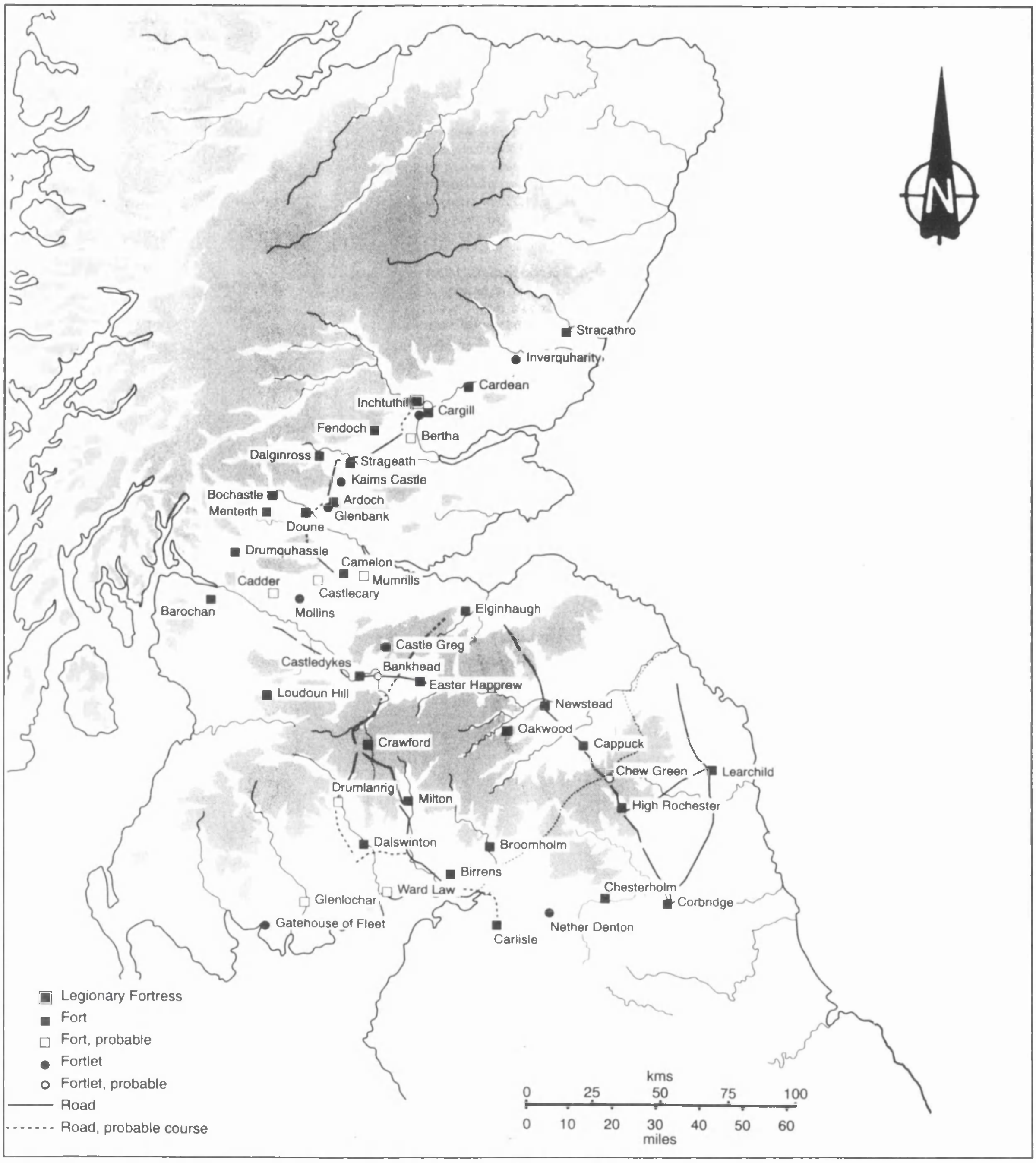

Figure 3.2 : Permanent forts, late first century (Flavian period) from McNeill and MacQueen (1996).

Hodgson's persuasive assessment of the dating evidence and the phases of occupation of the forts has challenged the existence of the temporary withdrawal from Scotland, supposedly occasioned by widespread trouble with the native population, followed by a reduced re-occupation. This hiatus is traditionally dated to AD 158 based on the literary reference of Pausanias (*Descriptio Graeciae* 8.43,3; 8.44,4), archaeological evidence of destruction by burning at some forts and an inscription from Heddon-on-the-Wall which indicates a re-occupation and refurbishment of installations on Hadrian's Wall (RIB I 1389). The well known problems of distinguishing destruction by hostile action from the normal clearing up of a site prior to abandonment by the Roman army merely providing fuel to the debate. In the later Antonine period the attested reduction in garrison strength is probably due to a strain put on the available manpower by the provision of such close control on the linear barrier (Hanson and Maxwell 1986). It therefore seems more likely that the trouble was more localised and did not cause the Wall itself to be given up, even briefly (Keppie 1998, 16). With the withdrawal back to Hadrian's Wall only outpost forts remained on Scotland's southern periphery, although on the eastern flank forts were maintained as far north as Melrose on the river Tweed in Roxburghshire for a further twenty years. From the mid 180's however, only outpost forts immediately north of the Tyne-Solway line were maintained (Breeze and Dobson 1987).

The third and, as it transpired, final attempt to conquer Scotland was conducted either in person by the emperor Septimius Severus or through his elder son, Caracalla, as legate between AD 208 and 210 (Reed 1976; Breeze 1982b; Martin 1995). These major campaigns were occasioned by an appeal from the Governor of Britain for the emperors personal intervention to quell major unrest by the Maeatae and Caledonii in eastern and northern Scotland (Herodian *History* 3.14,1). The progress of the invading army across the landscape and the number of columns that it constituted are conventionally followed by observation of temporary camps of similar size, in this instance the 25, 55 and the 65ha groups, since only two forts are known to have been occupied at this time. Cramond on the Forth was rebuilt and a new forward base was constructed at Carpow on the Tay though neither appear to have been occupied for more than one or two years after Severus' death at York in AD 211. The historian

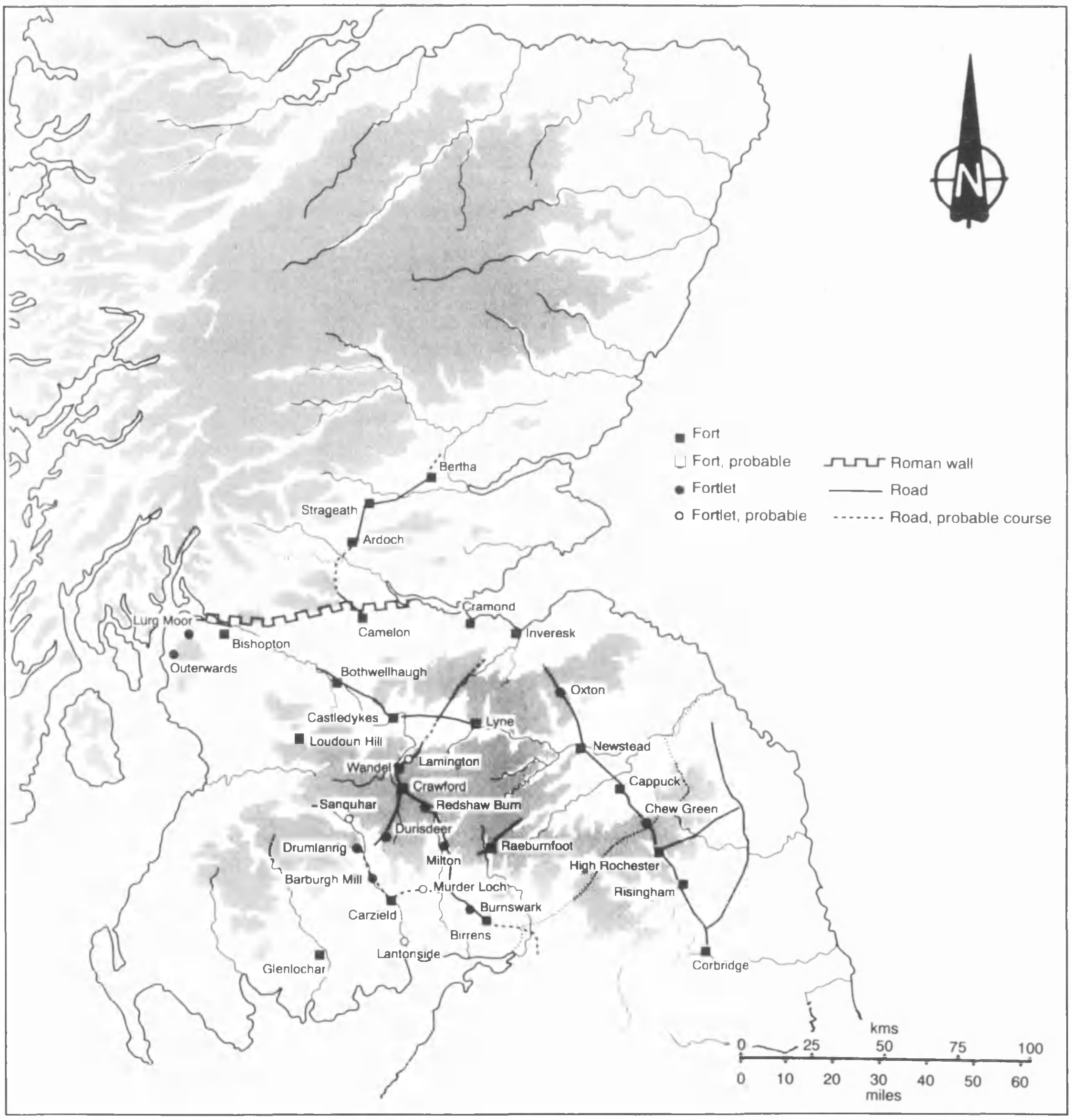

Figure 3.3: Permanent forts mid-first century (Antonine period) from McNeill and MacQueen (1996).

Dio (*Roman History* 77.1,1) tells us that after Severus' death Caracalla immediately abandoned the conquests and returned to Rome to consolidate his position. However, a dedicatory inscription from the east gate at Carpow would seem to indicate building activity by Caracalla after his fathers death (Wright 1964). Nevertheless these activities constitute an even shorter period of contact with the indigenous population than on the two previous occasions. Thereafter the frontier reverted to Hadrian's Wall and its outposts in northern England (Hanson and Maxwell 1986; Breeze and Dobson 1987).

The literary sources indicate that the Roman army campaigned on numerous occasions under high profile commanders for the remainder of the Roman period, but these were solely punitive exercises and no attempt to occupy territory was contemplated (*Panegyric of Constantine* 7. 1-2; *Anon vales.* 2.4; *Gallic Chronicler of 452;* Claudian *First Poem against Eutropius*).

3.3 ARMY DEMAND.

The bulk of the Roman army in Britain was stationed in the north for the majority of the Roman period . The actual strength of these forces fluctuated over time, depending largely on political events in other parts of the empire which influenced the changes in frontier policy and the extent of the troop dispositions. This size variation between periods of occupation is particularly marked in Scotland where Roman activity was generally in a state of flux. Moreover given its peripheral location on the margin of empire, North Britain was considered a comparatively safe place from which to remove troops to counteract crises on less peripheral and more active frontiers. A distinction must also be made between the size of the army in permanent garrison and the army utilised during a campaign of conquest. The latter was most likely larger by three complete legions or at least vexillations of them. Legionaries used as a tactical reserve on campaign and for major building projects, were rarely used in garrisoning the conquests thereafter.

Accurate figures for the three campaign armies involved in the various attempts to conquer Scotland are impossible to give, but estimates have been made from the extant literary sources and the size of temporary camps deemed to have been used in each campaign, (see Hanson 1978, 142-3 for the problems associated with these calculations). Approximate figures derived from the major ancient source for the size of Agricola's army at the battle of Mons Graupius, (Tacitus, *Agric* 35 & 37) are provided by Mann (1985, 23) and Hanson (1987, 137) and range from 17,000 to 20,000-30,000 men. The force involved in the second century re-conquest can be estimated on the basis of the size of the largest Antonine temporary camps known in the lowlands though that need not be the totality of the force involved. Combined with an estimate of troop density based on Polybius' (*Histories* VI.27-28) description of a camp for a consular army and the account of Hyginus (*Liber de Munitionibus castrorum*) gives a figure of about 740 men per hectare. Therefore, as little as 16,500 troops may have been involved. The better attested Severan camps would indicate a force of between 40,000 and 50,000 (Hanson 1997a, 203).

Current estimates based on analysis of the extant literary evidence (Breeze 1984, 266-268), and on current knowledge of the size and maximum number of forts occupied simultaneously in each period of occupation (Hanson 1997a, 204 table 11.1), indicate that the strength of the army of occupation was in the order of 25,000 men in the Flavian period, c. 24,000 in the early Antonine period, with a reduction to c. 17,500 in the later Antonine period and c. 3,300 at the time of the Severan invasion. It is clear that the various armies of occupation would require the provision of a large and extensive range of goods including food, clothing, arms, transport animals, tents and so on (Breeze 1982a, 1984, 268) which had to be provided by the local population or be imported from other parts of the empire.

There is probably also a difference between the demands of a campaign army and that of a garrison army. "The food supply of an army actively engaged on campaign is largely a problem of logistics and is probably ruled by short term policy, but that of a standing army is influenced by the carrying capacity and economic stability of the region in which it is stationed" (Groenman van Waateringe 1989, 96-99). Living off the land is beneficial to an army on campaign, operating far from its supply base, because it enhances its mobility and does away with the need to deplete the army by deploying troops to defend long supply lines.

But quantifying such a fluctuating demand is virtually impossible. Roman troops undoubtedly lived off the land on campaign, each soldier carried a sickle to reap crops (Josephus *BJ* III.95) and depiction's on Trajan's Column show he also carried a string bag to carry the collected forage. On the other hand the Roman army prepared thoroughly for major campaigns by laying in large stores of foodstuffs, as is graphically illustrated by the extensive suites of store buildings constructed at Red House, Corbridge (Hanson *et al.* 1979) in preparation for the Agricolan invasion of the late first century and the granaries at South Shields (Dore and Gillam 1979) and Corbridge (Bishop and Dore 1989) prior to the third century invasion of Septimius Severus. Each soldier was also issued with three days rations to carry with him (Josephus *BJ* III.95). Agricola relied heavily on the fleet for transport of troops and supplies (Tacitus *Agric.* 25.1), and forward bases were established by Septimius Severus with access to the sea, such as Carpow on the Tay and Cramond on the Forth, to avoid overland transport and extensive foraging .

The principle military requirement was for food for men and animals and, although the available evidence shows the soldiers had a mixed and extremely varied diet, the bulk of the demand was for grain. The diet of the Roman soldier is relatively well known from documentary, as well as archaeozoological and archaeobotanical sources (Davies 1971; Dickson 1989; Hambleton 1999; King 1978, 1984). The dietary staple was grain (usually wheat) supplemented with meat, cheese vegetables, sour wine and salt. A much greater variety of food could be obtained on high days and holidays and the soldiers could purchase extra out of their own pockets (Davies 1971). Plant remains recovered from Roman forts in Britain include wheat, barley, lentils, Celtic bean, dill, celery, coriander, linseed, poppy seed, figs, strawberries, black berries, raspberries and hazel nuts (Dickson 1989). Animal bones found at British Roman forts indicate the consumption of beef, lamb, mutton, pork, venison, chicken, hare, fish and shellfish, though bone evidence seems to show that beef was preferred by the military in the north (Hambleton 1999; Luff 1982; King 1984).

Estimates based on ancient sources indicate that each Roman soldier was rationed between 0.9kg (Polybius *Histories* VI.39, 12-14) and 1.36kg (*P Oxy* 204; Jones 1964, 624) per day of grain, which was made into bread, porridge pasta and soup. This equates to an annual equivalent of between 328.5 and 496.4kg. Thus the 25,000 men of the largest army of occupation in the Flavian period would require approximately 8,280-12,420 tonnes of grain per year. On top of this the grain for animal feed, draught animals and cavalry horses, would have to be added. Polybius (VI. 39. 12-14) indicates that the cereal feed requirement for the cavalry horses would be the equivalent of between 1.5kg and 9kg barley per day during the late Republic. This is generally considered to include up to three remounts, not generally provided as a matter of course in the army of the Principate (Dixon and Southern 1992, 210). The figure derived by Walker of 1.5kg is therefore, more realistic if it is recognised that the feed would be bulked up with hay (1973, 340). On our current understanding of the size of cavalry units compared with infantry units, and the ratio of cavalry to infantry in mixed units (*Cohortes Equitatae*), a ratio of approximately 2 : 1 infantry to cavalry seems not unreasonable. This would suggest a minimum additional requirement, since numbers of draught animals are unquantifyable, of 4,380 tonnes giving an overall minimum quantity in the period of the greatest garrison of between 12,660 and 16,700 tonnes. This equates to a very considerable demand for agricultural produce.

4.
METHODOLOGY

4.1 PLANT MACROFOSSILS

One of the most important categories of organic material in the study of farming activities in the late pre-Roman Iron Age and Roman Period are botanical macro-remains; seeds, fruits and vegetative parts. Through a study of this material, evidence may be obtained about agricultural produce, the landscape and the cultivation and processing activities that took place in the context of subsistence farming. When taken in conjunction with a detailed study of plant microfossils (pollen and spores) from suitable locations adjacent to archaeological sites, a comprehensive picture will also emerge of the environment during occupation and the resultant anthropogenic changes. Their interpretation, however, is not straight forward because of the complexities of the taphonomic routes from the living plant to their deposition in archaeological contexts (Evans and O'Connor 1999, 137 and 138 fig. 11.2). Seeds and fruits are generally difficult to spot in the normal course of an excavation and analysing the collected material is a time consuming process involving a high degree of specialist expertise. This has led the discipline of archaeobotany to develop specific methods for the more efficient collection and analysis of this material. In addition a number of statistical methods are being increasingly employed to interpret and analyse the data. It is therefore, obvious that the methods used in the field and the laboratory processing and subsequent analysis of the material will have a bearing on the eventual conclusions drawn. Accordingly it seems appropriate to discuss briefly the methods employed and their reliability.

4.1.2 Preservation

Archaeological sites vary considerably in the amount of plant material that survives because survival is highly dependent on the prevailing soil conditions of the burial context. Microbial activity is the major breakdown process for organic remains in the soil, therefore, where the deposit containing the plant remains was waterlogged and has remained wet since the time of deposition, the ensuing anaerobic conditions will inhibit bacterial activity and contribute to survival. Such deposits are found in deep pits and wells, where the bulk of the organic material has retained sufficient moisture, ditches (especially in clay soils) cut below the level of the natural water table, and places where water has inundated or reclaimed the site. However, the majority of settlement sites are quite naturally built on dry and reasonably free draining land where the remains are rapidly re-cycled after burial by the abundant micro-organisms and soil fauna. In these circumstances only the mineralised and carbonised remains will survive. Mineralised remains are deposited in moisture retaining or waterlogged soils where dissolved salts of potassium phosphate, for example, are able to impregnate the remains replacing the organic constituents thus ensuring survival when the deposits subsequently dry out (Green 1979). Preservation also occurs if organic remains come into contact with heavy metal ions from weapons or other bronze or iron objects because these poison micro-organisms and thus inhibit their growth. This form of preservation is selective and relatively unusual and contributes an interesting but generally unrepresentative sample to site macro-plant assemblages (Korber-Grohne 1991, 11-12). Carbonisation, or charring, is perhaps the most common means of preservation of plant remains on northern sites and occurs where the grains and seeds have been reduced to carbon while substantially retaining their characteristic morphology and shape due to being burnt in a reducing atmosphere which is insufficient to completely reduce the material to ash. However, some shrinkage and distortion can be expected but often not enough to preclude a successful identification. Carbon is an extremely inert substance and thus carbonised plant remains, though susceptible to mechanical damage, can survive in an otherwise adverse burial environment enabling them to be recovered from both dry and wet sites (Huntley and Stallibrass 1995, 21). Carbonised remains are highly anthropogenic in origin, resulting from crop assemblages, wild plants and wood species selected specifically for use on site. By comparison waterlogged assemblages yield a greater diversity of remains because of the very selective way in which carbonised remains are created before they become incorporated in archaeological deposits. Nevertheless both types of assemblage reveal those species selectively utilised by people on site, and the combination of carbonised and waterlogged remains provides a comprehensive picture of past plant use by these communities. (Figure 4.1)

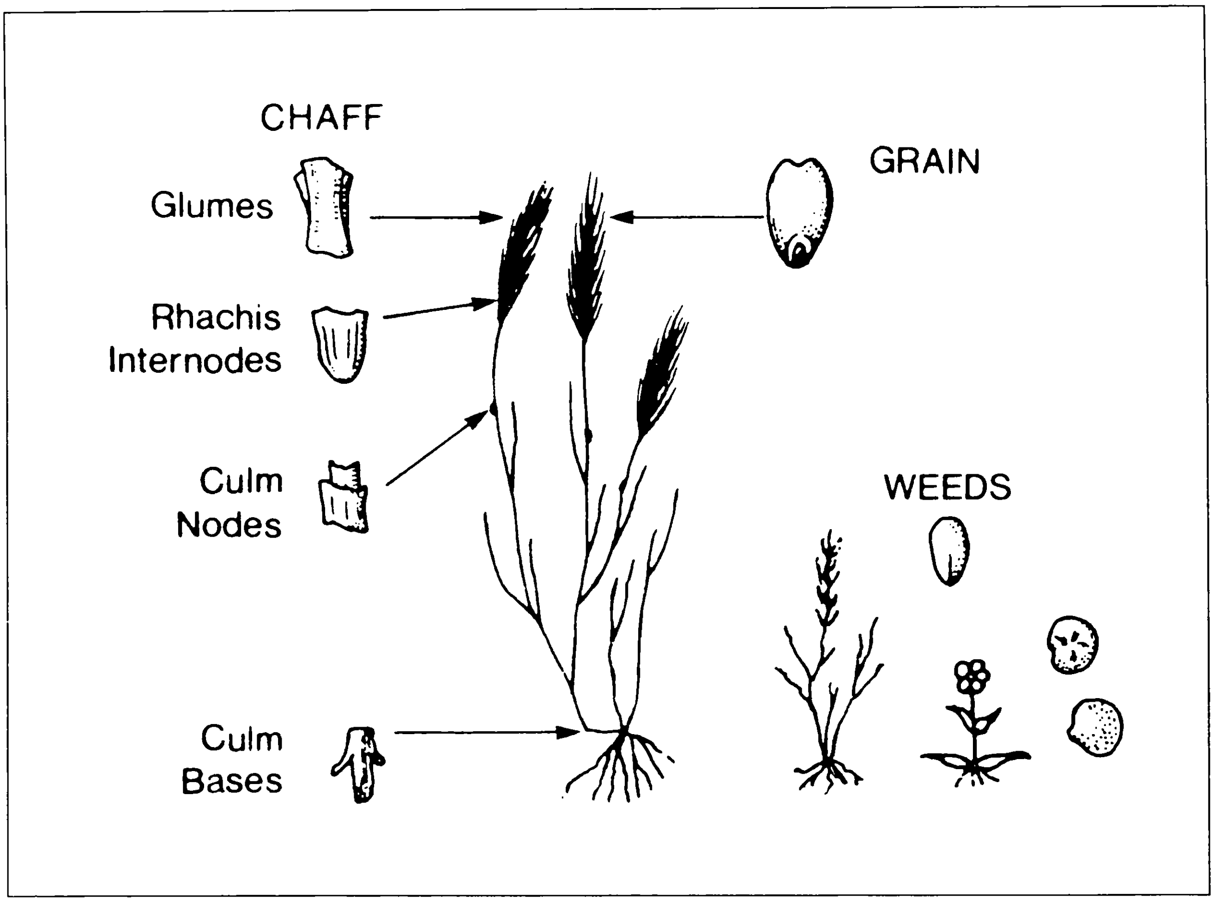

Figure 4.1: Three categories of plant remains commonly recovered from excavations (after Jones 1985)

4.1.3 Recovery

The object of any archaeobotanical sampling strategy is to recover a plant assemblage which is representative of the site as a whole. However, the majority of plant macro-remains are often small and contaminated with the soil matrix rendering them poorly visible, which means they cannot be gathered manually. For this reason a number of special techniques have been developed to assist the more efficient recovery of plant remains. They usually involve a combination of flotation and wet sieving. Flotation relies on the principle that organic remains (the flot) have a lower specific gravity than inorganic materials (the retent) such as soil and stone and will thus float on the top of a suitable liquid medium while the rest will sink (Renfrew *et al.* 1976). Water is commonly used for flotation, though there are disadvantages, since its fairly low specific gravity means that heavier material such as fruit stones will sink.

Alternative media have been used such as zinc chloride and carbontetrachloride, but many of these have their own disadvantages. Carbontetrachloride solution, for example, has volatile and noxious fumes. Normally, soil samples are poured into water containing paraffin or other flocculating agent to increase surface tension. The slurry is agitated by air currents or circulating water and the flot skimmed off into sieves of various mesh sizes to allow preliminary sorting (Jarman *et al.* 1972; Williams 1973). For smaller excavations samples can be separated from the surrounding soil by hand using a sieve and a bowl of water (wet sieving). This is more time consuming and labour intensive than machine flotation, but yields more accurate results because collection is more efficient. Usually a combination of both methods is utilised, depending on the context and size of soil sample available. Despite this greater efficiency in collection, none of these extraction procedures is 100% efficient. Plant remains are often present in large amounts which renders their full recovery and analysis virtually impossible. In practice, therefore, the full range of plant material is only partially retrieved and the materials studied almost certainly represent only a selective sample.

4.1.4 Sampling

Sampling strategy becomes crucial if the most effective amount of information to answer the research questions posed is to be obtained in the time available for the least effort and at the most economic cost. Therefore, the underlying research objective of the investigation informs the sampling programme. In a regional study such as this, compatibility of the individual on site data-sets is desirable to provide inter-site comparisons. However, most investigations are site specific and sampling procedures are rarely in practice standardised leading to problems when comparing results from different sites. Several sampling strategies have been tried. The most ideal sampling strategy is a comprehensive sampling of all contexts, but on all but the smaller sites this is usually impossible. Other approaches, which are more feasible given the constraints outlined above, are interval, probabilistic, judgmental, and incidental sampling. Interval sampling involves taking samples at fixed spatial intervals across the site or from an extensive and apparently homogenous layer. Alternatively, every N^{th} context or feature will be sampled or every tenth bucket of fill is processed at a later stage, for example. Probabilistic sampling attempts to produce a sample for analysis where the degree to which the sample reflects the assemblage from the whole site is testable by statistical analysis. These data sets also have the most usefulness for intra-site comparison. The simplest method is random sampling of a range of contexts, where all contexts have an equal chance of selection regardless of function or size. At the start of an excavation, a certain proportion of find numbers are labelled, using random number tables, and the deposits which end up with these labelled numbers are sampled. Probabilistic sampling has its disadvantages in that in giving all contexts equal prominence a feature which has a high density of plant remains may be un-sampled, therefore some element of judgmental sampling is also necessary. Judgmental sampling, which is most commonly practised, is informed collection of samples from features in which plant remains are expected such as ditches, post holes and pits. This is a most effective and economical method of sampling provided the basis on which the decisions to sample are made on sound archaeological and archaeobotanical grounds. Finally there is incidental sampling which constitutes chance finds of rich or interesting deposits unearthed during the course of excavation (Jones, M. K. 1991, 54-5). In practice, therefore, sampling is site specific and relies on the preference and judgement of the excavator in consultation with the archaeobotanist. Usually a combination of sampling methods is employed to achieve the most representative results.

The systematic collection of samples of sufficient size is important if an ample number of macro-remains is to be recovered to adequately represent the whole population from the site. This is also essential if comparison between sites and individual contexts is to be facilitated. The size of sample is usually determined on the basis of the processing method involved, flotation requiring a greater volume of soil than sieving because some of the sample can be lost in mechanical processing. Losses can be assessed by sampling the sludge (the retent) at the bottom of the flotation tank. But, it is also dependent on the type of questions that are going to be asked of the data. Some palaeoethnobotanists choose to vary the sample volume depending on the size and complexity of the context, while others take as far as is possible standard sample volumes from all sampled contexts. Varying-sized samples can also be taken based on the density or quantity of plant material being retrieved from any one unit

(Jones, G. 1991), or to ensure a statistically viable sample. In this case van der Veen (1985) advocates 500 specimens retrieved per sample. Other workers emphasise collecting a standardised soil sample that will have 500 specimens on average (Hastorf 1999). Furthermore, sampling decisions have to be made in the laboratory to minimise time in analysis while maintaining sufficient material for adequate results. Van der Veen (1984) and Van der Veen and Fieller (1982) have discussed ways of achieving this.

4.1.5 Analysis and Identification

The floated plant debris (the flot) collected on site is sorted and scanned for any items of archaeological or ecological interest under low power microscopy. These items are removed for subsequent identification. Identifications are then made using standard texts and modern reference material which is usually available to any laboratory routinely carrying out archaeobotanical work. Counting of each type of remain, seeds, fruits and vegetative parts, in the assemblage indicates the relative proportions of plant species and plant parts present. This gives some indication of the relative importance of each species and possible clues to plant use on the site. Larger assemblages can be analysed statistically. Multivariate statistical analysis, which can consider several variables simultaneously, may be used to determine any patterns in the data.

4.1.6 Interpretation

A number of attempts have been made to interpret plant remains based on the type of context from which the archaeobotanical sample was derived (Dennell 1972, 1974, 1976 and Renfrew 1973). It is recognised that the composition of samples of plant remains may vary between different contexts and that these different samples may represent different activities with characteristic plant assemblages. However, context does not always provide a reliable basis for identification of crop processing products and bi-products because mixing of these is relatively widespread (Hillman 1981, 125). The correlations between context and assemblage composition are not straightforward and the statistical methods used to assess the relative importance of the various crop species has been challenged (Hubbard 1976). Although the relationship between context and the archaeological associations of plant assemblages is useful in interpretation, ethnographic models are probably more useful when interpreting macro-plant assemblages from individual locations (Hillman 1981; Hastorf 1999). Analogies drawn from communities in the less industrialised parts of the world provide indications of the different crop husbandry regimes employed. The underlying assumption is that the technology available in the past was essentially similar to that employed by traditional non-mechanised societies as observed in modern ethnographic studies and that the purpose of crop processing had the same goals (van der Veen 1992, 81). Ideally ethnographic models developed from communities which operate in similar climatic and vegetational zones as those pertaining in Britain would be expected to yield more directly applicable results. However, traditional farming methods are no longer in use in northern Europe and as a consequence, much of this type of research has been carried out in south-eastern Europe and the western part of Turkey (Hillman 1972, 1973, and 1984 and Jones, G. 1984, 1990). This does not preclude their usefulness since there are a limited number of ways to process crops employing a traditional technology (Hillman 1981 and 1984 ; Jones, G. 1984), but caution must be exercised nevertheless. Traditional methods, however, were still being employed at the turn of the century and some accounts, such as that describing farming practice in Orkney and Shetland, are available (Fenton 1978). Historical records from earlier periods are also useful sources for information on farming practices.

The activities involved in crop processing as described in ethnographic studies indicate several phases which may be distinguished in the processing of a cereal harvest. The first phase is that of harvesting (reaping) where the ripened crop is gathered in. Various methods have been observed: uprooting and gathering of the whole plant; cutting of the stalks at the base; cutting of the stalks midway; or only harvesting the ears. In the latter two cases all or part of the straw remains standing. The straw can then be separately harvested or left in the field. The next stage in crop processing is threshing. After a period of drying, the crop is threshed, usually in the farmyard, to detach the grain from the chaff. After threshing the loose grains are separated from the chaff through winnowing followed by sieving. The end product of this crop processing is dependent on the type of cereal. In the case of the naked, free-threshing cereals, such as bread wheat, the end product will be cereal grains with an admixture of weed seeds of similar size to the cleaned grain. In the case of the hulled cereals, emmer and spelt, the grains will still be enclosed in the glumes. The winnowing and sieving will have removed the coarse and some fine threshing waste, but a second threshing and sieving after the crop has been lightly toasted to loosen the grains will be necessary. This process is known as parching. Each stage of crop processing releases secondary products which may be used as fodder, thatching or fuel. The residue will then constitute waste. The primary product, cleaned grain as free as possible of contaminants, can then be stored. Each of these processing stages alters the composition of the harvested plant assemblage and creates a product and bi-product, some of which may survive in the archaeological record. (Figure 4.2)

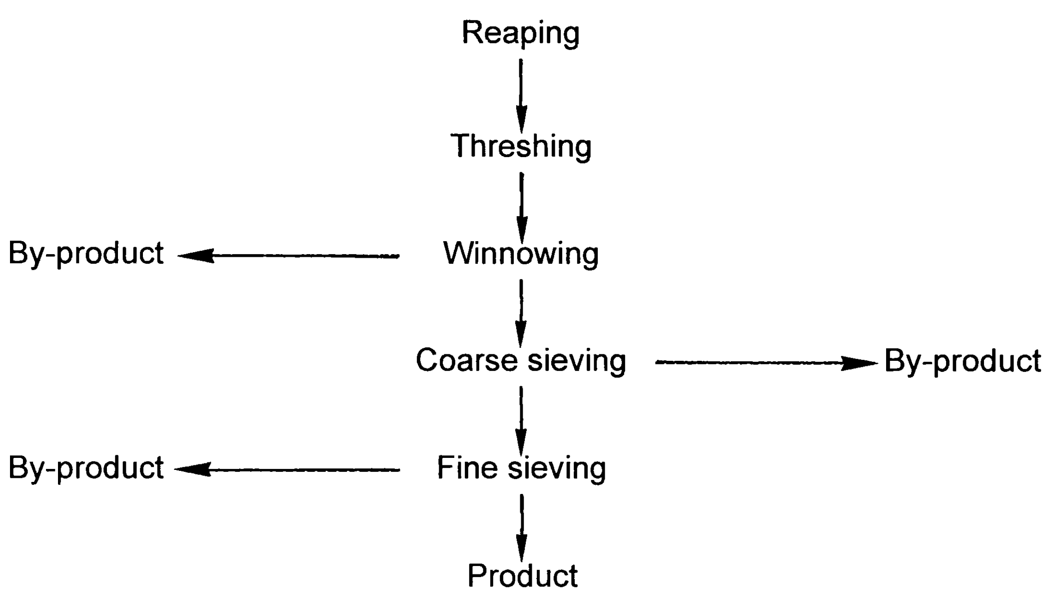

Figure 4.2: Simplified crop processing sequence (after Jones 1983, figure 2.)

In the case of preservation by carbonisation relatively few products are exposed to fire at the various stages of processing. These include cooking, parching and use of waste products as fuel (see Hillman 1981, 132-37 figures 5, 6 and 7). The parts of crop plants that will be able to survive charring are those which are small and dense enough to fall through the flames into the relatively protected environment of the ashes. Parts such as culm (stem) nodes and bases, caryopses (grains), glume bases, spikelet forks, rachis basal fragments and awn fragments (Hillman 1981, 140). (Figure 4.3) It is important to recognise which product or bi-products are represented in the excavated assemblage to be able to identify the crop processing activities taking place on a particular settlement site. Ethnographic observation has shown that there is a direct correlation between crop processing practices and sample composition despite some mixing of components between stages.

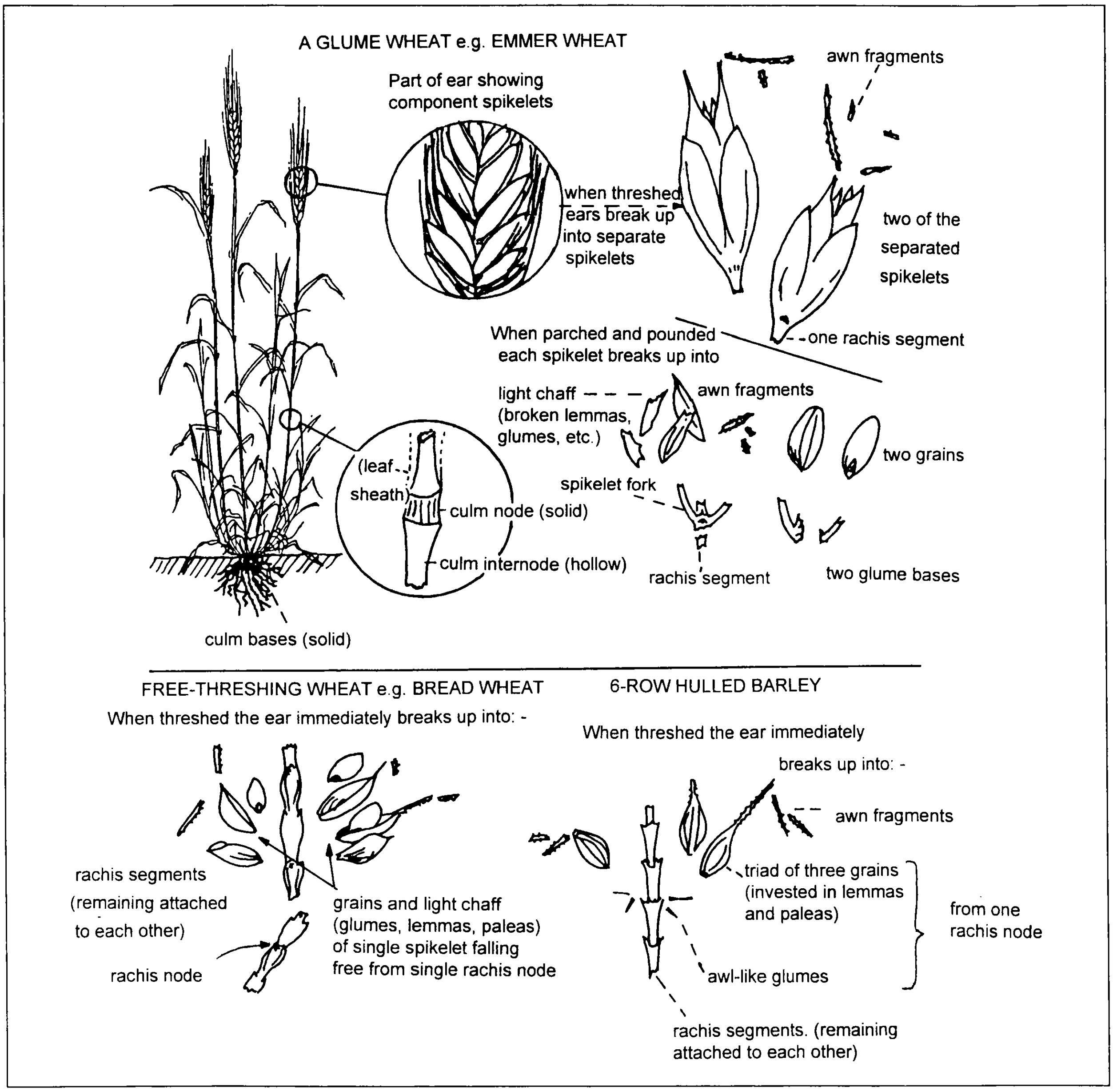

Figure 4.3: Some of the major componants of cereal ears - as an explanation of the terminology used in the text (redrawn after Hillman 1981).

Comparisons between ethnographic data and excavated data have been most usefully drawn to identify crop processing utilising statistical techniques. G. Jones (1984 ; 1987) has utilised discriminant analysis to define crop processing stages by measuring the ratio of grains to weed seeds to chaff fragments at each processing stage in her ethnographic examples. These are then compared with similar ratios in excavated examples to identify the processing stage likely to be represented on site. Plant assemblages from archaeobotanical samples cannot be directly compared with one another unless they are first screened for taphonomic processes, such as mode of preservation and crop processing stage because these factors alter the original composition of the assemblage. Based on the Jones model, a range of statistical techniques were applied by van der Veen (1992) to first assess which crop processing stage was represented by her various assemblages from the north east of England. Ratios of the major sample components and the categories of weed seeds present were examined. The size, aerodynamic properties and tendency of the seeds to remain in seed heads determines whether they can be effectively separated from the crop at the various processing stages. The weed assemblages were then subjected to a number of multivariate techniques to determine their response to a number of ecological factors (climatic, biotic, edaphic and anthropogenic). From the resultant analyses the type of agricultural regime probably practised was identified. This type of analysis can reveal a great deal about the economy of the site, its contexts and the activities that took place there. Comparison between modern traditional practices and excavated assemblages, therefore, provides the most profitable model for interpretation.

4.2 POLLEN ANALYSIS

There are numerous complicating factors which have to be taken into account in the interpretation of pollen assemblages. Some factors are related to the individual plants, such as contrasting pollination mechanisms, differential pollen production, and dispersal mechanisms. Other factors are taphonomic, such as preservation, together with the complex pathways leading to pollen incorporation in suitable deposits and diagenesis. Finally there are the methodological factors which introduce the many biases into sampling and analysis (see Moore *et al.* 1991). Nevertheless, pollen analysis is a useful adjunct to the study of macro-remains and although it may never approach the detailed reconstruction of crop growing techniques possible by means of plant macro-fossil analysis, it may indicate that arable farming is taking place in the vicinity of the pollen recruitment site. Pollen analysis is generally utilised to indicate regional vegetational patterns and the sites which are in consequence chosen for sampling are large mires and lake basins. The pollen arriving at the site will, therefore, have travelled some distance before deposition (Jacobson and Bradshaw 1981, fig. 1). Archaeological investigations are, however, primarily concerned with human impact on the landscape. Pollen studies have shown that the increases in anthropogenic indicators are only observed close to sites of known human habitation, indicating that they are a very localised component of pollen rain (Ramsay 1995). The nearer a site is to farming activity then the greater the chance will be to detect evidence of agriculture. The ideal site to obtain a pollen core to investigate the presence of agriculture is, therefore, a small mire close to sites of human settlement. Selecting a mire site also has the advantage that the deposits have formed in a stratigraphic sequence which may facilitate dating, although calibrated radio-carbon dates on pollen diagrams are not precise enough to link with known historical events because of the statistical uncertainties associated with calculating radiocarbon dates (Dumayne et al 1995).

To understand human influences on vegetation as represented in pollen diagrams, it is necessary to identify those indicator species with ecologies linked to anthropogenic aspects of the environment, such as fire, disturbed soils, forest canopy opening up, nitrogen and phosphorus flushing etc (Behre 1981 and 1986). However, the ecological latitude of many so-called indicators makes the specific determination of land use difficult (Dimbleby 1985). The principle anthropogenic indicators used by many pollen analysts are cereals, poaceae (grasses), *Plantago lanceolata* (ribwort plantain) and *Pteridium aquilinum* (bracken). These taxa often show synchroneity in their curves in pollen diagrams, each peaking at times of human activity, in particular woodland clearance leading to pastoral or arable agriculture (Turner 1964). *Poaceae* is the main taxon to increase with diminishing tree cover. However, it is not possible to say for certain whether grass recorded in a pollen diagram was a constituent of the vegetation of farmed land or derived from the sampling site, though growth of grass on the bog itself can probably be discounted. *Plantago lanceolata* is determinable to species level and is a regular constituent of sites disturbed by human activity (Moore *et al.* 1991, 189). Though *Plantago lanceolata* is a plant characteristic of pasture, it is able to grow in a diverse range of habitats (Dimbleby 1985, 146). Bracken can grow in shaded or un-shaded situations but tends to be a woodland plant. However, its spore production, and hence its representation in pollen spectra, is greatest in un-shaded habitats (Grime, Hodgeson and Hunt 1988). An increase in bracken spores represented in pollen diagrams indicates an opening up of woodland canopy usually related to clearance for agriculture. The most conclusive anthropogenic indicator in pollen diagrams are cereal pollen grains because they are produced in small quantities and most do not travel far from their site of release (Maguire 1983, 6-7). However, cereals, except rye, are autogamous (self pollinating) and will always be absent or under represented in pollen diagrams (Boyd 1984, 77). Therefore, if cereal pollen is identified from a pollen core there is a reasonable certainty that arable agriculture is being practised nearby. There is, though, difficulty sometimes in distinguishing between cereals and some wild grass species (Dickson 1988). Turner (1964) identified a further group of indicators that grow on arable fields and /or pasture land. These she characterised as 'weedy herbs' and devised a system by which arable land could be distinguished from pasture. They include various taxa such as *Asteraceae, Chenopodiacea, Ranunculaceae* and *Rumex* species. Turner devised an arable-pasture index based on the occurrence of cereal pollen and the relative proportions of weeds which are characteristic of arable and pastoral habitats respectively. Unfortunately pollen identification of these indicator species cannot be taken to a low enough taxonomic level and that level may include species with widely different habitats (Behre 1981, 226; Dimbleby 1985, 145). Relating groups such as *Potentilla* type, for example, directly to agriculture is not valid as species within this type have varied habitats including peat bogs themselves (Dumayne and Barber 1994).

An alternative strategy is to take on-site samples. Roman military sites for example, with their precise dating, can provide valuable chronological horizons for environmental samples. Pollen in sealed contexts beneath ramparts or roads can be usefully compared with that from ditch or pit fills to give some indication of the impact of the Romans on the environment. On-site pollen information indicating local vegetational change can be usefully compared with regional, off site pollen analysis to provide the wider environmental setting for Roman impact on the area north of the Tyne-Solway isthmus. However, archaeological site palynology frequently suffers from a number of problems. In well drained, base rich soils, such as those typically found at lowland archaeological sites, the action of soil micro-organisms and fauna decompose pollen leading to poor pollen preservation. Different pollen types have different degrees of resistance to decay and the sample will be biased towards these more resistant species (Dimbleby 1985). The relatively more recent pollen will also be more in evidence. Pollen may also be transported down the soil profile by soil invertebrates and to a lesser extent by percolating water mixing pollen of differing ages in the same deposit (Boyd 1985). Mixing of soils by agricultural activity and rampart construction can result in inversions in carbon-14 dated pollen profiles. Where the soils are acidic, as is the case at many upland sites, preservation of pollen is better due to reduced faunal activity. The evidence from on-site analysis is likely to be temporally and spatially restricted and consist of very localised vegetation and thus the extent to which wider extrapolation can be made remains a problem. The pollen catchment will also be restricted and difficult to define.

These problems notwithstanding, in the context of this thesis a Roman period stimulus to agricultural productivity and arable production might be indicated by an increased level of cereal pollen and arable indicators in the pollen spectra and conversely a depression may be signalled by a reduction in these factors. Furthermore, by integrating the palynological data with that from plant macrofossils and examining data obtained from native sites to determine processing activities, it may be possible to determine whether these sites were providing sources of food and if so in what forms. Information from Roman military sites can be compared with that derived from Iron age native sites. Bearing in mind the Roman dietary preference for wheat, an increase of wheat production may be reflected in samples recovered on excavations and differences between the two types of site may indicate local or imported sources. Samples, therefore, may be gathered from as wide an area as possible and from as many different types of site with secure contexts and closely defined dating as can be managed. The site specific work then can be compared on a regional basis to form an overall picture.

5.

THE BOTANICAL EVIDENCE IN CONTEXT: MILITARY SITES.

5.1 INTRODUCTION

What constituted the cereal component of the Roman military diet in northern Britain ?. Granaries from Roman forts might provide an ideal opportunity to ascertain what was being stored by the military particularly if there were severe fires in them brought about by accidents during fumigation and sterilisation to remove grain pests. Unfortunately, carbonised grain assemblages from Roman granaries in Britain are rare and few have been adequately recorded. Deposits of burnt grain were found at Roman forts in the past, such as Castlecary and Westerwood, both forts along the Antonine wall (Macdonald 1934, 256 and 453). Regrettably in most of these cases no botanical analysis was carried out, so that we do not know which species of grain was involved. Jessen and Helbaek (1944) analysed some material from Castlecary preserved in museum collections and listed six grains of bread wheat in amongst grains of emmer.

This paucity of grain assemblages led to a more recent analysis of material from three Antonine Roman forts held in museums in an attempt to answer this question (Dickson 1989). Dickson found mainly emmer and spelt with bread wheat in much smaller quantity. At Castlecary, emmer constituted 6.6% of the total, with spelt 10.8% and bread wheat ranging from 1-3.7%. Rough castle provided emmer at 2.6%, spelt 5.6% and bread wheat 2.1% of the total, whilst at Lyne, emmer was 3.2%, spelt 2.6% of the assemblage with no bread wheat recorded. Six-row barley (*Hordeum vulgare*) was also recorded at all three sites and constituted 1.1% of the available assemblage at Castlecary, just over half at Rough Castle, 54.1% and predominated at Lyne, 91.2%. These results must be treated with caution since the taphonomic processes that led to their survival and the less than ideal (by modern standards) mode of their recovery will have a profound effect on the material available for analysis. Nevertheless, these results give a good idea of the cereals in use, though their relative importance may be a matter of debate. In an effort to provide a synthesis of all of the available information, the botanical evidence from military sites within the study area, focusing on recent excavations with good botanical results, will be described and briefly discussed. In addition a description of the location and historical period of each site is given. The material under discussion in this chapter principally refers to plant remains, with occasional references to insects, other invertebrates and animal bones where appropriate.

5.2 THE SITES.

At **Newstead**, Roxburghshire, Scottish Borders, the largest known permanent Roman auxiliary base known in Scotland, a complex series of forts and their accompanying annexes has been gradually revealed over the years. The site, situated above the crossing of the river Tweed, is arguably the most important military centre on the northern frontier north of Hadrian's Wall because of its nodal position on the routes north. It is a multi-period site, occupied from the late first century through to the late second. Extensive excavations in the early part of this century recovered an outstanding collection of Roman artefacts and one of the earliest attempts was made to recover palaeobotanical information from the excavated sediments (Curle 1911). Sampling took place on a subjective basis from deposits discovered in various pits and trenches as the excavation proceeded and were analysed at the Royal Botanic Garden, Edinburgh (Tagg 1911, 353-61). Wheat and barley grains and chaff, were recovered from various pits and wells within the fort and its annexes (Curle 1911, 109, 121-2, pit XXII), but unfortunately the exact species was not defined. The chaff was identified as discarded refuse after winnowing and cleaning the grain, suggesting that grain processing took place at the fort. However, this may not indicate that the crops were grown nearby, since the wheat was probably emmer or spelt, (glume wheats) often stored and transported on the spikelet. The chaff may, therefore, represent final cleaning of an imported crop, by parching, prior to grinding. Newstead is nevertheless situated among one of the most fertile areas for arable farming in modern Scotland. This importance may have been paralleled in antiquity, since Eildon Hill North one of the two largest hillforts in the region, lies close to the site and some 150 settlement sites are known within a 25km radius.

The weed assemblage associated with the cereal grains and chaff indicates a number of typical habitats found around Roman forts in northern Britain. Weeds of cultivated and other disturbed and waste habitats predominate such as *Agrostemma githago* (corncockle), *Sinapis arvensis* (charlock), *Polygonum aviculare* (knotgrass), *Galeopsis tetrahit* (common hemp-nettle), *Polygonum convolvulus* (black bindweed), *Stellaria media* (chickweed) and *Chenopodium album* (fat hen). Although alternative habitats are possible for many of them, these weeds may tentatively indicate that the crops were being grown in the vicinity of the fort. Corncockle is an arable weed of autumn sown crops such as wheat, and charlock a weed of spring sown crops such as barley (Grieg 1983). A number of weeds with a preference for damp places, such as *Juncus* sp. (rushes) and *Carex* sp. (sedges), along with weeds of enriched disturbed soil, such as *Urtica dioica* (stinging nettle) and *Rumex acetosella* (sheep's sorrel), probably reflect the flora colonising the ditches and ramparts around the site. Poaceae of various species indicate extensive grassland in the vicinity of the site, some of it dry, as evidenced by *Potentilla argentea* (Hoary cinquefoil), *Geranium molle* (Dove's-foot cranesbill) and *Ranunculus bulbosus* (bulbous buttercup), and some damp, suggested by the presence of *Ranunculus repens* (creeping buttercup). Heather covered heathland in some areas is suggested by stems, flowers, leaves and fruits of *Calluna vulgaris* (heather) and *Erica* sp. (Ling), although these may have been brought to the site from further afield for use as bedding, thatch, fodder or fuel. A substantially cleared landscape of grassland and heath with patches of secondary woodland of birch, hazel and a little oak on the hill slopes is suggested by the plant remains. Along the streams and watercourses alder and willow, tree species with a preference for damper areas, were also found. The balance between arable and pastoral agriculture is difficult to ascertain but, the presence of extensive grassland in the vicinity of the fort argues for the latter. Whether arable agriculture took place near the site can only be tentatively suggested.

More recently the Newstead Project has completed five seasons of survey and excavation at Newstead and its environs, involving a comprehensive sampling strategy for environmental data (Jones 1990). At present only a preliminary assessment of that data has been carried out, and detailed analysis and interpretation are not yet available. However, it does show that there is a huge difference in terms of the abundance of the material between Newstead fort and the surrounding native sites (Carol Palmer pers. comm.). First impressions of the data set by the excavators indicates that there were large quantities of fully processed grain recorded from the fort, mostly wheat, perhaps suggesting import of the major staple, whilst the native sites produced and processed barley with little or no wheat (Simon Clark pers. comm.). It is entirely possible, therefore, that the barley component could have been supplied locally. Bread Wheat was also recorded at Newstead (van der Veen 1992, 153).

The strategic importance of **Birrens**, Dumfries and Galloway, guarding the western route into what is now Scotland is perhaps exemplified by the number of times that it was refurbished and re-occupied and the duration of its occupation into the 180's AD. Birrens served as an outpost fort when the frontier lay on the Tyne-Solway isthmus and as a hinterland fort when the frontier was advanced to the Antonine Wall. The fort sits on a plateau at 60m OD above the confluence of the Middlebie burn and the Mein water. Excavation between 1962 and 1969 recovered samples from ditch silts and occupation and demolition layers (Robertson 1975). Both waterlogged and carbonised remains were recorded. Four samples were analysed from the ditch silts, but few identifiable remains were recovered except seeds of the rushes *Juncus squarrosus* and *Juncus effusus* and a few moss leaves. The fine texture of the silt suggested that the deposits represented in-wash from the ditch sides and therefore, the plants recovered from those deposits represented those colonising the damp situation in and around the ditches. A well was discovered in what is probably the commanders house (Breeze 1977, contra Robertson 1975) of the early Antonine fort and the undisturbed layers were sampled, after removal of back-fill from previous excavations. Thirty seven samples were collected of which three (numbers 7, 16 and 35) were analysed.

Sample 7, a small cache of charred remains from a layer of burning near the top of the well, provided the only indication of the diet at the fort. This deposit was probably debris associated with the destruction of the first Antonine fort, since many of the remains were severely heat distorted, and slag and burnt mortar were mixed in with the plant macrofossils. Local soil conditions also contributed to a generally poor state of preservation of the remains. Consequently, identifications were tentative. However, most of the grains that could be identified consisted of bread wheat (*Triticum aestivum*: 8 grains). Four other grains were designated *Triticum* sp., possibly emmer or spelt, and barley was represented by four grains, one of them hulled. The bulk of the deposit, 20 caryopses, consisted of indeterminate cereal grains (Wilson 1975).

Samples 16 and 35 from middle and basal organic layers respectively contained a similar range of plant taxa. These consisted of weeds of cultivated ground, disturbed and waste places, areas with more or less acid soils and grassland. Both boggy and dry heaths were represented. In sample 16 in particular, plants representative of woodland, some damp, were recorded, such as *Salix* sp. (willow). The bulk of the remains, however, were indicative of heathland situations.

Pollen samples were collected from the ditch silts and compared with regional pollen records from within 35 km of the site. The pollen retrieved from the site was in very poor condition but, of those taxa that could be identified, plants characteristic of damp situations predominated. Alder (*Alnus glutinosa*), bog moss (*Sphagnum* sp.), polypody (*Polypodium)* and Devil's-bit scabious (*Succisa pratensis*) were abundant. The regional pollen picture provided no definitive evidence for agriculture in the immediate vicinity of the fort. This is not surprising since at the majority of sites certain agricultural activities such as cereal cultivation will be under-estimated (or not represented at all) due to the distance of the pollen core from the nearest source of cereal pollen, which generally does not travel far (Vuorela 1973). None of the larger Poaceae pollen grains could be attributed to cereals, though some of the non-tree pollen taxa may have been representative of arable weeds, for example *Artemesia, Compositae* and *Caryophyllaceae.* Typical pastoral indicators such as *Plantago* were also absent (Wilson 1975). The pollen record tends to confirm that from the macrofossils, indicating an open grassland, heath, bog, mosaic with secondary woodland of birch, alder and some oak. Pine, ash and elm were less frequent. Alder pollen was abundant at all levels reflecting both the prodigious pollen production of this species and the proximity of wetter areas along the nearby stream courses.

Continuing piecemeal excavations in **Kirkintilloch,** aimed at elucidating the morphology and occupational history of the Antonine Wall fort, revealed the ditch system at its south-east corner (McBrien 1995). Environmental samples were obtained from the inner of the two defensive ditches in the form of three staggered peat columns, representing the entire profile of the ditch silts (Boardman and Dickson 1995, 653-656; appendix 4, 666-668). Sub-samples from the more promising organic horizons were analysed for plant macrofossils and pollen was extracted from two lower ditch horizons thought to represent Roman accumulation.

Cereal bran, small quantities of cereal chaff, and seeds and fruits of various wild plant species were recovered, along with charred barley grains and some smaller charred seeds, fruits and other fragments of wild species. The bran comprised hilar fragments with little remaining testa (outer seed coat). The majority of testa fragments represented either wheat or rye since the diagnostic transverse cells were not preserved (Dickson 1987; Holden 1990). Much of the bran, however, was so degraded that it could only be identified to either wheat, rye or barley. This combination of small bran and chaff fragments probably represented coarse flour which had been ground nearby. Pericarp and seed fragments of brome /lop grass (*Bromus* sp.) and corncockle (*Agrostemma githago*) may have been contaminants in the flour, although corncockle is poisonous in small quantity. These are difficult to eliminate from the sieved grain, unless by hand sorting, because they are similar in size to cereal grains. The suggestion that the deposit was latrine residue and, therefore, more direct evidence of the diet of the garrison proved unfounded because no parasite ova or coprosterols were detected. No other food plants were found in the samples and the narrow range of taxa perhaps reflects the poorer preservation conditions in the predominantly minerogenic deposits of the ditch.

A range of other wild species was recorded including common arable weeds such as chickweed (*Stellaria media*), redshank (*Persicaria maculosa*), and knotgrass (*Polygonum aviculare*). However, these can of course occur in other disturbed habitats. Pollen analysis as might be expected indicated low levels of arable activity and the one and a half charred barley grains is hardly conclusive evidence for widespread local cultivation. A number of damp habitat species were identified reflecting the plants colonising the ditch bottom and bank sides.

Other habitats around the site were disturbed grassland, indicated by *Stellaria, Rumex* and *Galium* species and acidic and boggy heath conditions suggested by heather, bracken , cotton grass and bog moss. The charcoal and pollen evidence indicated the presence of birch, alder, willow and some oak, that is light secondary woodland. Grasses and low values for pastoral indicators, particularly ribwort plantain, did not suggest a heavily grazed landscape in the vicinity of the fort. Kirkintilloch proved to be no exception to the typical evidence obtained from Roman forts along the Antonine Wall, where very low values for arable indicators suggest a largely cleared rough grassland landscape with small patches of woodland. In one respect though, Kirkintilloch differs from comparable Antonine Wall sites such as Bearsden *c.* six miles to the west, in that a little more oak remained in the nearby woodland.

These forts discussed above provide limited evidence of the Roman military food supply. However, two forts excavated in the last twenty years at Elginhaugh and Bearsden, with their rich deposits of plant macroremains, have provided the opportunity for a more thorough examination. These forts are both single phase and represent in turn the two major periods of Roman occupation in Scotland.

Elginhaugh, is a Flavian timber-built auxiliary fort which, with an area of 1.26ha, conforms to the average to small size for such forts. An annexe of 0.96ha is attached to the fort on the western side. The fort sits on a plateau above the river north Esk, approximately 25miles north of Newstead, astride Dere street, the main eastern route for the Roman army into what is now Scotland from the line of Hadrian's Wall. Excavation took place in the late 1980's in advance of industrial development and the fort constitutes the only example of an auxiliary fort for which we have the complete plan (Hanson forthcoming). Both charred and waterlogged plant remains were recovered from a range of contexts associated with the occupation, demolition and post-demolition phases of the fort and annexe (Clapham forthcoming). Preservation of carbonised remains was generally poor in comparison with waterlogged remains. The high water table at the site contributed to very good waterlogged preservation in places and these remains were richer in terms of volume and numbers of taxa than the charred macrofossils in general. Seventy one 0.5-1Litre samples from 61 contexts were recovered for sieving. The weed assemblage indicated a range of habitats surrounding the site with taxa representing wetland, woodland, grassland and disturbed environments. Arable indicators were identified but, because most of these weed species are able to grow in a variety of other disturbed habitats, it could not be conclusively proved that crops were grown in the immediate environs of the fort. Both pollen (Dickson forthcoming) and macrofossil evidence from the site suggests that surrounding land was a patchwork of grassy habitats, perhaps controlled by grazing pressure, with patches of woodland along local stream courses. Structural timbers from the fort were predominantly Alder (*Alnus glutinosa*), a wet loving tree species commonly found by lakes and streams.

An interesting feature of the Elginhaugh charred macroplant assemblage is the clear difference among the cereal remains between the fort and its annexe. In the fort barley is the dominant species, comprising 66.5% of the recovered cereal grains, with wheat representing only 29.2%. Whilst in the annexe wheat at 78.6% predominates over barley at 20.5% (Clapham forthcoming). The types of cereal recorded indicate that emmer (*Triticum dicoccum*) was less well represented than spelt (*Triticum spelta*) within the fort, and particularly in the granaries. Whereas in the annexe emmer and spelt occur in approximately equal proportions at 45.28% and 45.49% respectively, with a small component of bread wheat (*Triticum aestivum* 9.1%). Barley is predominantly hulled, as might be expected for this period (van der Veen 1992), with 93.5% in the fort and 98% in the annexe. Probable contaminants of the main crop in the form of naked barley, 6.5% and 1.8% respectively, and oats, 4.2% and 0.8% respectively, occur in both contexts. The garrison is thought to have contained an element of cavalry and the predominance of barley in the fort may reflect the presence of horses. However, the presence of stable blocks was not conclusively proved. Barley may have been partly for human consumption despite the numerous literary references to the soldiers preference for wheat (Davies 1971). Barley bran was recovered from the inner north ditch and may suggest faecal material or discarded flour, but few human parasite ova were found in association with it. Barley is known to produce a quite palatable flour and its bran was recovered in amongst wheat bran fragments from latrine deposits within the fort at Carlisle (Huntley 1989a). However, it could just as likely represent soiled stable sweepings. The excavator suggested that the large quantity of barley probably reflects post-fort usage, when the fort was perhaps utilised by the Romans as a stock enclosure for the collection of taxation in kind in the area north of the Tyne-Solway isthmus (W. S. Hanson pers. comm.).

The paucity of cereal chaff remains suggests that the grain was brought on to the site already cleaned. However, the presence of probable grain drying kilns in the annexe may indicate drying of a freshly harvested locally produced crop. Culm nodes, arguably the most diagnostic feature for primary processing, were found in quantity in some contexts, however these were invariably demolition deposits and are likely to represent straw waste, bedding material, dumped into wells and ditches during clean-up operations. Of the cereals, emmer, and barley were probably imported onto the site from the local area, whilst spelt came from further south. Barley is far more suited to the cool wet climate and shorter growing season of north and west Britain (Bland 1971; Grieg 1991). An early maturing grain, it can be spring sown and usually crops well, with less dependence on weather. Emmer is generally more frost and cold susceptible than spelt, but is more often represented on native sites in Scotland where evidence is available. There is little evidence for spelt growing in Scotland before the Roman period, with the exception of Oakbank crannog, and records of its presence come almost exclusively from military sites.

Bearsden is a mostly timber-built auxiliary fort towards the western end of the Antonine Wall. The period of occupation, suggested by numismatic and ceramic evidence, was between AD 140 and AD 158. Excavation in advance of housing development revealed a fort of 1.12 ha with an annexe to the east of approximately half the size of the fort (0.48 ha). Bearsden was defended by three ditches on its western side, two ditches on its eastern side and by a large single ditch to the south (Breeze 1984b). Ditch sections were sampled for pollen analysis and recovery of plant macrofossils. However, all but the eastern annexe ditch were cleared out before the fort was slighted prior to abandonment. In addition, plant remains were identified from the pollen sievings and the better preserved rampart turves were extracted for pollen analysis. None of the remains were carbonised. The ditch fills proved to be sewage deposits from the fort latrine, as human parasitic worm eggs and analysis of coprosterols from the sediments confirmed (Knights *et al.* 1983). Thus they provide direct evidence of the food consumed on site.

In particular examination of the fill of the outer of the two eastern annexe ditch deposits, which had silted up to about half its original depth by the inflow of sewage and silty clay from the ditch sides, proved most fruitful. The ditch had a classic V-shaped profile and was 3.4m wide by 2.5m deep. A section was dug 10m south of north terminal end and a column 0.1m by 1.0m taken through the infilling layers. Several distinctive layers of silt were identified from the bottom to the top. Layer A, a 1.2m thick clay-silt with a 20% organic content of diverse origin merged into layer B, a more highly organic and finely layered deposit, which merged into layer C containing a high proportion of birch and willow present as coarse debris (Dickson *et al.* 1979). Above the silts plant remains indicated that the ditch was overgrown first by aquatic grass followed by sedges, ferns and trees which had subsequently sealed the Roman deposits.

Approximately 100 plant taxa were recovered from layer A which had entered the ditch by several routes. Plants may have blown, fallen, or been washed into the ditch which was open, waterlogged and silting-up. Species characteristic of peat bogs, heathlands, fens, shallow water, woodland, grassland, and weeds of enriched soil were identified (Knights *et al.* 1983). Cereal debris was recovered from throughout layer A, but particularly from towards the bottom. This consisted of fragments of cereal bran and a few fragmented grains of barley and many wheat glume bases, probably spelt (*Triticum spelta L.*). The bran comprised cereal grain testa and sometimes one or more layers of the pericarp, usually fused to the testa. The majority of the fragments were deemed to have the double layers characteristic of *Triticum* or *Secale* testa (Dickson and Dickson 1988). Chaff fragments were tentatively identified as emmer and spelt wheat. *Avena*, *Hordeum* and *Secale* were uncommon in the assemblage and were thought to represent weeds among the wheat crop, or relicts from pre-Roman periods of cultivation at the site. Typical cornfield weeds were also represented by fragments of grains of other grasses, such as lop grass (*Bromus hordeacus*) and seeds of corncockle (*Agrostema githago*) in addition to black bindweed (*Polygonum convolvulus*) and pale persicaria (*Polygonum* *lapathifolium*) represented by single fruit fragments (Dickson *et al.* 1979). Layers B and C contained fewer plants than A and no food plants.

Pollen analysis of rampart turves and samples taken from the sewage rich ditch fills indicated that both contained a broadly comparable assemblage with no clear indication of arable farming at the fort. Thirteen pollen samples from the ditch layers were analysed, nine from A, and two each from B and C. The three topmost samples from layer A, all within 7cm of each other, and two from B had greatly increased grass values as much as 60-80% of total pollen. Analysis of 6 lower ditch samples produced a tree pollen count close to 50% total pollen. A diverse range of habitats in the vicinity of the fort was identified from the various pollen analyses. A mosaic of partially cleared woodland, mainly alder and hazel restricted to copses and stream sides with an understory of herbaceous plants and mosses. Shrubs and open canopy indicators such as bracken probably grew at the woodland margins, with grasses, heather and rushes in cleared areas. The turf utilised to build the ramparts came from wet, well-grazed established pasture with damp rushy areas with dryer heathland at its margins. Low lying areas were evidenced by marsh and fen plants and ponds and streams by floating water plants, rushes, reeds and aquatic grasses.

Aerial photography has revealed that the northern British landscape abounds with the remains of Roman temporary camps that attest the movement of Roman armies as they traversed the land. The majority appear as cropmark features, but others are upstanding remains, such as the complex series at Ardoch (St. Joseph 1970). Roman temporary camps, though, are generally believed, by the academic community to be relatively barren environments for archaeological investigation. This is due to their short period of occupation and in consequence lack of artefacts and significant internal features. However, palaeoenvironmental investigation of their ditch silts may provide local environmental indications and clues to what extent the troops utilised local resources.

Excavation of a Roman temporary camp along the course of Dere street at **Pathhead,** Midlothian, ahead of housing development, enabled the first comprehensive sampling programme for plant remains to be carried out (Leslie forthcoming). Three camps are known in the area of Pathhead as cropmark features, a 13 acre camp in the east corner of a 50 acre camp both of which are intersected at their south-eastern ends by a 165 acre camp. It is the 50 acre camp which stood to be partially destroyed by the housing development. Samples were collected from appropriate locations, including carbonised hearth features, waterlogged ditch fills and a complete column of continuous ditch sediment.

The cereal assemblage consisted mainly of barley with a smaller component of wheat and rye. Oats were also present in such small numbers that they probably represent a mixed crop or contaminants among the main cereals. The carbonised remains were mostly cereal grains, predominantly barley, with a few arable weeds. Chaff was notably absent suggesting the presence of an almost cleaned crop of barley. Arable weed seeds were scant in the charred assemblage reinforcing the notion of a considerably cleaned crop. Parching in the later stages of crop processing probably accounts for the carbonisation (Hillman 1981). Waterlogged remains consisted of barley caryopses and chaff fragments. There were also numerous small bran fragments of wheat, rye and wheat/rye type. These represented ground food material such as whole meal flour (Miller forthcoming).

Evidence for several different crops was recorded from the various samples. These included hulled and naked barley, of which *Hordeum vulgare var vulgare* (hulled 6-row barley) was predominant. Trace levels of *Hordeum vulgare var nudum* (naked barley) were also recorded though whether this was a relict of an earlier cultivation tradition, a mixed crop or a contaminant of the main crop it was impossible to say. Wheat/rye bran fragments were frequent in lowest ditch fills mixed in with the barley remains. Most could only be identified to *Triticum /Secale* type, though there were some confirmed *Triticum* and some definite *Secale* present.

Waterlogged remains came mainly from lower ditch fills. The lower section from 116 to 120cm, of the ditch basal fill represents the open ditch when the temporary camp was occupied. Cereal bran, chaff, arable weeds and mosses were present. The entire cereal caryopses and chaff recovered were all barley, though the grains were in smaller quantity than in the charred assemblage. These were indicative of spoiled or dumped material, such as spoiled ears or waste from crop processing. The arable weeds associated with the barley seeds and chaff suggest dumped crop-processing waste. Of the species recorded, such as *Bromus*, *Chenopodium album*, *Persicaria maculosa* and *Stellaria media*, none grow naturally in wet ditch situations and therefore must have been placed there. Wheat and rye chaff were not found and since, these are diagnostic for identification of species, no indication of the wheat species present was obtained. Except for three charred wheat grains, all of the wheat found consisted of numerous small fragments of bran. This perhaps represented spoiled coarse ground flour disposed of in the ditch, or it may have been sewage. Three corncockle seed fragments and the entire weed seeds in the cereal assemblage suggest flour, whilst moss fragments recovered from the basal ditch fills, perhaps used as toilet wipes, may suggest sewage. However no human parasites were identified from the pollen slides, through time constraints preventing a more comprehensive search.

Weed seeds recovered represent the immediate environment in and around the ditches. Taxa represented were indicative of arable /ruderal habitats, along with grassland, moorland, heath and marsh/aquatic communities. *Juncus sp.* (rush) remains were present in quantity. However, the analyses of the sub-samples extracted for pollen identification give a clearer picture of the regional and local environment. Some in-situ pollen from the sampling site, that is the ditch itself, will also be present. Pollen samples were rich in grass at all levels suggesting that the surrounding landscape was open and substantially treeless. This is perhaps not surprising since it is quicker and involves less labour to construct a camp on land already cleared of trees. Tree pollen is dominated by alder, with damp scrub woodland of hazel (*Corylus*), willow (*Salix*) and birch (*Betula*)also present. Heather (*Calluna vulgaris*) was recorded at all levels indicating the presence of heath nearby. Ruderals and grassland indicator taxa were not abundant, although the species recorded were diverse enough to suggest an open pastoral landscape with areas of heath and patches of scrub woodland, especially in wetter areas (Miller forthcoming). Cereal pollen was absent and, as cereals are generally autogamous and their pollen does not carry very far, cereal was not grown close to the ditch (Vuorela 1973).

There is a difference in the mode of arrival of the cereals on site between the barley and the wheat. The carbonised cereals were almost exclusively grain with a few arable weeds associated with them, suggestive of parching of a thoroughly cleaned crop prior to grinding. The entire barley caryopses, chaff and weed seeds recovered from waterlogged deposits are suggestive of spoiled crop-processing waste from a locally grown crop. The wheat on the other hand was deemed to have been brought with the troops from stores in northern England. This was due primarily to its association with rye as a contaminant. Rye is rare in the archaeological record in the late Iron Age and Roman Period but is much more commonly found in the Anglo-Saxon and Medieval periods (Jones 1981). It is a free-threshing cereal which is associated with spelt and bread/club wheat at Roman period sites, such as Thornbrough and South Shields (van der Veen 1992). Therefore, it is from stores in northern England that it is thought to have come. No wheat chaff was recovered, in contrast to barley chaff, therefore, the wheat may have been a naked free-threshing variety, since parching-waste of the glume wheats is otherwise likely to have been present. If this inference is correct, local climatic and edaphic conditions are unlikely to suit such an open eared wheat variety (Miller forthcoming).

Comparable evidence, in the form of plant remains, is available from military sites on and around Hadrian's wall at South Shields, Birdoswald, Chesters, Peel Gap and Carlisle. At **South shields**, the fort constructed on the south bank of the Tyne to guard its estuary, deposits from a burnt granary during the third century supply base phase was analysed (van der Veen 1994). spelt and bread wheat predominated, with a little barley and rye considered as contaminants of the main crop. Weed seeds of *Danthonia decumbens* (heath grass), a modern heath plant but considered a weed of cultivation in the past (Hillman 1981), were highlighted as indicating that local farmers supplied the spelt crop.

Birdoswald a fort on the west central section of Hadrian's Wall excavated prior to consolidation for display provided the opportunity to employ an environmental sampling strategy. Samples were collected from between granary sleeper walls corresponding to the 3rd to 4th century phases at the site (Huntley 1991). Approximately equal amounts of barley and wheat were recorded, the wheat was spelt and bread wheat. Spelt and barley chaff were retrieved, but not in great quantities, and it was suggested that local edaphic and climatic conditions were suitable for barley cultivation but unlikely to be appropriate for wheat. Weed seeds were characteristic of cultivation generally rather than specifically arable farming, and adjacent pollen evidence gave no indication of local cultivation. Limited evidence for hulled barley and hexaploid wheat (probably spelt) was obtained from 3rd to 4th century deposits at the **Chesters** Roman bridge abutment excavation (Huntley 1992). A small assemblage was recovered from **Peel gap**, a turret on Hadrian's Wall (Huntley 1989b). Limited evidence for carbonised wheat and barley was obtained. No evidence for ruderals or the presence of other food plants was recorded. This confirmed the archaeological evidence that the site was a watchtower garrisoned by out-posted troops from adjacent forts with no permanent inhabitants.

Part of the Roman fort at **Carlisle** was excavated following demolition of buildings along Annetwell street. Waterlogged and carbonised remains were recovered from various contexts such as pits wells and occupation deposits associated with periods 3 and 5 at the site. Period 3 represents the first timber fort built during the Flavian period in the latter part of 72 or early in 73 AD (Caruana 1992,104-5). This lasted for around thirty years and was demolished sometime between 105 AD and 110 AD. The second substantial timber fort built in the second century constitutes period 5.

Hulled 6-row barley (*Hordeum vulgare* var *vulgare*) dominates the charred remains with a little naked barley (*Hordeum vulgare* var *nudum*) also found. This represented a fully cleaned grain .The wheat remains were predominantly spelt although some emmer and bread wheat were also recorded. Cereal chaff, in the form of barley rachis internodes, was discovered in relatively high amounts in some contexts suggesting processing of a locally grown crop.

Wheat chaff in the case of spelt may not represent locally grown wheat since glume wheats were often transported as spikelets and the chaff therefore represents parching waste prior to grinding. Measurements of glume bases indicated a mixture of emmer and spelt (Huntley 1989a). The earliest deposits at the site were dominated by barley and spelt with minor quantities of emmer and bread wheat, whilst in the later deposits emmer is entirely absent. McCarthy (1995, 493) has suggested that this may support the view that the Romans had little use for it, and certainly experiments have shown that spelt with its greater gluten content produces a lighter, more palatable loaf (Dickson 1990). Carbonised seeds of grassland species, abundant in a few samples indicated the presence of a species-rich neutral grassland in the local river valleys probably exploited for hay.

In contrast to the carbonised remains the waterlogged assemblage was dominated by wheat. Cereal caryopses were recovered from a few contexts, mostly from pits. These were often associated with the glume bases of wheat which were interpreted as an indication of the use of straw on site. Latrine deposits were recovered from pits and drains and are dominated by the usual suite of exotic food plants, fig pips etc., but also by wheat bran and a little barley. Arable weeds were not common though some samples contained large numbers and may represent cereal cleaning. Large numbers of the poisonous arable weed corncockle (*Agrostemma githago*) in some contexts demonstrates the deliberate hand cleaning of the grain prior to grinding. Ruderal taxa were generally represented throughout most samples and could represent cultivation nearby though of course they can also indicate other disturbed and waste ground in and around the fort. The bulk of the weed assemblage consisted of grassland and wetland plants taken to represent the import of hay on to the site for use as animal bedding and fodder as well as floor covering for human habitations (Huntley 1989a).

5.3 SUMMARY / DISCUSSION

Two main categories of remains were recovered at the military sites, charred macrofossils and waterlogged material. Carbonised remains generally relate to cereals and their associated weeds, the nature of the preservation ensuring some survival (see chapter 4). A few of the sites produced excellent waterlogged material where information about the wider habitats around the sites was found. In addition the latrine deposits excavated at Bearsden provided direct evidence of the military diet, though they are invariably biased towards the more robust remains which are able to survive the digestion process. Nevertheless, evidence relating to the import of exotic plants such as figs and coriander was recovered, and the residual remains of wholemeal bread (Dickson *et al.* 1979).

The species of cereal staple that are discovered on Roman military sites is pertinent to this study so that direct comparison can be made with indigenous native sites in the areas of occupation. The present study indicates that a total of six different cereal crop plants were found in the various assemblages from the individual military sites: *Triticum dicoccum*, (emmer wheat), *Triticum spelta*, (spelt wheat), *Triticum aestivo-compactum*, (bread/club wheat), *Hordeum vulgare*, (6-row barley), *Secale cereale*, (rye) and *Avena fatua/sativa*, (wild/cultivated oat) The presence or absence of these species at the individual sites is indicated below: (table 5.1)

			Roman Military Sites					
SITE	**Presence of cavalry**	**Barley 6-row**	**Emmer Wheat**	**Indet. Wheat**	**Spelt Wheat**	**Bread Wheat**	**Rye**	**Oats**
Bearsden	**?**	*	cf.	-	cf.	-	*	*
Birdoswald	-	*	-	-	*	*	*	*
Birrens	**coh. equit.**	*	cf.	-	cf.	*	-	*
Carlisle	**ala**	*	*	-	*	*	*	*
Castlcary	**coh. equit.**	*	*	-	*	*	*	*
Chesters	**ala**	*	-	-	cf.	-	-	-
Elginhaugh	**?**	*	*	-	*	*	-	*
Kirkintilloch	-	*	cf.	-	cf.	-	cf.	-
Lyne	-	*	*	-	*	-	-	*
Newstead	**ala**	*	-	*	-	*	-	-
Old Kilpatrick	**coh. equit.**	*	*	*	-	-	-	-
Pathhead	**?**	*	-	*	-	-	-	*
Peel Gap	-	*	-	-	*	-	-	-
Rough Castle	-	*	*	-	*	*	-	*
South shields	-	*	-	-	*	*	-	-
Westerwood	-	-	-	*	-	-	-	-

Table 5.1: Presence or absence of cereal species: Roman military sites.

cf. denotes an uncertain identification due to poor or fragmentary preservation or ill-defined morphology (after Dickson 1970); ? cavalry garrison presumed on structural grounds.

The relative importance of the various crops is difficult to assess because many of the identifications are tentative at best, the result of poor preservation leading to loss of diagnostic features. Assemblages are often too small to provide quantitative data and many of the earlier excavations merely record the presence of a particular species, if identification is undertaken at all. Nevertheless, in the literary sources wheat is attested as the preferred cereal in the Roman military diet (Davies 1971). Comparative evidence from Roman sites in Britain and the continent of Europe tends to bear this out (Dickson 1989). Emmer is present at nine of the fifteen sites listed (exclusively in first and second century contexts) and, with the exception of Carlisle, is recorded at the more northerly Scottish sites. It occurs in equal or slightly lesser proportion than Spelt. Emmer was the principle wheat crop in Britain during the earlier prehistoric period, but it had gradually become superseded by spelt during the Roman period (Jones 1981; Grieg 1991). However, it was generally considered that emmer remained the principle crop in northern Britain (Godwin 1975). Nevertheless finds of spelt from Coxhoe, Thorpe Thewles and Stanwick suggest that it had reached north-east England by the late Iron Age (van der Veen 1992). The third and fourth century contexts at South Shields, Birdoswald and Chesters indicate that spelt had superseded emmer as the foremost wheat crop at Roman forts in the later Roman period.

Spelt is recorded at all the sites except Newstead, Westerwood, Old Kilpatrick and Pathhead, but poor preservation at the latter and a lack of, or rudimentary, analysis at the former three sites precludes any significance being drawn. It occurs in marginally greater quantity than emmer. Evidence for spelt growing in Scotland is rare before the Roman period, Oakbank Crannog (discussed below) being the earliest instance, and records of its presence come primarily from military sites. There is therefore the distinct possibility that spelt was an imported cereal from further south.

Bread/club wheat is recorded as a minor component at most sites discussed above with the exception of South Shields. However, the status of bread/club wheat in Britain is poorly understood and it features only in very small quantity on the majority of sites where data are available (Boyd 1988). In Scotland in particular, Roman sites produce consistently very small numbers of bread/club wheat, but the species has never so far been found in large quantities or as the dominant crop (van der Veen 1994, 250). In assemblages from the north of England the third to fourth century assemblages from South Shields are the exception (van der Veen 1992). Here the Roman granary produced large amounts of bread/club wheat, where it occurred in equal quantity to spelt wheat. Huntley (1995) has suggested that the remains examined from the majority of sites are perhaps giving a biased view of what the Romans actually ate. This is because the majority of the deposits examined are of first and second century date and the evidence from South Shields, in combination with hints from north Yorkshire, may reflect that bread/club wheat was becoming more important in the later Roman period (Huntley and Stallibrass 1995).

According to a number of Roman authors barley was usually considered as animal feed, particularly as high energy food for the cavalry horses, for use in malting or as an emergency or punishment ration. (Frontinus *Strat.* IV.1, 37 & 46; Polybius *Hist.* VI. 38.3; Suetonius *Div. Aug.* 24; Vegetius *de re militari* 1.13). However, the results described above indicate that hulled 6-row barley was the dominant cereal at all of the military sites across the region irrespective of whether the garrison consisted of cavalry or not (see table). Of course, a number of horses would be available to every garrison whatever its type as officers mounts and pack animals. The greater tolerance for the cool wet climate and shorter growing season in northern Britain exhibited by barley would seem to make it a prime candidate for local supply. Traces of naked barley were recorded at most sites and the fact that these occur in very small quantity indicates that they may be contaminants of the main crop. There is also the possibility that the naked barley is a relict of an earlier cultivation tradition. The hulled variety is thought to have replaced the naked variety in the early part of the first millennium BC (Hillman 1981). The inherent conservatism implied by continued cultivation of naked barley may point to a local source of supply. In addition, the dominant position of barley among the assemblages would make it seem reasonable to suggest that it may have been more often used for human consumption than is generally acknowledged. This seems to be confirmed by the presence of small quantities of barley bran fragments found in the Bearsden sewage deposits (Dickson 1989, 138). Oats were a minor component of some assemblages, notably at

Elginhaugh, Bearsden and Pathhead temporary camp, and wild and cultivated varieties were identified. Oats were the dominant cereal from the first millennium AD in northern Britain, but they are rare before this (Huntley forthcoming), and therefore they probably represent a weed amongst the barley. The meagre quantity of rye found at the Pathhead temporary camp is probably a contaminant from archaeologically younger layers introduced by modern cultivation practices. It is usually considered to be a late introduction, first records beginning to appear in the late Iron Age and Roman period, though only as a minor component of assemblages. Rye only came into its own in the Anglo Saxon and Medieval periods (Green 1981).

Evidence is singularly lacking for arable cultivation in the immediate surroundings of the forts, though Roman forts are attested to have had land allocated to them, known as *territorium* or *prata,* for the cultivation of crops and grazing of livestock (Le Bohec 1994, 219; Salway 1965, 188; Johnson 1983 ; Dickson and Southern 1992, 196). The weed assemblages indicate an extensively cleared landscape representing a mosaic of different habitats, primarily grassland with areas of heathland and small patches of woodland along the stream courses. Weeds of cultivation such as *Agrostemma githago* (Corncockle), *Chenopodium album* (Fat Hen), *Galium aparine* (Cleavers), *Polygonium lapathifolium* (Pale persicaria), *Spergula arvensis* (Corn Spurrey) and *Stellaria media* (Chickweed) could represent cultivation nearby, but it must always be borne in mind that arable fields are not their exclusive habitats. The immediate environment of the forts will always be represented and ruderals inhabit waste and other disturbed places such as the areas between and around barrack blocks and the vicinity of ramparts and ditches. Wetter habitat plants such as rushes (Juncus sp.) and sedges (Carex sp.) are also indicative of the damp bottoms of defensive ditches.

The climax forest of mixed oak woodland had been substantially removed and replaced with secondary scrub forest of hazel and birch with alder and willow in damper areas before the Roman arrival. Hanson (1978) established that local timber was used wherever possible to construct the permanent forts. Oak is generally agreed to be the most durable for structural timbers. However, an illustration of the non-availability of suitable building timber can be discerned in the use of other less durable timber, such as alder, for construction purposes at many forts. Numerous small grasses and associated grassland taxa, such as *Stellaria, Rumex* and *Galium,* indicate that the majority of the forts were established amongst rough pasture. Seeds of *Geranium molle*, *Potentilla argentea* and *Ranunculus bulbosus* recovered at Newstead, for example, suggest dry grassland, but many areas were wet grassland as the presence of *Ranunculus repens* (creeping buttercup) suggests. Large numbers of grass species in the assemblages may also reflect the collection of hay, as was suggested at Birdoswald (Huntley 1991).

Heather (*Calluna vulgaris*) and ling (*Erica sp.*) indicate moorland nearby many of the forts some of it quite damp as suggested by finds of cotton grass and bog moss and, therefore, areas unsuitable for arable agriculture. However, they also probably reflect local resources collected from further afield for bedding, thatch and animal fodder. This is probably also true of woodland edge plants such as bracken, found at Bearsden and Carlisle, for example, which make ideal animal bedding and can be strewn onto packed earth floors.

It is generally assumed that cereal was stored as cleaned grain in military granaries (Bulmer 1969, 10). Indeed indications of primary processing, such as threshing, winnowing and course sieving, which might be better evidence of local production, is so far absent, suggesting that grain arrives on site already processed. This may imply that it is being collected from the producer sites in a completely cleaned state or is processed beyond the ramparts of the fort, though the grain drying kilns discovered in the annexe at Elginhaugh perhaps indicates the drying of a locally gathered crop. The chaff that is recovered relates to secondary processing, mainly of glume wheats, generally assumed to be transported and stored on the spikelet (Jones 1981). This is because the primary product of the threshing of glume wheats are spikelets, a further process of parching and pounding being required to free the grains. The spikelets are then processed in batches as required. However, it should be noted that spelt wheat found in the granary at South Shields was stored as cleaned grain (van der Veen 1994). The parching process is often the stage at which the material is charred, and only particular crop components will survive falling into the fire, therefore, Huntley (1999, 56) has suggested that we are gaining a biased picture of cereal usage. This is particularly true of bread wheat which does not need parching because it is a free threshing wheat and is consequently probably under-represented.

On-site pollen results tend to support that from the plant macrofossils, indicating a substantially treeless landscape of open grassland and moorland. Indications of arable agriculture are invariably lacking due to the localised nature of pollen rain. Indeed one would expect there to be a cleared area around the fort to provide a clear field of view for security reasons and to allow space for training exercises, parades and to accommodate the *vicus*. Consequently an abundance of grass (Poaceae) pollen means that pastoral agriculture is over represented. Nevertheless, these sites provide rare insights into the diet of the Roman military and the extent to which they exploited the local resources.

6.
THE BOTANICAL EVIDENCE IN CONTEXT: NATIVE SITES

6.1 INTRODUCTION

In this chapter the botanical evidence from indigenous native settlements within the study area, will be described and briefly discussed and a description of the type and location of each site is given focusing on recent excavations with good botanical results. As with the military sites the material under discussion in this chapter principally refers to plant remains, with occasional references to insects, other invertebrates and animal bones where appropriate. Within the native site category, those occupied prior to the arrival of the Romans are examined for comparison with Roman period sites. Thus changes in crop husbandry regime, if any, potentially attributable to the Roman military presence may be highlighted.

Iron Age sites in mainland Scotland rarely produce large quantities of charred plant remains. The evidence for the second half of the first millennium BC is, therefore, generally fragmentary, but most Iron Age sites excavated provide records of single or a few grains and several have produced small fossil assemblages. The presence of arable land in the area may be attested by the various weeds of cultivation recovered from the samples in addition to the few barley grains that were identified.

6.2 NATIVE SITES.

The late Bronze Age to early Iron Age crannog of **Oakbank**, Loch Tay , Highland, (Dixon 1984) provided the earliest attested incidence of spelt (*T. spelta L.*) in a Scottish context, identified from waterlogged chaff including glume and spikelet bases (Clapham and Scaife 1988; Hansson 1988; Miller 1997). Emmer (*T. dicoccum Schubl.*) was also found, though hulled 6-row barley (*H. vulgare var vulgare*) was the main crop (Miller 1997). This was considered a rare incidence of wheat growing this far north and only on a small scale. With a mild winter and with autumn conditions conducive to planting it could be grown in the best area of sheltered, well drained land adjacent to the crannog (Miller *et al.* 1998). Barley with its greater tolerance for variable weather conditions was probably grown on the rest of the cultivable land available to the settlement.

Douglasmuir, Angus an Iron age settlement of six penannular ring ditched houses broadly dating to the mid-first millennium BC, yielded a small macrofossil assemblage mainly from house contexts and associated post holes (Kendrick 1982; 1995). Barley predominated with wheat and the earliest incidence of oats in Scotland. Weeds of cultivation and disturbed ground dominate the non-economic taxa, such as runch *(Raphanus raphanistrum)* and knotgrass *(Polygonium aviculare)*. Arable farming with some wheat is indicated, but the absence of bone surviving on the site makes it impossible to discern the balance of the economy.

Eildon hill North, Roxburghshire, a substantial hillfort with occupation spanning the late Bronze Age to the early fourth century AD, was partially excavated in 1986 (Owen 1992). Three carbonised barley caryopses were recovered from house platform 2, probably from a hearth context. The barley grains were found associated with small roundwood (hazel, birch and alder) interpreted as firewood and, therefore, deemed carbonised in a cooking or parching accident. An absence of processing waste indicated consumption on site, but no evidence of processing.

Broxmouth, an Iron Age site of considerable complexity in East Lothian, was a multivallate hill fort of nine periods each with several phases. Occupation of the site encompassed a period probably from the fifth or sixth centuries BC to the second century AD. The site excavated in the late seventies yielded the most complete bone assemblage so far recovered on an Iron Age site in Scotland (Barnetson 1982), but very few plant remains. These consisted of a few barley grains (Hill 1982). However the recovery of 80 querns of various types indicates that cereal grains were certainly ground on the site even if evidence of crop husbandry and processing was completely lacking.

The site at **Lower Greenyards**, Bannockburn is situated in a very productive landscape on very good (class 3.2), agricultural land capable of high crop yields, which have produced cereals and root crops in abundance in modern times (Rideout 1996, 102). Pollen evidence from the adjacent valley bog indicates cultivation from the Neolithic onwards (Birnie 1996, 242-7). Excavation in advance of road building and housing development from 1982-5 revealed a palisaded homestead which was succeeded by a promontory fort. Occupation spanned the second half of the first millennium BC till early first millennium AD (Rideout 1996). The artefact assemblage denoted a generally domestic function for the site. The small charred macrofossil assemblage consisted of mainly barley grains, nearly all a hulled, compact 6-row type, identified on the range and proportion of grain size and the degree of twisting of the grains. A very few grains (7) of *Triticum* Sp. were tentatively identified but none were sufficiently undamaged to identify beyond genus. *Avena* sp., probably *fatua/strigosa,* determined on size criteria were also recovered (Fairweather 1996, 247-8 and fiche 1/C14-D14). Typically the incidence of grains, particularly the wheat, in the assemblage is low and the lack of cereal parts other than grains did not indicate cleaning or crop processing. The associated burnt bone assemblage indicated animal husbandry involving sheep cattle and pigs (Barnetson 1996, 259 and fiche 1/E1-E3). With such little material that could be described as chaff and a meagre weed assemblage consisting primarily of ruderal and segetal taxa, a partly arable economy with barley and oats and possibly wheat can be tentatively suggested.

Buiston crannog, Ayrshire is a former wetland site now situated in drained and reclaimed land with two distinct occupation periods in the later Iron age and the post Roman period. (Barber and Crone 1993). The later Iron age occupation deposits were essentially removed, but 3 grains of carbonised barley, two of them a hulled variety were recovered (Holden, 1996, 956).

Romancamp Gate, Moray was a late Iron age non-defensive settlement comprising four timber round houses (Barclay 1993). Three two-litre samples were collected for wet sieving from the possible occupation layer, but poor preservation resulted in many of the charred remains being difficult to identify beyond genus level. The economic taxa consisted of three grains of barley, two of which were naked forms, and one grain which exhibited the characteristic twisted form of a 6-row variety. The occasional cultivated oat grain was recovered, probably representing a tolerated weed within the main crop (Holden 1993, 263). The associated weed species were typical early colonisers of disturbed ground and thus constitute common components of wasteland and agricultural habitats. Their arrival on site and subsequent charring could reflect a waste fraction from crop processing, although the absence of chaff components perhaps argues against this interpretation. Equally they could represent accidental burning of plants growing in the vicinity of the site. The small assemblage and poor preservation of the remains makes any conclusions necessarily tentative (Holden 1993, 263).

A site situated in the same general area and with a similar period of occupation, which shows a number of structural similarities to Romancamp Gate is **Wardens of Durris** Aberdeenshire. It was a multi-phase Iron Age settlement site with a period of occupation lasting several hundred years from the later half of the first millennium BC through to the early centuries of the first millennium AD. The majority of the radiocarbon dates fall between 400 BC and 240 AD at 2 sigma. The site comprises a series of consecutive enclosures, each containing one or several small timber-built round-houses (Russell-White 1995).

Despite an extensive sampling strategy, the number of components from individual contexts was very low making it difficult to assess the origin and importance of plant species in individual samples. The vast bulk of the carbonised assemblage came from a single context, an undated pit to the north of enclosure two. 600 components were recorded, all but two of which were seeds. Barley and wheat comprised 80% of the cereals present, with hulled barley 33.5% and emmer 35%. 16.5% was oats and 4.5% indeterminate cereals. Other features such as gullies, pits and post holes provided a handful of wild and weed species along with a few (30 or less per sample) cereals, mainly barley and oats (Boardman 1995, 18-20). *Hordeum vulgare L.* grains predominated, some of which were a 6-row variety. A few grains of *H. vulgare var. nudum* were also present. The wheat, mostly grains and two glume bases was emmer (*Triticum dicoccum* Schubl.), though many grains could not be assigned to any particular species, in the absence of floret bases. The *Avena* sp. may have included cultivated and wild varieties. Due to the paucity of chaff and straw remains, for example rachis internodes, there was no evidence of on-site threshing. This lack of chaff and smaller seeds suggests processing of a fully cleaned crop charred by accident while drying or parching. An absence of chaff probably reflects preservation biases brought about by unfavourable soil conditions, although crop processing may have taken place beyond the site.

The weed seed assemblage indicates that a number of habitats around the site are represented. The suite of taxa representing cultivated ground and waste places includes *Atriplex, Bromus, Chenopodium, Galeopsis, Polygonum, Rumex, Spergula, Stachys* and *Stellaria.* A grassland habitat is suggested by *Poaceae, Lathyrus, Plantago, Rannunculus, Rumex Sieglingia and Vicia.* Scrubland is perhaps indicated by *Galeopsis, Lathyrus* and *Vicia,* while damp habitats are characterised by *Carex, Polygonum and Persicaria/lapathifolium.* A few species preferring acid soils, for example *Raphanus raphanistrum L., Rumex acetosella L.* and *Sieglingia decumbens L.* and also light well drained soils such as *Spergula arvensis L.* were also present. All the above taxa are common in prehistoric crop assemblages (Grieg 1991), indicating that a number of soil types around the site appear to have been utilised. That wheat was also a crop may reflect in part the more favourable cultivation conditions in this part of Scotland .

The Dunion, Roxburghshire is a hillfort excavated from 1984 to 1986 in advance of further quarrying operations which threatened the site (Rideout 1992). Radiocarbon dates give an estimate for the date and duration of the settlement as 200 BC to AD 125. A group of six scooped house platforms within the hillfort were sampled for macroplant remains (Butler 1992; Fairweather 1992). Sampling sites were chosen from house contexts which were likely to yield high levels of carbonised material such as occupation layers and gully fills. However, of the twelve contexts sampled only one sample produced any quantity of significant remains and few seeds were present. 19 grains of hulled barley, (*Hordeum vulgare*), 12 fragments of *Hordeum* sp. and 6 grains of *Avena* were recovered from the occupation material in house 4. These were possibly weeds, although two species were represented. Measurements of grain size suggested *A. fatua* or *A. strigosa*, but there were not sufficient parts to identify more closely. The weed assemblage consisted of two damaged fruits of *Polygonium cf. persicaria/lapathifolium* type, two *Polygonium cf. Persicaria,* one achene of *Cirsium* sp. one *Carex* sp. and three caryopses of non-cereal Poaceae (two comparable to *Poa annua* annual meadow grass). The quern pit in house two contained three seeds of *Polygonium persicaria,* three seeds of *Polygonium aviculare*, four seeds of *Rumex cf. acetosella*, and four *Hordeum* sp. caryopses (Butler 1992 106). Such a small amount of environmental information and lack of artefacts makes any assertions about the sites economy extremely tentative. Querns were recovered from the excavation and, therefore, grain was ground on site. However, the small amount of burnt bone along with the few grains of barley may suggest a mixed economy. The settlement was quite extensive and may have gathered its food from a wide area, possibly from smaller satellite settlements.

Balloch hill, Argyll is a small stone-built fort on the Mull of Kintyre (Peltenburg 1982). Four phases were discerned with phase III, a later first millennium BC enclosed settlement, being succeeded by phase IV, an open settlement extending into the early first millennium AD. Excavation in the north-west interior of the fort revealed a large pit filled with stones with a thin lining of occupation material which yielded two grains of hulled barley. A small dump of comminuted bone and charcoal flecks embedded in a matrix of dense black soil also yielded three charred grains of emmer, two grains of hulled barley and one grain of indeterminate barley (Dickson 1982, 208-9). Indications of processing and cultivation were lacking as the assemblage consisted entirely of caryopses.

An extensive number of settlement enclosures, both in upland and lowland situations have been identified by aerial photography and ground survey across south-west Scotland (RCAHMS 1997). A number have been excavated such as Long Knowe, Eskdale, (Mercer 1981), Boonies, Westerkirk, (Jobey 1974b) and Candyburn, Tweeddale, (Lane 1986). However only three have provided indications of their economy through plant remains.

Uppercleuch, Annandale (Terry 1993) was a sub-rectangular ditched enclosure 2,500 sq. m in area, with probably an internal bank. This lowland settlement consisted of a cobbled yard with an associated hut circle and a number of other enclosures delineated by construction slots and post holes. A pre-Roman Iron Age/Roman Iron Age date is assumed on morphological analogy with dated examples from the Borders region. A near 100% sampling strategy was pursued taking 20 litre samples from every context wherever possible. However the generally poor preservation of organic remains in northern soils is amply illustrated by the paucity of the macro plant assemblage.

The remains consisted mainly of charred cereal caryopses, with chaff debris being notably sparse, and few other seeds (Scaife and Clapham 1993, 64-67). *T. dicoccum/spelta* type was the most abundant, the lack of chaff making a more precise identification of wheat type difficult. The wheat was, therefore tentatively identified as emmer since, while spelt was dominant in the first millennium BC in southern Britain, in the north it was predominantly emmer (Jones 1981). Conclusively identified spelt was absent throughout. *Avena* and *Hordeum* were present, including a barley rachis fragment, as sporadic occurrences throughout the site, but their degree of importance was difficult to assess because of the paucity of the sample. A small pit outside the enclosure entrance produced the largest quantity of charred seeds (258), all other contexts produced less than 30. The sample contexts were mainly pits and dump deposits concerned with rubbish disposal outside the enclosure entrance, and post holes associated with the habitation area and cobbled yard. The seeds in these contexts were probably incorporated during construction or post removal. The few weed seeds recovered were all individual occurrences and represented those typically associated with cultivation, such as *Agrostis* type grass, other small *Poaceae, Brassica* sp., *Vicia/Lathyrus* (small), *Chysanthemum segetum* and *Chenopodium* sp. Poor preservation at the site is an ample reason for the small sample and lack of chaff remains, but it is possible that the local crop was processed outwith the confines of the excavated area of the site. The largest sample from the pit suggested a cleaned and sorted crop which may have been accidentally charred prior to domestic use perhaps during parching to remove the glumes and chaff, although some of the glumes should have been recovered in the sample.

Pollen monoliths taken from the ditch sections indicated that the site was surrounded by extensive grassland, consisting of wet meadows and pasture, and heathland. Cereal pollen numbers were very low indicating perhaps limited cereal production (Hale 1993, 68-74). The limited database from the site suggests that emmer was the most important crop at the site with barley secondary in importance, while the pollen evidence suggests a predominantly pastoral economy. However, quantifying the balance between arable farming and pastoral farming is not possible

Woodend Farm, Annandale, Dumfries and Galloway (Banks forthcoming) is an Iron Age double banked and ditched enclosure. Carbon-14 dates indicate a Roman Iron Age date, probably from the first to the third centuries AD, though one date hinted at a PRIA date for the beginning of occupation on the site. Eight blocks of structures, many of them overlying each other, attest to a fluctuating pattern of occupation through time. Both dwellings and a possible animal pen were discerned among these remains. 106 flots were analysed, 71 of which contained charred plant macrofossils, though in very low numbers (Aldritt forthcoming).

Weeds species of cultivated and waste ground were the most commonly found non-cultivated taxa with *Persicaria maculosa* (redshank) and *Stellaria media* (chickweed) typically in most samples. Barley, *Hordeum sp.* was the only cereal recorded. Fourteen samples contained barley, four of which had *H vulgare var. vulgare* (6-row hulled barley) in them. Barley therefore, may have been cultivated near the site, although no chaff was preserved which could indicate any processing activity taking place on site. Post-depositional processes may account for this deficiency, but the possibility that the crop processing took place elsewhere should be entertained.

A small waterlogged sample was retrieved from the lower ditch fill in which 240 macrofossils were recorded, most sufficiently well preserved to identify to species. Between these two macrofossil assemblages a number of habitats around the site were identified. Weeds of cultivation indicate that the crop was fairly heavily contaminated by buttercups (*Rannunculus sp.*), redshank (*Persicaria maculosa*), docks (*Rumex sp.*), fat hen (*Chenopodium* *album*) and chickweed (*Stellaria media*). A suggestion of crop processing may be discerned by the possibility that these weeds were introduced to the site as part of the crop being processed. Caution, however, should be exercised with this assertion, since most of these weeds have a varying ecology including waste ground and disturbed areas. It is therefore, equally possible that their presence on site reflects the uncultivated areas around the site. Wet meadows are attested by the presence of *Rannunculus acris* (Meadow buttercup) and *Montia fontana* (blinks). The ditches may have been permanently waterlogged allowing the growth of rushes *(Juncus sp.)* and sedges *(Carex sp.).* Grassland and cultivated ground taxa are well represented by *Rumex acetosella* (sheep's sorrel), *Persicaria maculosa* (redshank) and numerous small *Poaceae* (grasses) as well as well drained soils by *Aphanes arvensis* (parsley piert). Animal husbandry on some of the wetter pasture areas is suggested by the presence of *Urtica dioica* (stinging nettle) and *Potentilla erecta* (tormentil). The presence of animals is confirmed by phosphate analysis and micromorphological analysis of soils from the site. Overall the palaeobotanical evidence indicated a mixed economy with cereal crops being grown around the settlement, while the fragments of querns indicated that the cereals were probably processed on the site.

Most enclosures found across south-west Scotland are sub-circular, but **Rispain Camp,** Whithorn, Galloway, (Haggarty and Haggarty 1983), is one of the few rectilinear examples known. It is therefore, probably a Romano-British settlement on morphological comparison with sites investigated in Northumberland by Jobey. The site consisted of a double banked and ditched enclosure 3072 m^2 in area. The vast majority of the carbonised seeds were recovered from one context, a possible storage pit associated with the substantial house occupying the interior of the enclosure. For this reason the assemblage almost certainly does not represent the complete corpus of crops grown on site. However, bread wheat outnumbered barley by 3 : 1 in the assemblage. The unfortunate absence of processing waste provided no clue to whether crops were being threshed on site. This may have been due to poor survival in the burial context or an indication that the crops were processed elsewhere (Fairweather 1983, table 1, 37, table 2, 39). The weed assemblage consisted of taxa characteristic of heavier soils, knotweeds, *Polygonium* sp. and Chenopodiaceae, and may indicate that bread wheat (also tolerant of heavier soils) was a local crop.

Shiels, Govan (Scott 1973, 66-7; 1974, 82-3) was a Roman Iron Age on the basis of carbon-14 analysis of two worked 'stakes'. An oval ditched enclosure on the river Clyde flood plain, with an interior area of 1512 m^2, it exhibited internal structures represented by stains in the subsoil. A ditch section monolith was recovered and 100cm^3 sub-samples analysed for plant macrofossils wherever possible (Robinson 1983). The economic taxa consisted of one carbonised barley grain and seven carbonised rachis fragments from a single sub-sample at 142 cm. However, weeds of cultivation and other disturbed ground, such as *Polygonium lapathifolium,* (pale persicaria) *Polygonium persicaria,* (red shank) *Chenopodium album,* (fat hen) *Spergula arvensis* (corn spurry) were common. Domestic waste, apart from the cereal remains, was singularly lacking. The ditch monolith was also sub-sampled for pollen analysis and indicated the presence of pollen from open habitat and agricultural weed species. Arable agriculture was represented by *Chenopodiaceae, Polygonaceae* and *Cruciferae*, and pastoral agriculture by *Plantago,* in particular *P. lanceolata, Trifolium, Rumex* and *Rannunculus.* The pollen and plant macrofossil data suggest that the Shiels enclosure was surrounded by an open landscape with well established arable and pastoral agriculture.

Brixwold, Midlothian, a sub rectangular ditched enclosure of 0.16ha with no internal features due to severe plough truncation, is an example of the many small rectilinear enclosures that cluster around the major hillfort at Traprain law. The site is carbon-14 dated to the first and second centuries AD. Analysis of waterlogged ditch fills recovered three barley grains, cleared landscape weed indicators and numerous dung beetle remains suggesting that waste from a dwelling house or byre had been deposited in the ditch. The coleopteran remains further hinted at the possibility of livestock grazing nearby, a suggestion supported by the recovery of a sheep mandible (Crone and O'Sullivan 1997).

Another Romano-British small rectilinear enclosure, typical of those found all over the Tyne-Forth province, at **Doubstead**, Northumberland (Jobey 1982b) yielded two carbonised grains of *Hordeum vulgare* (6-row hulled barley) and one rachis segment from a disposal pit at the rear of the enclosure. Associated weed seeds from the pit and the primary silt in the north terminal of the ditch indicated species usually taken to represent arable and ruderal habitats along with wetland taxa from the ditch itself. Insect remains recovered along with the plant macrofossils again indicated the presence of herbivores nearby (Donaldson 1982, 18-19).

In 1961 a circular house with four defensive ditches situated on a promontory at 22.86 OD over looking the river Carron was excavated at **Camelon**. The site was situated north of the Roman fort in close proximity to the so called north camp (Proudfoot 1978). The native settlement is not closely dated, but pottery and a bronze pennanular brooch suggested that it probably dates to the first and second centuries AD. Some few carbonised hulled barley grains were recovered from a large rectangular pit, interpreted as a probable storage pit subsequently used for rubbish disposal. The fill could therefore be intrusive. No internodes were recovered, therefore identification beyond possible lax eared 4-row or dense eared 6-row varieties was impossible (Dimbleby and Sheldon 1978).

Part of a native settlement was discovered during excavation of a Roman temporary camp at **Pathhead**, Midlothian ahead of housing development (Leslie forthcoming). The terminus of the perimeter ditch of a circular, heavily plough truncated cropmark enclosure was excavated, but unfortunately no stratigraphic relationship with the camp could be discerned. A small sample of plant remains, all carbonised, were recovered in which cereal grains, though few in number and poorly preserved, predominated (Miller forthcoming). *Hordeum vulgare var vulgare* (hulled 6-row barley) was the major crop with one *Triticum* also recovered. The weed flora exhibited the typical suite of ruderal and grassland species (knotgrass, fumitory, red goosefoot and bent).

Buchlyvie, was a broch situated on a mound on the edge of the fertile fluvial deposits of the river Forth in Stirlingshire, known as the carse lands, and surrounded by intensively cultivated agricultural land. The relative dating scheme suggested by the rich assemblage of Roman artefacts recovered, which were exclusively Flavian, placed the period of use in the first and early second centuries AD, but falling out of use before AD 140. Excavation between 1975 and 78 revealed layers of occupation deposits including hearths within the broch which were sampled for archaeobotanical remains (Main 1978; 1979; 1984, 1998). 29 samples were recovered, (including four examined by C. A. Dickson in 1978) only one of which had sufficient charred plant remains for detailed analysis. This was a grain rich sample from the destruction layer of the broch. Because the bulk of the remains were derived from one sample, the assemblage may not be representative of the whole suite of crops probably grown at the site. It also represents a single event, possibly an accident during processing (Boyd 1983; 1998).

However, some clues to the agricultural regime at Buchlyvie could be discerned from the limited suite of evidence. The most abundant cereal was barley, a lax eared 6-row variety (*H. vulgare*), recovered mainly from occupation samples. Other cereals were represented by small quantities of emmer (*T. dicoccum Schubl.*), club/bread wheat (*T. aestivum/compactum*), bristle (*A. strigosa*) and wild oat (*A .fatua*). Cultivated oat (*A. sativa*) was not present. Weeds mainly from the barley rich sample were typically weeds of cultivation and waste ground such as fat hen, (*Chenopodium album*); black bindweed, (*Fallopia convolvulus*); goosegrass, (*Gallium aparine*); knotgrass, (*Polygonum aviculare* agg.); pale persicaria, (*Polygonum lapathifolium*); runch, (*Raphanus raphanistrum*); sheep's sorrel, (*Rumex acetosella*); red-veined dock, (*Rumex sanguineus*); chickweed, (*Stellaria media*); and stinging nettle (*Urtica dioica*). The marked predominance of barley indicated it was the principle crop with wheat as a supplementary crop. The various avena species may represent a tolerated weed of the main crop useful for bulking up the yield. However, given the former widespread cultivation of *A. strigosa* in Scotland, it was deemed likely that bristle oats were grown at Buchlyvie as a crop in their own right (Boyd 1998).

Comparison of the Buchlyvie assemblage with the model of crop processing for free threshing cereals derived from ethnographic parallels (Hillman 1984) suggested that the grain was locally processed and probably grown near the site. The proportions of grains to weed seeds and their relative sizes, plus the types and frequency of chaff elements in the assemblage, suggested that the crop processing stage represented at Buchlyvie was after threshing and winnowing. Probably falling between stage 6 (coarse sieving to remove larger fragments such as weed heads, large weeds, un-threashed ears and straw nodes) and 7 (fine sieving to screen out finer material such as small weed seeds and immature grain), or after both sievings (Hillman 1981, figure 6). An accidental charring during grain drying could then account for the survival of this grain rich sample.

Detailed models of crop processing derived from ethnographic studies, for example (Hillman 1984; Jones1984) are inappropriate for the majority of the sites described above, because of the small quantities of grain available for analysis and the general absence and poor preservation of chaff elements. By far and away the best investigated sites for the region and for the later prehistoric period are Fishers Road East and Fishers Road West, Port Seton, East Lothian.

Fishers Road East was a major defended enclosure complex of 0.8ha in internal area, exhibiting a limited period of occupation, but with evidence for intensive activity on site (Haselgrove and McCullagh 1996; forthcoming). The site composed a double-ditched enclosure with a larger single ditched enclosure connected to it on its eastern side. Within the enclosure four roundhouses were revealed, along with a number of associated post holes which may reflect industrial activity. The whole complex appeared to be of a single phase construction suggesting that the botanical assemblage was probably a coherent whole. The dating evidence suggests that Fishers Road East was occupied from about 400 BC through to AD 200. Excavation of the ditches yielded clues to the economy of the site in the form of animal bone, carbonised grain, artefacts associated with weaving and small fragments of pottery.

Bulk samples of 30 litres were taken from the most appropriate contexts, principally ditch fills from the substantial enclosure ditches, gully and slot fills associated with the round houses and industrially related post holes. 207 contexts were fully analysed, although many contained few identifiable items. The bulk of the plant remains were charred with some waterlogged remains from the lowest fills from the enclosure ditches. However, it became apparent that these latter samples had not been waterlogged since their time of deposition and consequently the assemblage had a bias towards the more decay resistant woody seed forms. Nevertheless, this suite of macrofossils provided useful local environmental and vegetation indications. Cereal grains, chaff and weeds made up the bulk of the assemblage. Barley was the most common cereal represented with grain and chaff in approximately equal amounts. Wheat represented predominantly by chaff was the next most abundant and oats were rare. Primary processing of cereals on site was indicated by the presence of 35 culm nodes, however, these are the basal parts (the stem), of all cereals and consequently exact species could not be determined. Culm nodes indicate that whole sheaves were brought on to site for threshing and reflect an early stage in processing. The relatively low numbers recorded may suggest that the straw was being removed for use elsewhere and little was being burnt and discarded on site (Huntley forthcoming)

The majority of the identifiable barley grains were hulled, some of them exhibited twisting indicating that the 6-row variety was present. Naked grains were also recorded in small numbers (13). Chaff comprised rachis internodes, a few ear basal internodes, whole florets and numerous glume fragments. Of the rachis internodes half were from a six row variety and the rest were too fragmentary for successful identification. A few basal internodes of the ears were present suggesting that whole ears were perhaps processed on site. Length and breadth ratios of complete internodes suggest that both a lax and a dense-eared barley was grown. A mixed crop was probably grown so that at least part of the crop would survive conditions adverse to the other (Huntley forthcoming).

Wheat recovered from the site was represented primarily by chaff; grains were far less common. However, an examination of the grains present indicated that a few on morphological characteristics were bread wheat. A few exhibited the dorsal ridge and glume impressions of spelt and a small number displayed the classic tear drop shape of emmer. A number were classified as *T. Hexaploid* being indistinguishable between spelt or bread wheat. The majority of the grains could only be characterised as simply wheat. Chaff is, arguably, a more reliable diagnostic material for identification of wheats and it was present in fairly large quantities. The bulk of the chaff present came from glume wheats, most of which exhibited the characteristics of emmer, though a smaller number were characteristic of spelt. A number of bread wheat internodes were also recorded. In addition a few complete spikelet forks of each species was recorded.

An assessment of crop husbandry practices and whether crops were being grown locally was carried out by investigating the crop processing by-products evident in the plant macrofossil record from the site. An indication of the crop processing stage (after Hillman 1981) for the glume wheats, bearing in mind that most sampled contexts contain a mixture of processes, was determined by calculating the ratio of glumes to grains in the assemblage. Normally the ratio is 1, that is 2 glumes to 2 grains in each spikelet, with the rachis making up the ear. Therefore, a ratio greater than 1 will suggest fine sieving residue. Of the 16 samples large enough to be used in the calculations all bar one had ratios considerably greater than 1 therefore, it is clear that all of the samples contained material from the fine sieving stage for glume wheats. As might be expected from a native site, this evidence for disposal of crop processing waste in the ditches indicates local production. Barley is free threshing and the ear consequently does not break up on threshing neither are the glumes released in hulled barley. Therefore, the ratio between the number of grains and the number of rachis internodes is calculated. In 6-row barley the ratio is one internode to 3 grains, hence 0.3, a ratio of less than 0.3 would imply more internodes than grain and therefore, probably represents winnowing or coarse sieving debris. The Port Seton samples had values considerably higher than 0.3 (i.e. more grains than internodes) and recognising the possibility of poor survival of chaff relative to the more robust grains, suggested a fully processed and cleaned crop. The ratio of the number of weed seeds to cereal grains was also calculated, despite the varying ecology of wild plants, making weed categorisation problematic. A high proportion of weeds in an assemblage would suggest crop cleaning debris. The majority of the samples had a ratio of approximately 1 with two contexts having a value of nearly 2 and two showing almost four times as many weeds as grains. It was not possible to discern whether the weed seeds were associated with the wheat or the barley. A variable pattern was exhibited in these results suggesting that some contexts contained fine sieving debris from both the glume wheats and barley, whilst others contained discarded whole barley with the fine sieving residue from wheat.

The weed assemblage comprised weeds of cultivation, ruderals, grassland taxa, heathland taxa and wet ground species. Weeds of cultivation were rare, but ruderals were abundant. Overall the weed taxa suggest that a variety of soils were being cultivated, which is not surprising if the population were to maximise the use of land. Soils around the site determined from the weed taxa present were mainly nutrient enriched neutral to slightly acid with some indication of the better dry acidic sandy soils in some areas. The samples recovered at the site from some contexts are rich enough to suggest processing waste, particularly where basal internodes were present, and the richer samples consist exclusively of processing waste. There is clear evidence, therefore, that crops were grown locally. That wheat was grown at Port Seton East, a lowland site on the east coast is not surprising since wheat grows well at lower altitudes in north Britain where soil temperatures are nearer optimal for wheat growth (Bland 1971, 12). The steep lapse rate on higher ground and wetter conditions on the west coast are generally unfavourable for its cultivation.

Close by is **Fishers Road West,** a site contemporary with Fishers Road East at least for the earlier stages of occupation. (Haselgrove and McCullagh 1996 forthcoming). This comprises a plough truncated, sub-rectangular enclosure defined by a sequence of ditches. Five phases of activity were identified on the 3.5 ha site dating from the late pre-Roman Iron Age to the first century AD. 283 samples of varying size, depending on circumstances, were collected from a range of contexts including ditches, gateways, structures, pits and fence lines. Although the assemblage was generally less rich than that from its sister site, both carbonised and significant amounts of waterlogged remains were recovered.

The concentration of charred material in the samples was low, with only four containing significant amounts of remains. Preservation of carbonised cereals was in general poor leading to difficulties with identification, though this did not preclude a significant number of successful identifications. The taxa represented by the charred assemblage were almost exclusively cereal related. A large cache of carbonised cereals from an isolated pit in a first century AD context was the exception and yielded over 7,000 well preserve cereal caryopses.

The main crop appears to have been barley, predominantly, *Hordeum vulgare var vulgare* (hulled 6-row barley) with a minor presence of *Hordeum vulgare var nudum* (naked barley). This probably represents a mixed crop or a relict of an earlier cultivation regime. Local cultivation of barley, which can be spring sown because it is more suited to a damper climate and shorter growing season (Harlan 1995), is hinted at by the presence of weeds of the Chenopodiaceae. These have a modern ecology which is indicative of spring sown crops (Hillman 1981). Wheat was most likely a secondary crop as it is not a major component of the assemblage. *Triticum dicoccum Schubl.* (Emmer) was recorded most with bread wheat a meagre presence. A spikelet base of *Triticum spelta L.* (spelt wheat) suggests that spelt was probably also grown. A few cultivated oats (*Avena sativa)* were recorded from the ditch deposits and may reflect their presence as a common weed of the disturbed areas on the margins of the site or as a crop contaminant. This may be emphasised by the absence of oats in the large pit deposit where they may have been cleaned out of the crop prior to storage.

Within the weed assemblage weeds of cultivation are rare though ruderals are more common such as *Chenopodium album* (fathen), *Stellaria media* (chickweed), *Plantago major* (greater plantain), *Polygonum* and *Persicaria* species (knotweeds). Damp ground taxa, for example *Juncus sp.* (rush) and *Carex sp.* (Sedge), indicate that the ditches were wet. The diversity in the weed taxa indicates that different soils around the site were being cultivated.

Crop processing indications in the form of chaff were present at very low levels reflecting the taphonomic processes in the midden deposits from basal ditch contexts or, perhaps, overheating during carbonisation (Miller *et al.* forthcoming). However, some on-site cereal processing may be suggested by the presence of carbonised heath turf indicators, such as capsules, stems and leaves of heather, in association with cereals in the ditch deposits. The suggestion is that a slow burning turf fire was used for parching grain (Miller *et al.* forthcoming). There is also good evidence for storage of a mainly cleaned crop of barley grains in the large pit. That low levels of chaff were recovered at Fishers Road West compared to Fishers Road East may reflect differences in sampling strategy or preservation biases between the two sites. Alternatively this may be a real phenomenon and indicate a different function with regard to crop processing at the site. Fishers Road West may be involved with final preparation for storage and storage of a harvest processed elsewhere. Phase 4 deposits, dated to the first century AD, indicate a less diverse composition in the cereals grown than in the phase 3 deposits with barley predominating and wheat forming a smaller part than before. These changes were interpreted as indicating a move from an open social organisation with wide exchange links and an interdependence with other communities to a more insular and defensive outlook with a greater element of self-sufficiency.

Other sites with sufficient evidence for an analysis of crop husbandry lie considerably further south in the Tweed - Tyne region of north-east England. It is in this region that the most comprehensive and thorough study to date on crop husbandry regimes was undertaken (van der Veen 1992). Four native sites of the pre-Roman Iron Age and Roman Period examined in Northumberland fall within the study area. These are Murton (Jobey 1987), Dod Law (Smith 1985, 1986, 1990), Chester House (Holbrook 1988) and Thornbrough Scar (Clack 1984) respectively. All of these sites were settlements considered to produce some at least of their own food because much of the cereal material consisted of chaff.

Murton is a small hillfort at 90m OD in northern Northumberland just south of the River Tweed. The site consisted of an oval enclosure partially excavated to rescue the remains from plough damage and quarrying. An earlier Bronze Age unenclosed settlement was succeeded by the main Iron Age phases of the settlement, the first series of which was a triple palisaded defensive enclosure with timber-built round houses. Two carbon-14 dates were obtained indicating a later Iron Age (late 2nd century BC – 1st century AD). The timber-built phase was superseded by a stone built phase, dated to the Roman period by associated pottery.

Samples were collected from 12 contexts within the timber built phase and 68 litres in all were sieved. However, the volume of many of the samples was very small and in consequence three contexts provided the bulk of the sediment sieved. The assemblage therefore, can only be considered to represent a partial record of the possible crops that were grown around the site. Six-row hulled barley was the dominant species but a few grains of the naked variety were present. Wheat grains and wheat chaff were particularly common with suggestions that emmer was the more common wheat, although spelt was present (van der Veen 1987, 192-6). This indicated that regional differences in the distribution of wheat species existed between the north and south of the study region. Spelt had generally superseded emmer by the late Iron age in the southern parts of the north-east of England, while emmer retained its dominance in the north (Jones 1981). However, the results from Murton suggested that while spelt had been introduced into northern England by the late Iron Age it had yet to establish itself as the principle wheat species. Also present were weeds many of them common to arable fields and waste places. The weed assemblage also indicated that there were areas of reasonably well drained, nitrogen rich soils where cereals could be grown in the vicinity of the site. Other soils indicated the majority were poorly draining acid soils, but both of these types were utilised by the inhabitants of the site.

Dod Law, Northumberland, a small bivallate hillfort with a univallate annexe to the north-west occupies a commanding position at 182m OD overlooking the Milfield plain to the west (Smith 1990). The main enclosure is c. 0.3ha in area and the remains of stone-built round houses are visible in the north-western part of the enclosure. The occupation of the site is thought to have spanned the period from *c.* 300 BC to *c.* 200 AD. Sections were dug through the inner and outer ramparts of the main enclosure, the annexe rampart and the junction of the annexe bank with the main enclosure bank on the eastern side of the fort. Samples were recovered from well-sealed deposits in all of these areas, though, the bulk came from the rich rubbish deposits sealed by the collapse of the inner rampart. In all 308 litres of sediment were wet sieved. The cereal grains were dominated by 6-row hulled barley (*Hordeum vulgare)* though a few grains of naked barley were present. A mixture of emmer (*Triticum dicoccum Schubl.*) and spelt (*Triticum spelta L.*) was present as evidenced by their chaff fragments, although emmer dominated. The associated weed seeds were those commonly found in arable fields and waste places (van der Veen 1990, 33-38).

Chester House was a small rectangular enclosure built on a slight rise at 41m OD., on the Northumberland coastal plain. The site was partially excavated in advance of open cast mining. A 0.2ha. enclosure within its ditch contained evidence of three plough-truncated round houses, which stratigraphic relationships showed not all were contemporary. Unfortunately no stratigraphic relationship could be determined between the enclosure and the round houses within it. There were Carbon-14 dating problems, but the overall date seems likely to be Iron Age. The entire fill of all features was sieved, comprising 890 litres of sediment from 31 samples representing 14 different contexts. Despite this, the numbers of seeds within the individual samples was small. Van der Veen (1992) identified 6-row hulled barley and possibly some which were 6-row naked varieties. Emmer and spelt were recorded with emmer probably the more abundant of the two. The samples also contained a range of weed seeds indicative of disturbed ground, waste places and pasture including *Ranunculus, Danthonia decumbens and* small grasses.

Thornbrough Scar is situated at 55m OD. just south of Hadrian's Wall on the northern bank of river Tyne. Rescue excavation in advance of gravel extraction exposed a rectangular enclosure with an entrance to the east, within which no plans of structures could be discerned due to the extreme stoniness of the subsoil. A Romano-British date for the site was suggested on the basis of the recovered artefact assemblage. A sampling strategy of recovering deposits from all well stratified contexts was intended, but in the end both well and poorly stratified contexts were sampled. 134 samples from 95 contexts were ultimately recovered, and after preliminary examination, 23 contexts (24% of the total), were chosen for analysis. The assemblage was dominated by cereal grains although cereal chaff was also common. Weed seeds however, appeared in low numbers. The barley present was 6-row hulled barley. Spelt wheat was the only wheat crop present, some in the form of spikelets, although a very small number of emmer glume bases was recorded. These were regarded as a contaminant or relict of an earlier agricultural tradition residual to the main crop. Grains of rye and rachis internodes were identified as a minor component of the assemblage, but because it is assumed to be a late introduction from the late Iron Age onwards with its floruit in the Saxon and Medieval periods it was considered likely to be a contaminant. The weeds were dominated by brome grass, a plant found in waste places and disturbed ground including arable fields.

6.3 SUMMARY / DISCUSSION

Botanical reports, of varying quality and comprehensiveness, from twenty five native sites situated within the study area were examined. Both waterlogged and charred remains were recovered from these sites though the quantities were often inadequate in many instances. However, a reasonable, though not necessarily complete, assessment of the crops utilised could be obtained from the carbonised assemblages. A number of the sites provided excellent waterlogged material enabling a fairly comprehensive picture of the wider environment and utilisation of local resources to be built up. In addition by reviewing data from sites with a range of periods of occupation spanning the Iron Age and Roman period some comparison between the period before and the period after the arrival of the Roman army could be made.

As with the military sites six cereal crop species have been recorded from the indigenous native settlements: *Triticum dicoccum Schubl.*, (emmer wheat), *Triticum spelta L.*, (spelt wheat), *Triticum aestivo-compactum*, (bread/club wheat), *Hordeum vulgare*, (6-row barley), *Secale cereale*, (rye) and *Avena fatua/sativa,* (wild/cultivated oat). Their presence or absence on the various indigenous native sites during the indicated periods of occupation Bronze Age (BA), Early Iron Age (EIA), Middle Iron Age (MIA), Late Iron Age (LIA) and Roman period (RP) are listed below: (table 6.1)

Site	Period of Occupation	Native Sites Barley 6-row	Emmer Wheat	Spelt Wheat	Bread Wheat	Rye	Oats
Oakbank	BA - EIA	*	*	*	-	-	-
Douglasmuir	EIA	*	*	-	-	-	*
Eildon Hill North	EIA - RP	*	-	-	-	-	-
Broxmouth	MIA - RP	*	-	-	-	-	-
Buiston	LIA	*	-	-	-	-	-
Murton	LIA	*	*	*	-	-	-
Romancamp Gate	LIA	*	-	-	-	-	*
Wardend of Durris	LIA	*	*	-	-	-	*
Balloch Hill	LIA - RP	*	-	-	-	-	*
Dod Law	LIA - RP	*	*	*	-	-	-
Fishers Road east	LIA - RP	*	*	*	*	*	*
Fishers Road west	LIA - RP	*	*	*	*	-	-
Lower Greenyards	LIA - RP	*	*	-	-	-	*
Rispain Camp	LIA - RP	*	-	-	*	-	-
The Dunion	LIA - RP	*	-	-	-	-	*
Upper Cleuch	LIA - RP	*	*	-	-	-	*
Brixwold	RP	*	-	-	-	-	-
Buchlyvie	RP	*	*	-	*	-	*
Camelon	RP	*	-	-	-	-	-
Doubstead	RP	*	-	-	-	-	-
Pathhead	RP	*	cf.	-	-	-	-
Shiels, Govan	RP	*	-	-	-	-	-
Thornborough	RP	*	-	*	-	*	-
Woodend	RP	*	-	-	-	-	-

Table 6.1: Presence or absence of cereal species: indigenous native sites.

cf. denotes an uncertain identification due to poor or fragmentary preservation or ill-defined morphology (after Dickson 1970).

Of the twenty-five indigenous native sites reviewed in this study, many provide entirely inadequate material for analysis, however, hulled 6-row barley is demonstrably the principle cereal crop throughout the Iron age and Roman period. It is recorded at all sites and is exclusively found at eleven (44%) of them, reflecting its tolerance of variable weather conditions and those adverse to the growth of wheat. Naked barley occurs in trace amounts, perhaps suggesting that it was a relict of earlier cultivation traditions appearing as a residual or unwitting contaminant of the main crop. Alternatively, it may have been a component of a mixed crop. Mono-crops are a modern innovation and it is not in the ancient farmers interest to have a genetically homogenous crop since survival of part of the crop may be enhanced when adverse conditions occur that effect the remainder.

Wheat is a secondary component of crop assemblages at all sites in numerical terms, and this probably reflects its status in the indigenous native economies. Climate and edaphic factors were not universally conducive to the cultivation of wheat in northern Britain, though emmer and spelt are relatively more hardy than the free threshing wheats. Emmer is the most abundant wheat species, and is recorded at twelve of the sites, (48%), reflecting its status as the favoured wheat species from the Neolithic onwards in Britain (Grieg 1991). However, emmer was gradually being replaced by spelt by the late Iron Age. The vagaries of survival in northern soils notwithstanding, the data presented here indicate that spelt is more prevalent on late Iron age sites than in earlier periods though, clearly this was not a uniform replacement in space or time as its early occurrence at Oakbank indicates. Social reasons have been postulated for this seeming continuity throughout the period, involving an element of conservatism with respect to their crops and a strong adherence to tradition (van der Veen 1991).

Spelt occurs at the Early Iron Age crannog of Oakbank, where it is the earliest Scottish record to date in a pre-Roman context (Clapham and Scaife 1988; Miller 1997). This is a rare instance of small scale cultivation, but only on sheltered well drained land in climatically favourable years (Miller *et al.* 1998). A more regular supply would probably have been obtained from further south by the various exchange mechanisms operating within society. Spelt grows on heavier soils and is hardier than emmer and is, therefore, suited to winter sowing (Jones 1981), with barley capable of being spring sown, this helps to spread the agricultural labour burden throughout the year. Recent crop trials over a number of years have also shown that spelt is higher yielding than emmer in most soil and climatic conditions (van der Veen and Palmer 1997). Furthermore, Dickson (1990) has shown that both emmer and spelt flour have good working properties, though emmer makes a heavier flat loaf, whilst spelt makes a more palatable, lighter loaf of bread. Emmer does nevertheless make a delicious and nourishing porridge. However, spelt is numerically secondary to emmer at all of the late Iron Age sites where it is recorded (Murton, Chester House, Dod Law, Fishers Road East and

Fishers Road West). This is an instance of an innovation which was not automatically accepted even when the benefits were obvious and suggests that whilst spelt was available to northern farmers, emmer was preferred and the choice was made based on non-utilitarian criteria, perhaps social and cultural grounds (van der Veen and O'Connor 1998). The late Iron Age to Roman period site at Thornbrough was unique among the native sites in that spelt was the only wheat species recorded in significant quantity. Emmer was recovered in such minute quantity that it was thought likely to be an impurity among the major crop (van der Veen 1992). Sites south of the Tyne show a greater prevalence for spelt, indicating that it had taken over completely from emmer as the principle wheat crop by the later Iron Age (van der Veen 1992).

Despite the limited size of the data base, the sites where spelt is recorded are all situated towards the eastern side of the country where the climate is warmer and the land more fertile and better drained. Moreover, they are located in lowland situations on the East Lothian coast (Fishers Road East and West), Northumberland coastal plain (Chester House) and the north bank of the Tyne (Thornbrough). Murton and Dod Law on the Northumberland uplands are small hillforts located on eminences adjacent to lowland areas from where their agricultural produce would have come.

Bread/club wheat is found as a very minor component at only four sites: Fishers Road West, Fishers Road East, Rispain Camp and Buchlyvie. However, traces of bread wheat have been recovered on a number of Iron Age sites, but problems with the dating evidence have led to the identifications being suspect. At Chester House and Thorpe Thewles carbon-14 dating indicated that the wheat was modern and Medieval respectively, though that from Rock castle proved to be of late Iron Age in date (van der Veen 1992, 60, 74; van der Veen and O'Connor 1998, 130-31). Furthermore, identifications from grains alone, without the more diagnostic chaff elements, must be treated with caution. Bread wheat grows well on heavier land with a significant proportion of silt or clay. Its advantages include winter hardiness, a high yield potential and a loosely packed head for ease of threshing. However, it is also vulnerable to attack from birds, is susceptible to damp, leaving it open to fungal attack, competes poorly with weeds, and requires greater soil fertility than other wheats (Hillman 1981; Jones 1981). But bread wheat is not thought to have become a major crop till the later Roman period because it has been suggested that it was favoured only when it became possible and desirable to invest the greater amount of fertiliser and man hours in the form of cultivation and weeding that would be necessary to obtain its high yield potential (Jones 1981, 107). It is, therefore, possible that it represents a contaminant in the late Iron Age. However, the first three sites have occupation phases in the Roman period, and Buchlyvie is exclusively occupied in the early part of the first millennium AD. This may, therefore, represent innovation at these sites or suggest that they had some status and links with wider exchange networks from further south. At Rispain Camp, in particular, wheat in the assemblage outnumbers barley by a ratio of 3:1. Despite the inherent difficulties in relying on evidence from a single pit, the wheat was recovered in association with weeds indicative of the heavy soils favoured by wheat. Though it should be noted that, assuming it is valid, with caution, to project climatic conditions into the past, all of the sites are situated in fertile regions in lowland areas where climate and edaphic factors are more conducive to the growth of wheat

It is difficult to distinguish between the wild and cultivated varieties of oats unless the floret bases are present and for this reason many of the identifications recorded above are necessarily tentative. Nevertheless, oats are recorded as a very minor component at nine sites with the earliest recorded incidence in Scotland at the early Iron Age site at Douglasmuir. Oats have a high tolerance for acid and infertile soils and were grown extensively on marginal land from the first millennium AD throughout Scotland and Wales (Boyd 1983). However, *Avena sativa* (cultivated oat) and *Avena strigosa* (bristle oat) are known to occur only in small amounts in larger samples of emmer and barley in several Iron Age and Roman period finds, particularly in samples from the highland zone (Godwin 1975, 408; Jones 1981). This probably points to it being an accidental contaminant of other crops, throughout the Iron Age and early Roman period, as is almost certainly the case with. *Avena fatua* (wild oat) which was probably never cultivated. This suggestion is supported by the absence of oats amongst the cleaned grain in the storage pit at Fishers Road West when it was present in other samples. The ditch deposits at Fishers Road West contained a few oat grains indicating that it was also probably a common weed of the disturbed areas of the site margins or ditches. In some areas it may have been a tolerated weed during the Iron Age used to bulk up the yield, for example at the Dunion where oats were recovered from the occupation deposits in house four.

Rye was recorded as a very minor component at two sites, but since it is generally viewed as a later introduction, it probably represents a sporadic weed at Fishers Road East and at Thornbrough. The identification at Fishers Road East was tentative, diagnostic features being absent, but the possibility that it was a contaminant present amongst a consignment of imported grain was entertained in keeping with the view that the site was part of an extensive exchange network (Huntley forthcoming). Whether rye was a crop or a weed at the Roman period site at Thornbrough was unclear, but if the former it may have been an indication of the changeover to growing a new cereal crop (van der Veen 1992).

Crop processing is more difficult to deduce because of a general lack of waste products, perhaps reflecting preservation biases or off-site processing, though it would seem reasonable to suggest that these sites produced at least some of their own food and were in the main self sufficient. Querns are common finds on the majority of settlement sites and aerial reconnaissance has highlighted numerous patches of cord rig and small field systems around upland settlements all over southern Scotland and northern England (Halliday 1982 and 1986; Topping 1989; Gates 1999). If cereals are locally grown then the harvested crop will be brought directly to the settlement with the weeds and straw, and the release of grains from the ears will take place on the site. This will result in specific and characteristic by-products indicative of the various crop processing stages (Hillman 1981). Where crop processing waste was recovered in sufficient quantity for analysis at Chester House, Dod Law, Fishers Road East, Fishers Road West, Murton and Thornbrough, it consisted primarily of the fine sieving debris of glume wheats and the residue of the later processing stages for barley. Primary processing residue was generally absent except at Dod Law and Murton, where the remains of the early processing stages for barley in the form of rachis fragments were recovered.

At Fishers Road West the remains were characterised by midden deposits, that is waste products of crop processing dumped into the ditch system. The remains were principally barley with a scant presence of wheat chaff, perhaps reflecting preservation biases or off-site processing. A fully cleaned grain cache was also recovered from an isolated pit, conceivably indicating storage of the processed crop on this site. In addition an indirect suggestion of crop processing was identified by the presence of charred heathland taxa in close association with cereal waste perhaps indicating the use of heather to slow down a fire to parch grain (Miller *et al.* forthcoming). Fishers Road East provided a generally richer assemblage than at Fishers Road West. Some contexts consisted predominantly of cleaned barley grains, others contained the fine sieving residue of barley and glume wheats and some discarded barley with the fine sieving residue from wheat. (Huntley forthcoming). The differences in the assemblages from the two sites - storage of cleaned barley grains at Fishers Road West and exclusively processing waste at Fishers Road East - provide a clue to the interdependency of the sites, suggesting storage at the former and processing taking place at the latter. This perhaps suggests a more complex social structure generally with producer and consumer sites. The evidence from Thornbrough indicates the presence of two fully cleaned crops, spelt and barley, both of which may have been brought in from elsewhere (van der Veen 1992, 99). The chaff provides strong evidence of crop processing, as might be expected from indigenous native sites. Barley is the pre-eminent crop with wheat as a secondary cereal only cultivated locally on the drier, better drained soils of the east coast. Wheat is more prevalent on sites from northern England, therefore, wheat could have been brought in from sources further south. Perhaps through the extensive exchange networks operating in society to enhance social status and maintain power amongst competing elites.

The diversity of the weed species indicates a number of different habitats around the individual sites. Weeds of disturbed ground, including cultivated fields, and other waste places predominate, such as Knotgrass (*Polygonum aviculare*), Redshank (*Polygonum maculosa*) and Chickweed (*Stellaria media*). The category next in importance are indicators of extensive grassland, such as seeds of wild grasses (*Poaceae*) and grassland taxa (*Lathyrus* sp., *Ranunculus* sp., *Rumex* sp., *Sieglingia* sp. and *Vicia* sp.). This exhibits a number of forms such as pasture suggested by *Plantago* sp., damp grassland or wet meadows, suggested by *Ranunculus acris* (meadow buttercup) and *Montia fontana* (blinks), and scrub grassland suggested by *Galeopsis* and *Stachys* sp. Large tracts of heathland or heather moor are indicated by numerous parts of *Calluna vulgaris* (heather), such as stems, leaves and capsules which were commonly utilised for bedding, thatch and fuel.

A range of different soils were being utilised for cultivation. People in the past were in part able, and in part required, to cultivate differing qualities of land in the absence of mechanisation and in an effort to maximise the crop yield. Areas of light well drained land are suggested by the presence of *Spergula arvensis* (corn spurry) and *Aphanes arvensis* (parsley piert), and light nitrogen rich soil by *Stellaria media* (chickweed) and *Urtica urens* (small nettle). Heavier nitrogen rich conditions are indicated by *Chenopodium album* (fathen), *Polygonum lapathifolium* (pale persicaria) and *Polygonum persicaria* (spotted persicaria). *Danthonia decumbens* (heath grass), *Rumex acetosella* (sheep's sorrel) and *Raphanus raphanistrum* (runch) demonstrate that quite acid conditions were also cultivated. *Polygonum lapathifolium* and *Polygonum persicaria* are also indicative of damper conditions or poorly drained land. *Juncus* sp. (rushes) and *Carex* sp. (sedges) are also very common among the cereals, probably indicating cultivation on wetter ground or less well drained land than is acceptable today. *Juncus* and *Carex* probably also represent the environment in and around the damp and often waterlogged enclosure ditches.

The statistical analysis of the charred seed assemblages at Murton, Dod Law, Chester House, Thornbrough and the others in van der Veen's study, (1992) identified two distinct groups of sites, A and B. These differed from one another in both the types of cereals cultivated and the weed flora associated with these crops. Group A sites were deemed to have an intensive small scale cultivation regime. The sites were characterised by the presence of emmer wheat, some spelt wheat and barley. The arable weed species were predominantly annuals, which are able to recover from high levels of soil disturbance, suggesting intensive soil working involving high labour input, such as digging or ploughing, weeding and manuring. Consequently, fertile soil conditions were thought to ensue. Group B sites seemed to have a more extensive cultivation regime involving larger areas under crops. These sites are characterised by spelt wheat and barley. Arable weed species in these assemblages were perennials with some annuals, indicative of limited soil working, manuring and low labour input which allows these plants to thrive. The soil conditions were consequently less fertile (van der Veen 1992). There appeared to be no correlation between physical factors, such as climate, soil conditions and altitude, which would account for these differences in crop husbandry regimes. Moreover, the differences between the two groups of sites were not confined to crops and weed species. The sites were located in different parts of the region, and were characterised by different types of settlement, group A sites tended to be defended, whilst group B sites were non-defended sites. The social structure of society between the two groups, A and B, involved different degrees of centralisation, and differing tribal affinities with either the Votadini or the Brigantes respectively. Therefore, social and cultural differences were postulated as the underlying cause. In both groups of sites barley was treated differently from wheat. In both cases it was associated with the poorest soil indicators, suggesting that the barley crop was grown under a more extensive range of soil conditions than the wheat crop, highlighting differences in the relative status of these crops and the fact that both cultivation regimes can be in operation on the same farm (van der Veen and O'Connor 1998). Murton, Dod Law and Chester House were placed in group A, the intensely conservative less centralised group, whilst Thornbrough Scar was categorised as a group B site linked to a more centralised political regime which encouraged the expansion of large scale agriculture.

Because of the small data base and lack of reliable evidence to the contrary the A regime was taken to be the general pattern in the north. Indeed, most of the native sites described above which were not considered in the van der Veen study would be categorised as group A sites, that is small-scale, intensive, conservative cultivation regimes growing barley, emmer and in some cases a little spelt. This would seem to be confirmed by Gates (1999, 6-7), based on the aerial survey of Northumberland National Park, who has suggested that the small plots of cord rig found around numerous settlements in Northumberland and the borders are not large enough to generate a surplus and are, therefore, indicative of basic small scale intensive subsistence cultivation. Furthermore, work on the spatial organisation by Ferrell

(1995 and 1997) both within and between settlements in the landscape of north-east England, has suggested that a conservative social structure operated in this area. Ferrell's analysis suggested that particular spatial patterning and architectural styles indicated different social formations within society which could be linked to the archaeobotanically observed modes of production. Northumberland upland sites (i.e. group A sites) displayed no evidence for settlement hierarchy. They consisted of isolated enclosures exhibiting little variation in size, and little in terms of size and location to suggest special status. Individual enclosures had many buildings within them with no clear boundaries between the houses, suggesting a communal social structure of extended family groups.

The data base, however, is spatially restricted and areas such as those west of the Pennines are particularly under-represented. Diversity in native communities is apparent in the differential uptake of spelt and the differences in the settlement pattern in south-eastern Scotland. Here the concentration of hill forts exhibiting a range of sizes and distinctive structures displaying some architectural sophistication and social pretension, such as the lowland brochs, suggests some settlement hierarchy. In addition, higher status is implied by the number of exotic items found on certain sites, such as Buchlyvie (Main 1998) suggesting exchange contact with wider networks within Scotland and beyond. The large number of rectilinear settlements clustering around the large hillfort of Traprain Law would seem to indicate the possibility of a complex social hierarchy of mutual dependence. The evidence from sites generally believed to be of higher or elite status, such as Traprain Law, has been re-interpreted in recent years, moving away from models of control, centrality, corporate involvement and re-distributive functions to an emphasis on ritual and ceremonial (Hill 1987). However the analysis of the distribution of finds from Traprain Law by Erdrich *et al.* (forthcoming) has identified areas of domestic and industrial activity and brought back into focus the primarily settlement function of parts of the site.

It is recognised that plant macrofossil and pollen evidence does not constitute closely comparable evidence in that they reflect agricultural practices in different ways and often reflect different practices. Nevertheless, the pollen evidence appears to undermine the harsh regional pattern discerned by van der Veen (1992), especially of small scale intensive strategies in the northern part of Northumberland and south-eastern Scotland. A rise in pastoral and arable herb indicators is seen at most sites, with cereal recorded at many of them. Also a spatially extensive system of crop production is reflected in the pollen evidence. Therefore, the uniformity and extensiveness of the clearance pattern indicated in the available pollen spectra may imply a more sophisticated arable cropping regime in parts of northern England and southern Scotland (Tipping 1997). Perhaps akin to that south of the river Tyne described by van der Veen (1992). Whilst there are perhaps indications of sophisticated and extensive farming regimes in certain areas from the present data there is no discernible difference in the range of crops being exploited between the late Iron Age and the Roman Period.

Whether the expansion of agriculture was accompanied by a population expansion is less clear. The varied and numerous settlements highlighted by aerial photography, even if they are not all contemporary, suggest a large population. Surveys by Jobey (1974a) of enclosed settlements in the Tyne Forth province show clear indications of settlement expansion. Approximately one third of existent Romano-British settlements in Northumberland and the Scottish Borders showed an increase in the number of dwellings over time. It is more difficult to demonstrate an increase in the number of new settlements, but in some areas their density is considerable. Along an approximately 5km stretch of the Breamish valley in Northumberland, for example, 150 houses were identified in 21 enclosures (Hanson forthcoming, quantifying Jobey 1966, 4). The apparent arable expansion in southern Scotland is suggestive of an increased demand for cereals broadly contemporary with the Roman incursions in the early first millennium AD (Armit and Ralston 1997 193).

7.
DISCUSSION AND CONCLUSION

7.1 Limitations of the Database

The question of whether the garrison of northern Britain north of the Tyne-Solway isthmus could be supplied wholly on the basis of cereals drawn from local sources is extremely difficult to answer for a number of reasons. The assertion made back in 1982 to the effect that "the evidence for arable farming is generally limited to a few seeds and the presence of quern-stones" (Halliday 1982, 74) is still substantially true. Querns, which are practically ubiquitous on indigenous native sites indicate preparation of the cleaned product with little indication of where or in what quantity it was grown. Though it would seem reasonable to suppose that crops in the main were grown for domestic consumption and each individual settlement would produce some of their own food. Seeds however, without chaff merely indicate presence or access to grain on site. From the bulk of the evidence, therefore, it is easier to demonstrate consumption of agricultural produce than primary processing. The number of sites excavated with botanical information available remains relatively small despite greater awareness of the need for environmental sampling over the last two decades or more. Not all sites provide the quality and quantity of botanical material required for a comprehensive and rigorous analysis of past cereal distribution and use. There is also a restricted distribution across the region reflecting research bias and the vagaries of survival in northern soil conditions. Sites are, therefore, geographically restricted mainly to the southern and eastern fringes of the study area. Periods of occupation of many of the sites covers a long time span from the late Bronze Age to the Romano-British period, often without obvious chronologically defined horizons which can be linked to the Roman period. The relationship to the Roman presence is often difficult to establish in the absence in many cases of Roman artefacts on sites. However, the potential to supply the Roman army may be assumed if producer sites of Roman Iron Age date are within reasonable proximity to military installations. There is, therefore, a geographically restricted data set with which to view the Roman impact.

7.2 Size of the Roman demands.

The regular and reliable supply of food products must have been a matter of constant concern to the Roman Army, both when on campaign and when stationed in permanent garrison during periods of occupation. Conversely, since the bulk of the Roman army was stationed mainly in the north the arrival of large numbers of troops probably had a major impact on the native economy. However, the settlement evidence in many areas is extensive implying a reasonably large population. Therefore, the numbers of soldiers present is unlikely to have represented a significant rise in population and consequently it may only have required a very small rise in agricultural production to meet its needs. But any attempt to consider this question and its impact on the environment and economy of northern Britain must first consider not only its extent but also its size. Demand fluctuates considerably over the three major periods of occupation and the consequent variations in the numbers of soldiers must have influenced the magnitude of the grain demands at any one time. The demand for grain was a continuing yearly burden while the Roman occupation lasted. This could presumably only be met after the needs of the local population for food, animal feed and seed corn had been fulfilled, unless the food was forcibly taken, which would be a very short sighted strategy if supply in subsequent years was to be ensured.

Estimating the capacity of the local agricultural economy to provide the 12 - 16,000 tonnes of grain required (see chapter 3) and its impact on the local population requires some idea of the annual yield and the area under cultivation. Crop yields are highly dependent on climatic factors and the local soil environment, therefore conditions vary considerably in different places, and hence the figures can only be guessed at. The burden can be most usefully expressed as a percentage of local production figures. Until recently it has been usual to estimate ancient wheat yields by using the average figures obtained at the experimental Iron Age farm at Butser, Hampshire where yields of 2 tonnes per hectare for spelt and emmer were obtained from a chalk soil without manure or residual nutrient from previous land management (Reynolds 1979, 61; 1992). However, the yields achieved at Butser are unlikely to be typical of the country as a whole since climatic factors, generally more severe in the north, and edaphic factors, particular to individual growing areas, significantly affect yields, though the associations of the different factors are as yet incompletely understood (van der Veen and Palmer 1997). Therefore, taking figures from the attested barley yields from south-eastern Scotland in the 1950's before the onset of widespread mechanisation, and agro-chemical usage (Meikeljohn 1951, 100) and reducing them by one third to allow for the change in the economic basis of agriculture away from subsistence, and climatic change since the later Iron Age, the area necessary to produce the barley requirement would be in the order of 1,745 ha. If the total cereal requirement (barley and wheat) were met between 5,042 and 6,651ha would be needed. This equates to an average of between 126 and 166ha per fort for each of the approximately forty forts presumed to be occupied in the first century. If a total catchment radius of 10km is assumed for each of these forty forts, then between 0.4 % and 0.5% of the available land within this catchment would be required. But only about 38% of the total land area of Scotland (classes 1-4) is today considered suitable for arable agriculture under the land capability assessment (LCA) (Bibby et al. 1982) and although this assessment is made with reference to present day agriculture, the same relative contrasts would have existed in the past. This is because the LCA is assessed on permanent or semi-permanent soil characteristics including accumulated temperature, soil moisture deficit, soil depth, drainage and stoniness (Davidson and Carter 1997). The assessment takes into account mechanisation, and land now unsuitable for cultivation by tractor because of steep gradients or rock outcrops was almost certainly utilised in the past, thus taking in class 5 marginal land on the fringes of present day cultivation. Cultivation was therefore, more extensive in the past as the abundant field remains above the present limit of agriculture indicate. Moreover, the surviving evidence for cord-rig cultivation (cf. Halliday 1986) in upland locations suggests that arable farming was fairly extensive, particularly since cultivation traces in the more fertile low lying areas have been eradicated by subsequent use. Notable is the fact that the Romans occupied less than 50% of the country even at its greatest extent, but that which they did occupy is the majority of the available arable land, i.e. the land in LCA classes 1-4 designated suitable for arable cropping today. The total area under arable cultivation for Scotland in 1965 was 615,000 ha (Coppock 1976). Taken as a very rough guide this indicates that a very small percentage (0.8-1.0%) of the potentially cultivable land need be utilised to fulfil the military requirement. This is the minimum requirement, since variable local crop yields often of indifferent quality would necessitate wider foraging to make supply sustainable over the longer term. Moreover these calculations do not take into account socio-political factors, which are invariably attendant on the workings of embedded economies such as are believed to pertain in northern Britain, or regional differences in crop husbandry practices reflecting cultural and social differences.

7.3 How was the demand met?

The impact of these various demands upon native society and economy largely depends on to what extent they were met locally. As Breeze (1984a) has shown from a comprehensive review of the literary and documentary evidence from the wider empire it is clear that the process of army supply was both complex and variable, involving purchase, requisition, military production and tax commuted into agricultural produce. On the one hand there is unequivocal epigraphic, literary, and archaeological evidence to attest the provision of military supplies from long distances. Grain was transported from the province in the mid-fourth century and Tacitus (*Agric.* 19) implies that grain requisitioned in the civil province was occasionally sent to garrisons on the northern frontier. The survival of distinctive pottery of diverse origins on military sites graphically illustrates that soldiers drew supplies such as wine and olive oil from outside the province. Since most of the regular supply items sent to the northern frontier consisted of perishable commodities, such as food, they are generally invisible in the archaeological record. However, Middleton (1979) has stated the case for using pottery as a proxy indicator for the much larger shipment of supplies along the Rhine frontier, arguing that pottery was attracted along the official supply lines as a make-weight cargo. The quantity and variety of coarse wares found on the northern frontier is cited by Fulford (1984) to illustrate this in a British context. Botanical remains sometimes indicate the import of the products from outside a province. One of the simplest methods is by comparing macrofossil plant remains recovered from native and Roman sites in the same area. Groenman van Waateringe (1989) draws attention to the consistent presence of wheat in the forts of the lower Rhineland when the available evidence from neighbouring native settlements points to barley as the major cereal. More direct evidence recovered on Roman sites, such as the fig pips from

Bearsden and Elginhaugh, also sometimes indicate the import of the products of warmer climes (Knights *et al.* 1983,143; Hanson forthcoming a).

On the other hand it has long been recognised that, as far as possible, supplies were drawn from the local area in view of the high cost, low carrying capacity and relative slowness of overland transport Manning (1975). The difficulty lies in demonstrating to what extent it did so. Roman forts by their very nature are primarily consumer sites though there is epigraphic and literary evidence to indicate that Roman garrisons possessed lands (*Territorium* or *Prata*), upon which to cultivate crops and graze livestock. That agriculture was a normal part of the soldiers existence is indicated by Tacitus (*Ann.* XIII, 54, 2-3) who mentions 'fields left empty for the use of the soldiers'. The evidence for land surrounding forts comes primarily from Legionary fortresses such as, Xanten in Germany (Salway 1965; MacMullen 1963) and Spain where *Legio* IIII *Macedonica* erected boundary stones to separate their lands from the adjacent civilian areas (ILS 2454, 2455). It is probable that lands were also attached to auxiliary forts as demonstrated by the inscription from Chester-le-Street (RIB 1049), where the 'domain lands' of an un-named cavalry unit are mentioned. More prosaic evidence is provided by the agricultural implements that have been recovered on numerous Roman fort sites, including Newstead (Curle 1911, 283-4), many of which show repair suggesting repeated use (Dixon and Southern 1992, 196). However, the association of these tools with Roman forts may not necessarily mean that the soldiers used them. How widespread the Roman practice of confiscating large tracts of land was is uncertain and how it was administered has engendered much debate (Sommer 1984). The botanical evidence examined here indicates that the majority of forts were situated among rough pasture with some heathland and scrub forest, and the evidence for cultivation in close proximity to the forts is generally slight. However, plough marks are commonly found beneath the excavated ramparts of Roman forts, for example at Birdoswald (Wilmot 1997) and Wallsend (Griffiths 1993) on Hadrian's Wall and at Cramond on the river Forth (Goodburn 1978, 418) suggesting that many were established amongst agricultural land. Though the Roman remains merely provide a *terminus ante quem* for these marks since it is otherwise not possible to date the ploughing. They could have occurred at almost any time between the Neolithic and the earliest Roman phases on the site where they were found. It is, therefore, likely that the army was unable to involve itself directly in arable production for human consumption in many places, particularly in the wetter western districts, though grazing for stock and horses would have been widely available.

By examining grain deposits in forts it may be possible to demonstrate the environment in which it was grown, on the basis of the type of cereal and its associated weeds. Local supply is perhaps indicated by the presence of weed seeds characteristic of the north-east of England in association with spelt wheat in the 3rd century granary assemblage at South Shields (van der Veen 1992, 154). Similarly at Segontium, North Wales, the local weed ecology is paralleled in the weed seeds in the cereal assemblages (Nye 1993, 84-86). The weed assemblages here indicate that cereals could have been grown locally since those from the fort sites and the native settlements are similar. However, this approach has found less favour amongst archaeobotanists in recent years, recognising that very few weeds have an exclusively arable habitat. A very localised weed would have to turn up in quantity in close association with cereal for such a distinction to be made. The so-called arable indicators in the weed assemblages are of wide distribution with no specifically local weeds, though we are of course comparing them to their modern weed ecologies and certain weeds may have had a narrower distribution in the past (Grieg 1991). Likewise, material evidence such as grain drying kilns in the annexe at Elginhaugh suggest the processing of locally gathered grain (Hanson and Yeoman 1988, 9; Hanson forthcoming a).

7.4 Availability of cereals

We have seen in chapters 5 and 6 that the macrofossil plant remains point to a local emphasis on barley growth and 6-row hulled barley (*Hordeum vulgare*) is clearly the dominant crop species recovered from the indigenous native sites. This is perhaps not surprising since barley is far more suited to the cool wet climate and shorter growing season of north and west Britain (Bland 1971; Grieg 1991). Moreover, dated regional pollen diagrams emphasise mixed farming and tend to confirm the prevalence of barley (Topping 1989; Whittington and Edwards 1993). Barley likewise predominates on the Roman military sites reviewed, suggesting that the availability and importance of barley in the military diet is probably considerably underestimated. According to a number of Roman authors barley is usually considered as animal feed, for use in malting or as an emergency or punishment ration. Though the sample scrutinised here is small and the majority of the forts from where cereal assemblages are available have cavalry contingents attested, epigraphically or structurally, contemporaneous with the plant remains, (see table 5.1) Nevertheless barley predominates at all forts and the quantities of barley recovered seem greater than is warranted by the presumed numbers of cavalry units making up the garrison of the region in the various periods of occupation. Though it is recognised that a military unit of whatever kind would have some horses, not least for the officers, and a few pack or draught animals. But would Roman soldiers eat barley normally if it were more readily available? Though barley flour makes a rather flat bannock, pearl barley provides a nourishing bulking element in soups and stews. A stores list from Vindolanda (tab Vind 33.i-iii) mentions barley several times indicating it was consumed, although the list was compiled in June and may reflect a period of shortage at the end of the season before new supplies of wheat became available (Bowman 1974). At Elginhaugh in the first century the presence of barley in quantity within the fort may represent the provision of animal fodder or simply the only type of grain which the garrison was able to acquire in quantity locally (Hanson and Yeoman 1988, 9). Similarly at Segontium, in north Wales, a high proportion of barley in the grain assemblage, particularly in the late 4th century given the probability of local recruitment, could represent locally grown grain consumed by a garrison long accustomed to a readily available crop (Davies 1997, 269). Celtic auxiliaries probably did not regard barley with the same dislike as the Italian legionaries with whom the literary references are usually associated. However, the longevity of occupation at Segontium may be significant and local recruitment negligible in a Scottish context. Barley fragments amongst the sewage deposits at Bearsden (Dickson 1989) and Carlisle (Huntley 1989) perhaps indicate its consumption beyond the hapless few on punishment rations. The ubiquity of barley among crop assemblages from the native sites in both upland and lowland locations, its widespread distribution throughout the study region, and its ability to crop well in most northern climatic conditions indicate that it would have been widely available to the Roman army.

Wheat has hitherto been seen as a minor or secondary crop to barley in Iron Age assemblages, a reduction from its former predominance in earlier periods. For example in the Neolithic in Orkney at Knap of Howar (Ritchie 1983) and on the mainland at Balbridie, Grampian (Fairweather and Ralston 1993). Here, of the 15,000 grains recovered, emmer made up 80% of the assemblage with barley 18% and bread wheat 2%, though a note of caution about samples derived from post holes, and thus the representativeness of these figures should be sounded since bread wheat made up 76% of one fill. Climatic deterioration involving increased precipitation from the later Bronze Age onwards is usually put forward as the underlying cause for this reduction in wheat growing (van der Veen 1992). However, the climate in the Roman period is generally believed to be very similar to that pertaining today (van der Veen 1992). The results discussed here confirm that wheat was of secondary importance to barley in the indigenous economies. Emmer (*Triticum dicoccum Schubl.*) is the predominant wheat species on the native sites, whilst spelt wheat (*Triticum spelta L.*) is the dominant wheat species recovered from forts. This parallels the situation in other upland areas of Britain, such as Wales, for example at Segontium (Nye 1993) and Carmarthen (Hillman 1978). However, emmer makes up a larger proportion of the wheat on the more northerly military sites in contrast to those on Hadrian's Wall with the exception of Carlisle. This may suggest that the emmer component was gathered locally. Spelt has only rarely been recorded in Scotland on native sites, but the new evidence from the Fishers Road sites suggests that it may have been grown in the more favourable locations on the eastern side of the country where lower rainfall and higher sunshine are experienced. In so far as the results from the Port Seton sites are harbingers of future additions to the database, Spelt may also have been more readily available in the eastern part of the region. At many of the sites emmer and spelt were associated with one another suggesting that they may have been grown together as a mixed crop (van der Veen and O'Connor 1998, 133). Nevertheless, quantities are small and the army would probably have to forage widely and supplement their supply from further south.

Bread/club wheat (*Triticum aestivum/compactum*) is found in minor quantities at Roman forts and at very few native sites. The status of bread wheat is unclear because there are problems of identification when chaff is not present. It is difficult to distinguish it from spelt and hard wheat, such as durum (Hillman *et al.* 1996) therefore, earlier records of bread wheat may be suspect. Durum (*Triticum durum*) is a species more commonly found in the eastern Mediterranean, for example in Roman Egypt where it was a common grain crop. Indeed it has been recovered in quantity from the excavations at the Roman fort and quarry site at Mons Claudianus (van der Veen 1998). Recent preliminary work on charred pottery residues from the Roman fort at Bearsden have tentatively identified the presence of durum wheat. Though the technique of infrared spectrometry utilised is in its infancy for identifying taxonomic and genetic differences between wheats (van der Veen and O'Connor 1998 quoting a personal communication from C. Dickson). The implications are obvious for the debate between local and long distance grain supply from beyond the province of Britannia. Conditions are unlikely to be conducive to the growth of bread/club wheat over much of the study area, though at Rispain Camp, the associated weed seeds suggest that it may have been grown on a small scale (Hagarty and Hagarty 1983). At native sites where it is recorded this may represent innovation and a pioneering introduction. The current evidence though suggests that the Roman army would not have been able to gain a reliable supply in sufficient quantity and import would have been necessary. However bread wheat is generally underrepresented at early forts (1st-2nd century AD) and may not be important till the later Roman period as its presence in equal quantity with spelt in the 3rd century granaries at South Shields demonstrates (Huntley and Stallibrass 1995). The indigenous native sites where bread wheat is recorded combine impressive architecture, for example at Buchlyvie, or a substantial boundary enclosure such as Rispain Camp with the exotic presence of bread wheat. This perhaps reflects wide exchange contacts and may be a manifestation of status expressed through access to a rare commodity. The database is still too small to judge and interpretation is really no more than informed speculation.

Climatic conditions in the north are variable from year to year and in the more western districts generally conditions were probably not conducive to the cultivation of wheat. A wet autumn and winter prevents successful sowing, and heavy winter rains can result in failure even of a well established crop (Bland 1971, 12). Whilst the local farmers, to some extent, were used to accepting a variable yield and poorer quality harvests this would constitute a less than reliable supply to the military if grain were available only in good years. Native sites where wheat is recovered are distributed in the warmer better drained eastern side of the region in areas such as Aberdeenshire, Angus, Fife, East Lothian, Midlothian, Peebles and Roxburghshire. The siting of Roman forts is primarily tactical and concerned with the control of movement along natural routeways. However, these valleys and river crossings are coincidentally close to the best agricultural land perhaps indicating also a concern to ensure that control was maintained over land that had the ability or potential to sustain Roman garrisons (Manning 1975; Breeze 1989; Hanson 1997; *contra* Higham 1989). If the known distribution of permanent Roman forts at their greatest extent in the Flavian period are plotted against a map of modern land capability classes, for example, (Figure 7.1). It appears that forts are principally found on soils of classes 1-4 in terms of land-use capability. The distribution appears to agree with the better soils in the east of Scotland; those which are best suited to arable agriculture.

A few oat grains were noted in many of the assemblages from the forts, some which may have been the cultivated type (*Avena sativa*), but in such small numbers to suggest a wild oat growing as a weed rather than a main crop. The presence of cultivated oats, particularly bristle oat (*Avena strigosa*), on native sites may hint at the beginnings of deliberate cultivation, but the quantities are again small and unlikely to interest the Roman military even as supplementary horse fodder. Rye occurs as an anomalous weed at only two sites and is probably a crop contaminant.

Therefore, only in the more fertile areas where a surplus could be generated could the military demand probably be met, unless the agricultural economy was encouraged to expand by the Roman presence. This appears to have been the case in the Netherlands where the local population attempted, or were compelled, to take advantage of the Roman market by growing wheat on lands inherently unsuitable without extensive improvement. In the lower Rhine area pollen spectra indicate increased cultivation of wheat, and plant macrofossil evidence from native sites with continuity of occupation from the pre-Roman Iron Age into the Roman period shows the progressive increase in importance of wheat at the expense of barley (Groenman van Waateringe 1989).

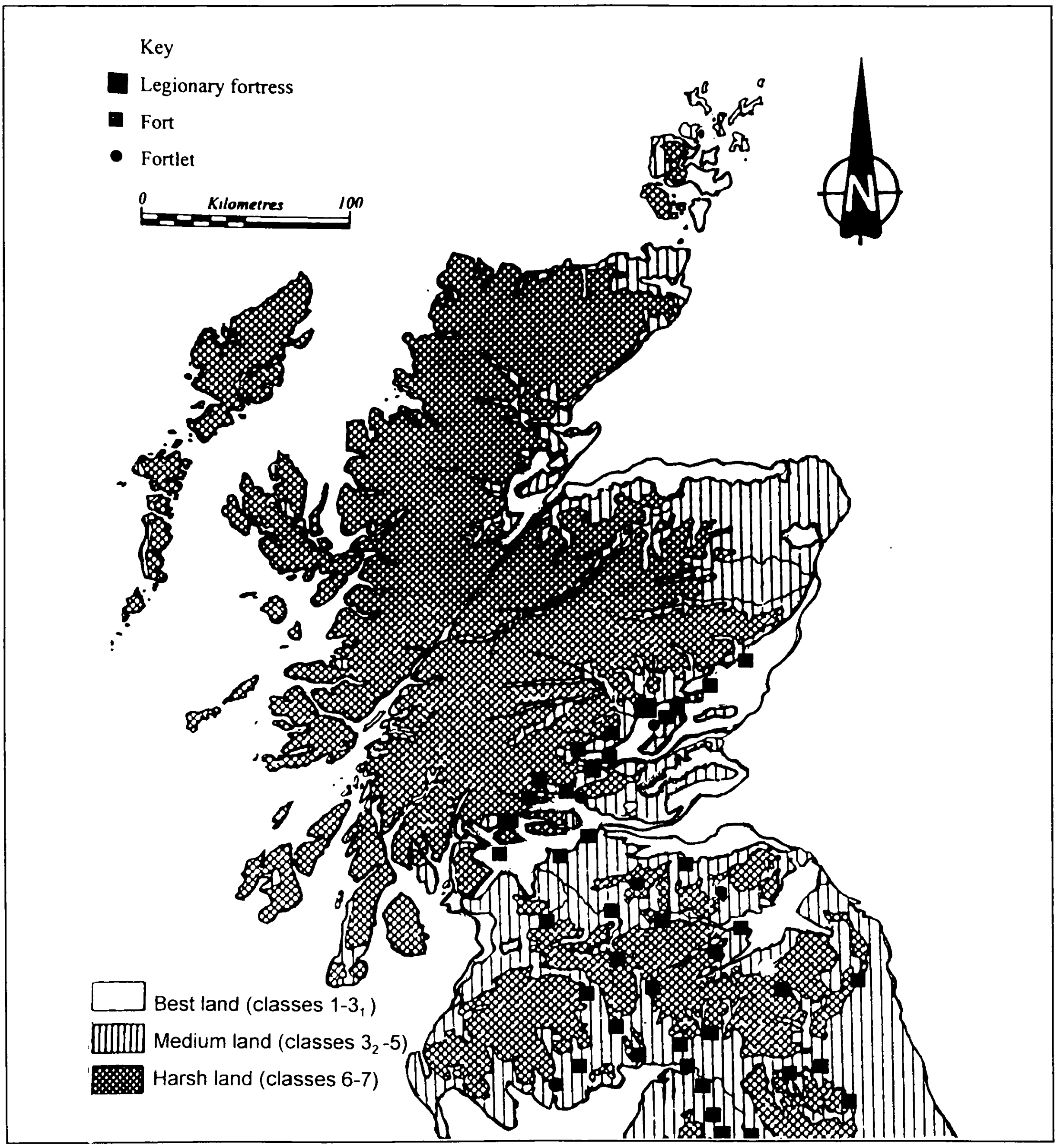

Figure 7.1: The distribution of permanent forts in the late first century plotted against the availability of agricultural land as expressed by the land capability classes for agriculture. After (Hanson 1997, and McNeill and MacQueen 1996).

By contrast the evidence for agricultural expansion from northern Britain is patchy and circumstantial. Pollen diagrams show an increase in cereal indicators in many places (Tipping 1997) and macrofossils indicate that wheat was grown, but barley remained the predominant crop throughout the Roman period (Boyd 1988). Sustained forest clearance evident in the available pollen diagrams suggests a requirement for more agricultural land (Dumayne 1993a & b; Whittington and Edwards 1993; Tipping 1995). The pollen diagrams also suggest that farmers were cultivating the more marginal upland. areas implying an increase in population in the late pre-Roman Iron Age, though close dating precision is problematic. Nevertheless, bearing in mind the well documented phenomenon of cereal pollen fall off, pollen diagrams from Roman forts in central Scotland show that the economy was predominantly pastoral with only very limited cereal cultivation taking place, and that which was, was exclusively barley (Newell 1983; Boyd 1984, 1985a, 1985b; Dunwell and Coles 1998). This then would tend to indicate that the fodder for the animals might have been readily available in most areas, but wheat for human consumption would be of more restricted availability, with some requirement for additional supplies to be brought from long distance. On this basis, Whittaker (1994) has argued that the halt in the expansion of empire had an underlying economic cause because it had reached the limit of intensive agricultural production.

However, estimates of the Roman impact on agriculture and the environment has to be set against a longer timescale. The pollen evidence in the main shows forest clearance to have taken place in the Iron Age before the advent of Rome and continuing right through the Roman period (Dumayne-Peaty 1998). The results are diachronous, the landscape being made up of a mosaic of cleared areas, some scrub woodland and areas of woodland regeneration. This implies that the expansion in agriculture was a wholly indigenous phenomenon. Furthermore, the macrofossil evidence from the sites indicates that barley was being cultivated throughout the pre-Roman Iron Age and continued into the period of the Roman occupation. Emmer remained the dominant wheat species throughout, only being replaced by spelt on a sporadic basis in the later Iron Age. Evidence for intensification, that is of a switch to a more extensive and larger scale of arable production, though hinted at in the pollen and settlement evidence, is absent in the macrofossil record. Jones (1981) has interpreted the shift from emmer to spelt in lowland Britain as a move towards intensification and an expansion onto heavier soils. However, instances of spelt on indigenous sites in the north are few and spelt is a very minor component of the economy at these sites. Moreover, evidence of surplus production, such as wastage of grain rather than just the chaff element and weed seeds and widespread bulk storage of grain, is not conclusive. Storage pits are recorded, as at Rispain camp (Haggarty and Haggarty 1983) and Fishers Road West (Miller *et al.* forthcoming), though their identification as such is tentative. Souterrains, if they are indeed storage places, may suggest that in areas such as the Lothian plain a surplus was being produced, but plant macro-remains from these structures are few. In addition the lack of innovations in agricultural practice, either in relation to the introduction of improved tools (Rees 1979) or more generally (Jones 1981), suggest little fundamental change associated with the Roman invasion and therefore, emphasises broad rural continuity.

7.6 Conclusion

The nature of the current database is variable both in terms of quantity and quality and is spatially restricted so that any interpretation is in the nature of an interim statement. Currently available assemblages, therefore, are not necessarily representative of the agricultural diversity that probably existed across the region. The evidence does, however, indicate fairly widespread pre-Roman Iron Age arable farming, though its intensity is more difficult to assess. Circumstantial evidence in the form of pollen diagrams, field systems and the settlement pattern suggest expansion and areas of intensity increasing in the Roman period, though there is no direct evidence from the plant remains. There is little doubt that mixed farming was the normal economic strategy. As more data appears the apparent imbalance between arable and pastoral agriculture evident in pollen diagrams, caused by poor cereal pollen dispersal, will be addressed. It is becoming increasingly likely that local supply for the Roman army was possible to a degree. The climate has a profound effect on agricultural production so that only in the more favourable areas would adequate supplies have been available. On present evidence an adequate supply of barley could be procured because it is tolerant of a wide range of climatic conditions. Despite the emphasis on wheat in the literary references it seems likely that barley was readily consumed by auxiliary soldiers. Whilst the failure of wheat supplies due to adverse climatic conditions or transport problems may have necessitated the exclusive consumption of barley at times its ready availability suggests that it was a regular part of the military diet both as bread and in soups and stews. However, quantities of emmer would only have been obtainable from areas of more fertile, drier soils. Spelt is recorded in lesser quantity than emmer at the native sites and probably could have been procured, but in much smaller quantity from favourable eastern districts. The scarcity of bread wheat on sites suggests that it was most probably a crop contaminant in the first and second centuries since current evidence seems to indicate that it was more prevalent as a military staple in the later Roman period.

Was it possible to obtain sufficient wheat given the unpredictable and variable climate over much of the region ? In many areas a reliable crop was only obtainable in good years, and much of the time the yields may have been low and the quality poor. However, the new evidence from the two Port Seton sites suggests that wheat growing was more prevalent than hitherto assumed, and that further palaeobotanical studies will show that at least in the east of the region a supply of wheat would probably have been obtained. This evidence notwithstanding, a reasonable proportion of the wheat, particularly much of the spelt may still have had to be imported, a task that was well within the capability of the Roman army to organise. Bread wheat was probably not a staple in Scotland in the first and second centuries, but the small quantity that may have been consumed (perhaps by officers) would have to be imported. The siting of Roman forts is significant, though they are placed primarily for tactical reasons, concerning the control of people and population movement along natural corridors, it seems to be no accident that they were also situated in more fertile regions. Though population concentrations are naturally found on the most fertile land, this nevertheless indicates perhaps a deliberate concern to ensure that control was maintained over land that had the ability or potential to sustain Roman garrisons. The Roman impact was limited, operating within a framework of continuity and gradual development. The evidence currently available indicates no discernible disruption or major change. Where changes did take place, they do so within a longer timescale and are thus difficult to attribute to the Roman presence. This is probably a consequence of the short duration and intermittent nature of the occupation north of the Tyne-Solway isthmus.

Appendix 1: Location of sites.

This appendix locates the sites reviewed in this present study on a map of the study area.

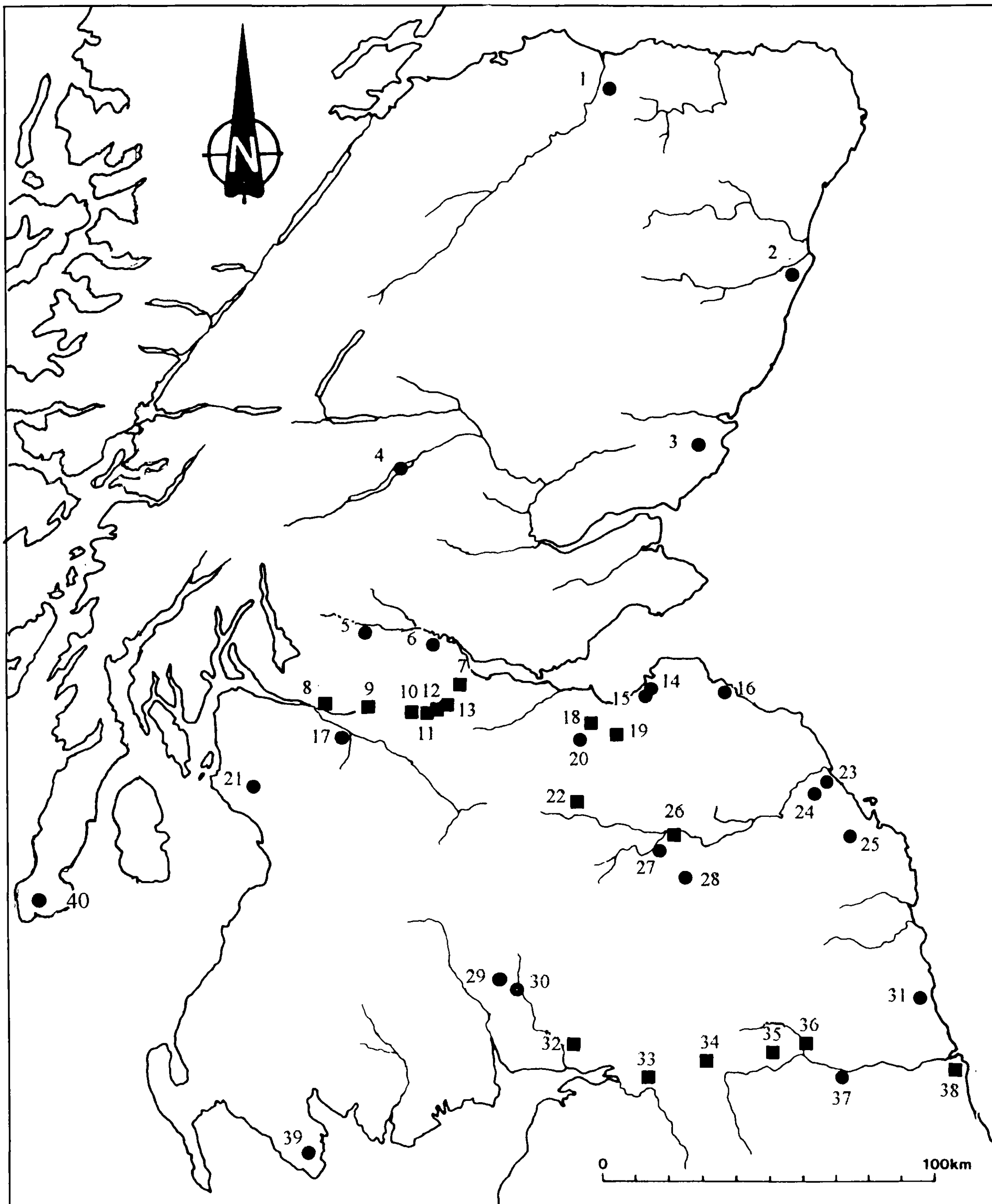

Figure A.1: Location of the sites with botanical remains discussed in the text.

Map Key.

1. Romancamp Gate.
2. Wardend of Durris.

21. Buiston.
22. Lyne.

3. Douglasmuir.
4. Oakbank Crannog.
5. Buchlyvie.
6. Lower Greenyards.
7. Camelon.
8. Old Kilpatrick.
9. Bearsden.
10. Kirkintilloch.
11. Westerwood.
12. Castlecary.
13. Rough Castle.
14. Fishers Road East.
15. Fishers Road West.
16. Broxmouth.
17. Shiels
18. Elginhaugh.
19. Pathhead.
20. Brixwold.
23. Murton.
24. Doubstead.
25. Dod Law.
26. Newstead.
27. Eildon Hill North.
28. The Dunion.
29. Uppercleuch.
30. Woodend.
31. Chester House.
32. Birrens
33. Carlisle.
34. Birdoswald.
35. Peel Gap.
36. Chesters.
37. Thornborough.
38. South Shields.
39. Rispain Camp.
40. Balloch Hill.

Appendix 2: Gazetteer of sites.

This gazetteer includes all of the sites discussed in the text as part of this research project and provides details of the broad periods of occupation covered by each as well as the types of plant remains recovered.

Biological material abbreviations are as follows:

C	-- Carbonised/charred plant remains.
W	-- Waterlogged plant remains.
P	-- Pollen core .

Chronological period abbreviations are as follows:

IA	-- Iron Age
RB	-- Roman Period (non-military).

Appendix 2.1: Roman military sites.

Site name.	Site type	Reference	Location	Grid Ref	P	C	W
Bearsden	Antonine Wall Fort	J.Arch.Sci 10, 1983 & Antiquity 53, 1979.	Glasgow	NS 545 721	*		*
Birdoswald	Hadrian's Wall Fort	Huntley 1991.	Cumbria	Ny 615 663		*	*
Birrens	Fort	Robertson 1975.	Dumfries	NY 219 752	*	*	*
Carlisle	Fort	Huntley 1989.	Cumbria	NY399 559		*	*
Castlecary	Fort	Dickson1989.	Stirlingshire	NS 790 783		*	
Chesters	Fort	Huntly 1992	Northumberland	NY 912 705		*	*
Elginhaugh	Flavian Fort	Hanson forthcoming.	Midlothian	NT 322 674	*	*	*
Kirkintilloch	Antonine Wall Fort	PSAS 125, 1995	Kirkintilloch	NS 652 739	*	*	*
Lyne	Flavian Fort	Dickson 1989.	Peebles	NT 187 405		*	
Newstead	Fort	Curle 1911.	Melrose	NT 571 343		*	
Pathhead	Temporary Camp	Leslie forthcoming.	Midlothian	NT 395 639		*	*
Peel Gap	Hadrian's Wall turret	Huntley 1989.	Northumberland	NY 753 675		*	*
Rough Castle	Antonine Wall Fort	Dickson 1989.	Stirlingshire	NS 843 798		*	
South shields	Fort/supply base	van der Veen 1992 & 1994.	Tyne & Weir	NZ 365 679		*	
Westerwood	Antonine Fortlet	MacDonald 193,.256.	Lanarkshire	NS 760 773		*	

Appendix 2.2: native sites.

Site name.	Site type	Reference	Location	Grid Ref.	P	C	W	I.A.	RB
Balloch Hill	Hillfort	Peltenberg, 1982.	Argyll	NR 371 468		*		*	*
Brixwold	Native enclosure	Crone & O'Sullivan 1997.	Midlothian	NT 318 645		*	*		*
Broxmouth	Hillfort	Harding 1982.	East Lothian	NT 701 774		*		*	
Buchlyvie	Broch	Main 1998.	Stirling	NS 5856 9426		*			*
Buiston	Crannog	Holden 1996.	Ayrshire	NS 415 435		*		*	
Camelon	Native settlement	Proudfoot 1978.	Falkirk	NS 863 812		*			*
Chester House	Native enclosure	van der Veen 1992.	Northumberland	NU 237 025		*		*	
Dod Law	Small Hillfort	van der Veen 1992.	Northumberland	NU 004 317		*		*	
Doubstead	Native settlement	Jobey 1982.	Northumberland	NU 007 487		*			*
Douglasmuir	Native settlement	Kendrick 1995.	Angus	NO 617 481		*		*	
Eildon Hill North	Hilfort	Rideout *et al.* 1992.	Roxburgh	NT 555 328	*	*		*	*
Fishers Road east	Ditched rectilinear enclosure	Haselgrove & McCullagh forthcoming.	East Lothian	NT 409 754		*	*	*	*
Fishers Road west	Ditched curvilinear enclosure	Haselgrove & McCullagh forthcoming.	East Lothian	NT 406 752		*	*	*	*
Lower Greenyards	Promontory fort & homestead	Rideout 1996.	Stirling	NS 816 903		*		*	
Murton	Native enclosures	Jobey & Jobey 1987; van der Veen 1992	Northumberland	NT 965 496		*		*	
Oakbank	Crannog	Murphy & French, 1988; Miller *et al.* 1998	Perthshire	NN 7228 4425	*		*	*	
Pathhead	Native settlement	Leslie forthcoming.	Midlothian	NT 395 639		*	*		*
Rispain Camp	Rectilinear enclosure	Haggarty & Haggarty 1983.	Whithorn	NX 429 399		*		*	*
Romancamp Gate	Pit circles	Barclay 1993.	Moray	NJ 3568 6172		*		*	
Shiels, Govan	Ditched enclosure	Robinson 1983.	Glasgow	NS 523 667	*	*			*
The Dunion	Hillfort	Rideout *et al.* 1992.	Roxburgh	NT 625 190	*	*		*	
Thornborough	Native enclosure	van der Veen 1992.	Northumberland	NZ 011 633		*			*
Upper Cleuch	Farmstead enclosure	Terry 1993.	Annandale	NY 1132 8714		*		*	*
Wardend of Durris	Native settlement	Russell-White 1995.	Aberdeenshire	NO 752 928		*		*	
Woodend	Enclosure	Banks forthcoming.	Dumfries & Galloway	NY 1053 9516		*	*		*

Appendix 3: Summary of plant remains.

This section summarises the plant assemblages from the various sites and illustrates the disparity in quality of analysis and sample quantity between them. The types of cereal seeds and chaff present are categorised and indications of the general environment in the vicinity of each site are highlighted. The more detailed analyses that these summaries are based upon can be consulted by referring to the original botanical reports fully referenced in the bibliography.

A note on Nomenclature:

Secalinitalia (dry soil arable weeds), The classical weeds of cereal cultivation. This community is most commonly found on dry light sandy soils in a moderately continental climate. In northern Britain it is most likely to be represented by seeds coming in with cereal crops grown either in southern Britain or brought in from the continent (Huntley 1989).

Chenopoditelia (manured weeds), comprising taxa which prefer a slightly heavier, wetter soil and are more tolerant of cold, wet oceanic conditions. They are found on cultivated land throughout the British Isles and on fallow plots of short-term waste ground (Huntley 1989).

cf. denotes an uncertain identification due to poor or fragmentary preservation or ill-defined morphology (after Dickson 1970).

(X) tentative identification.

X indicates relative presence.

Appendix 3.1: Roman military sites 1.

site	Birrens	Bearsden	Birdoswald	Chesters	Carlisle	Castlecary	Elginhaugh
date	Antonine	Antonine	3rd-4thC	3rd-4thC	1st-2nd C	Antonine	Flavian
# samples	42	19	289		229	1	101
sample vol. proc	various	300ml	3000	3830	various	500grains	
nature of analysis	full	full	full	full	full	full	full
Hordeum vulgare	5	x	368	x	651	36.3	562
Triticum spelta		cf.	112		654	54	251
T. hexaploid				x			
Triticum dicoccon		cf.			3	33	63
Triticum aestivum	8	?	16		5	5.5	229
Triticum sp.	4	x	283		71	303	52+36f
Avena		x	58		92	40	65+18f
Secale cereale		x	7		8		
Ceralia indeterminate	20		373		58		1000's
barley rachis			21		214		27
spelt glumes		x	36		728		4
emmer glumes		x			83		
wheat chaff		x	10		289		16
bread wheat chaff					14		27
oat chaff					50		
rye chaff							
culm nodes							1000's
Chenopodetalia	x	x	xx		x		x
Secalinetalia		x	(x)		(x)		x
grassland weeds		x	x		xxx		xxx
heathland taxa	xx	x			(x)		
wet ground taxa	x	x	(x)		(x)		xx

Appendix 3.2: Roman military sites 2.

site	Kirkintilloch	Lyne	Newstead	Pathhead	Peel Gap	Rough Castle	South Shields	Westerwood
date	Antonine	Antonine		Antonine?		Antonine	3rd-4thC	Antonine
# samples	6	1	16	32	24	1	63	
sample vol. proc	25-50ml	500 grains	various		1kg	500 grains	various	
nature of analysis	full	full	rudimentary	full	full	full	full	none
Hordeum vulgare	1	496	x	235	3	270.5	293	
Triticum spelta		13				17.5	8284	
T. hexaploid								
Triticum dicoccon		16				10.5		
Triticum aestivum			x				6221	
Triticum sp.		16		21+(28)	1	28		x
Avena		3				1		
Secale cereale				7+ (1)				
Ceralia indeterminate				67	1		18507	
barley rachis				3			4	
spelt glumes							539	
emmer glumes	1							
wheat chaff	2		x		1			
bread wheat chaff								
oat chaff					1		11	
rye chaff								
culm nodes								
Chenopodetalia	x		x	x			(x)	
Secalinetalia	x		x				(x)	
grassland weeds	x		x	x	xx			
heathland taxa	x		x	x	xx			
wet ground taxa	x		x	xxx	x		(x)	

Appendix 3.3: native sites 1.

site	Broxmouth	Brixwold	Buchlyvie	Balloch hill	Buiston	Chester House	Camelon	Dod Law
# samples		14	29	5		15	2	12
sample vol. proc		5kg	100ml			various		various
nature of analysis		selective	selective			full		full
Hordeum vulgare	x	3	2930	8	?	33	x	1040
Triticum spelta						1		17
T. hexaploid								
Triticum dicoccon			4	3				10
Triticum aestivum			2					
Triticum sp.						7		41
Avena			364	1				
Secale cereale								
Ceralia indeterminate						59		819
barley rachis						40		538
spelt glumes						4		54
emmer glumes						49		324
wheat chaff						36		236
bread wheat chaff								
oat chaff						6		
rye chaff								
culm nodes								
Chenopodetalia			x			x		xx
Secalinetalia						(x)		(x)
grassland weeds		x	x			x		x
heathland taxa		x			x	(x)		xx
wet ground taxa		x	xx		xx	x		xx

Appendix 3.4: native sites 2.

site	Fishers Road east	Fishers Road west	Lower Greenyards	Murton	Oakbank	Doubstead	Douglasmuir	Eildon Hill North
# samples	207	284	248	11	18	6		
sample vol. proc	30L	various	various	various	200ml	>2.75kg		
nature of analysis	full	full	selective	full	full	partial		none
Hordeum vulgare	1109	5953	716	141	58wl+1c	2	74	3
Triticum spelta	5	-5		2	6			
T. hexaploid	40							
Triticum dicoccon	4	105+ (3)		2	1			
Triticum aestivum	9	33+ (1)						
Triticum sp.	43	37+ (1)	7	6	21		>120	
Avena	15	43+ (9)	663		8		12	
Secale cereale		-1						
Ceralia indeterminate	430	2597	38	74	549+20cf+2c			
barley rachis	615	11+ (1)		106	59+cf2	1		
spelt glumes	158			18	75+(5)			
emmer glumes	577			37	86+(12)			
wheat chaff	1112	1+(2)		40	272			
bread wheat chaff	2	1						
oat chaff	1							
rye chaff								
culm nodes		2						
Chenopodetalia	xx	x		xx	xx	x	x	
Secalinetalia	(x)			(x)	x			
grassland weeds	xx	x		xx	x	x	x	
heathland taxa	x	x		(x)	x	x		
wet ground taxa	xxx	xx		xx	x	x	x	

Appendix 3.5: native sites 3.

site	Pathhead	Rispain Camp	Romancamp Gate	Shiels	The Dunion	Thornborough	Uppercleuch	Wardend of Durris	Woodend
	32	13	3	monolith	12	23	39	231	81
# samples	various		2L	100cm		various			
sample vol. proc	full		selective	full	assessment	full	full	full	full
nature of analysis	235	x	3	1	19	1989	10	x 33.5%	xxx
Hordeum vulgare						625			
Triticum spelta									
T. hexaploid							194	x 35%	
Triticum dicoccon		xxx							
Triticum aestivum	21+(28)					66	5		
Triticum sp.			x		6		11	x	
Avena	7+ (1)					50			
Secale cereale	67					2108	185		
Ceralia indeterminate									
	3			7		35	1		
barley rachis						1097			
spelt glumes						10		2	
emmer glumes						816			
wheat chaff									
bread wheat chaff						7			
oat chaff						39			
rye chaff							1		
culm nodes									
Chenopodetalia	x	x	x	x		(x)		x	
Secalinetalia						(x)			
grassland weeds	x			(x) (x)	(x)	xxx	x	x	x
heathland taxa	x			(x)		x			
wet ground taxa	xxx			(x)	(x)	(x)		x	x

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