

Dissertation Improvement Grant: Paleoethnobotanical Study of Economic Change (c. AD 900-1400) at Quoysgrew Farm, Orkney, Scotland.

INTRODUCTION

The period from the late 10th century through the early 13th century in Northern Europe involved an economic and social “revolution” in the words of many historians, including expansion of a market economy, state formation, and religious conversion (Barthelemy and White 1996; Bisson 1994; Bisson 1997; Hodges 1989; Moore 2000; Reuter and Wickham 1997). By the early 14th century, population growth and increasing surplus production had led to an economic and societal “crisis” even before the drastic population drops associated with the bubonic plague (Campbell 1991; Hatcher 1994). Although general trends of economic growth and decline have been described by economic historians, written records from these time periods in Scotland and Norway are rare, and our understanding of what these changes meant in terms of quality of life as well as the farmer response to rapidly changing markets during these time periods is very limited.

Paleoethnobotanical analysis is an ideal avenue of research for investigating these economic transitions in areas with little representation in the historical record. Paleoethnobotanists have made significant contributions to the study of prehistoric relationships between changes in economic decision-making at the community level and larger socio-political changes (e.g. Chernoff and Paley 1998; Hastorf 1990). Studies of botanical macroremains are particularly useful for understanding the process of agricultural intensification (Morrison 1994; Van Zeist 1991), and environmental impacts of increased fuel use (Miller 1990). Environmental archaeologists, including paleoethnobotanists, have successfully used carbonized plant remains from medieval sites to interpret economic changes taking place there (Bond 1994; van Haaster 1994; Hall and Kenward 1994; van Zeist 1990; van Zeist et al.1994; Zutter 1997).

I propose to analyze data uniquely available from paleoethnobotanical study of carbonized macroremains from Quoysgrew, a high-status farm site in Orkney, Scotland, in combination with available data from other specialist studies of the site in order to meet the following objectives: 1) to identify economic activity patterns at the site across time and space; 2) to understand the relationship between fishing, farming, and animal husbandry practices during a period of drastic economic change in the North Atlantic; and 3) to understand how increased production of commodities affects availability of natural resources in an island environment. Published paleoethnobotanical data from other sites in the region during these time periods (Batey 1987; Batey and Morris 1992; Bond 1994; Groenman-Van Waateringe and van Wijngaarden-Bakker1987; Huntley 2000; Huntley and Turner 1995; Jensen 1979; Jorgensen et al. 1986; van Haaster 1994; van Zeist 1990; van Zeist et al.1994; Zutter 1992; Zutter 1997; Zutter 1999) will be aggregated and compared with results from the proposed study in order to put Quoysgrew in broader context within the North Atlantic, and answer questions about whether trends seen in the archaeobotanical record at Quoysgrew are typical of the region or particular to the site.

BACKGROUND

Much about the economic history of the Middle Ages is known from English records, because of the quantity of account rolls, court rolls, extents and surveys available from that country (Masschaele 1994). Historical records from northern Scotland (Fossier 1999; Webster 1975) and Scandinavia (Andren 1989:586) during this critical period are much more scarce,

placing archaeology in a prime position to address questions about changes taking place at this time.

ECONOMIC EXPANSION (AD 900-1300)

While the Viking/Medieval (V/M) transition through the Early Medieval period (AD 900-1300) is associated with marked economic growth, there is much debate among anthropologists and economic historians over the nature and chronology of the shift towards a market economy in Medieval Europe (Barrett et al. 2004; Fossier 1999; Saunders 1995). The V/M transition involved not only the beginnings of a market economy and expanding international trade, but also radical changes in religious ideology, centralization of power, and the rise of urban centers (Barrett et al. 2000; Blindheim 1982; Fossier 1999; Johanek 1999; Thurston 1997). Expansion of the economy accompanied changes in the structure and organization of trade (Johanek 1999). Trade in high-bulk, low-value staple goods replaced trade in luxury goods fueled by traditional reciprocal obligations (Griffiths 2003).

With some exceptions, many sites in the North Atlantic appear to have been economically diverse: inhabitants utilized a range of resources obtained through fishing, farming and animal husbandry (Amorosi et al. 1998; Batey 1987; Bond 1994; Huntley 1994; Huntley and Turner 1995; Morris et al. 1995). Enhanced food production during the V/M transition in each of these areas is evident in the archaeological record. Intensification of marine resources appears in the zooarchaeological record in the form of coastal fish middens, while analysis of cattle bones suggests a shift towards managing herds for dairy production (Barrett et al. 2000; Bigelow 1989; Bond 1994). Agricultural intensification is indicated by formation of heavily fertilized anthropogenic "plaggen" soils during this period (Barrett et al. 1999; Simpson et al. 1998). Because plaggen soils at Quoygrew have been identified and dated (Simpson et al. 2005), the proposed paleoethnobotanical study represents a rare opportunity to identify changes in charred macroremains occurring during development of the plaggen technique.

During the V/M transition, a shift from subsistence-based to exchange-based production resulted in the production of regular surpluses. Although many sites retained multi-component production strategies, there was specialization of production in some regions, particularly those most marginal to farming, including Shetland (Bigelow 1992), Iceland and Greenland (Marcus 1957; McGovern 1990), and Northern Norway (Martens 1992; Perdikaris 1999). In areas like Iceland and Northern Norway, agriculture was marginal at best, and the trade of dried fish and fish oil for barley or malt became standard. However, this left community leaders vulnerable to manipulation of trade networks for political gain (Demarrais et al. 1996; Dietler 1995; Earle 1987; Perdikaris 1999). Changes in the production of barley at Quoygrew (part of the largely autonomous Orkney Earldom) may have had political consequences for Orkney as well as those areas relying on Orcadian barley (Bigelow 1992; Marcus 1957; McGovern 1990; Perdikaris 1999).

Both specialist and generalist producers had a new primary motivation for surplus accumulation during this period: to pay taxes and tithes. In Denmark and Norway (and likely Orkney, as an Earldom of Norway), taxes were collected beginning in AD 1150, and by 1190 tithes were collected in all Scandinavian dioceses (Andren 1989; Sawyer and Sawyer 1993). Areas marginal to farming were occupied by communities engaged in trade for cattle, timber, iron, and other products useful in obtaining cash for paying taxes (Martens 1992). Surplus was also required for tenants to pay rents on the land they farmed. Population growth probably led to more competition for land, higher rents, smaller holdings by peasants, and cultivation of more

marginal lands (Ditchburn 2000). Many new farms in the 11th to 13th centuries were established on land marginal for cultivation (Sawyer and Sawyer 1993). Farms established earlier, such as Quoygrew, were founded on better land and thus had distinct production advantages over later farms. Increasingly over the course of the early middle ages, small farmers became tenants, as the amount of land they farmed was no longer sufficient to provide buffer supplies in the event of lean years (Amorosi et al. 1998). In Norway, rents were equal to approximately 1/5 to 1/6 of income, and were paid in local produce: dried fish, *wadmál* (cloth), butter, or grain (Sawyer and Sawyer 1993).

Production of surpluses in many areas meant both intensifying land already in cultivation, and bringing new land, often with poorer soils, into cultivation. Both methods were dependant on the ability to enrich the soil with fertilizers, primarily animal dung. In such systems, there exists a tension between pastoral and agricultural pursuits: simply increasing arable land at the expense of pasture reduces the number of animals that can be kept, which decreases the available amount of manure for fertilizer. Postan argues that such a pattern led to the debilitation of soils through overuse and inadequate fertilization, and thus that the decline of AD1300-1400 was a natural consequence of overproduction (Postan 1973; Schneider 1991). However, the individualistic farming practices occurring in many areas during this period, including Orkney, tended to blur traditional distinctions between arable land and pasture (Britnell 1977). For example, oats can be produced on arable land and used for high quality fodder in addition to use for taxes, trade, or human consumption. Providing dairy cows with better fodder than could be foraged in pasture may have led to an increase in milk production necessary for producing surpluses of dairy products. Additional fertilizers were available to farmers in Orkney in the form of seaweed. While labor-intensive to collect, these supplies could be used to byre animals in the winter months, and thus in compost with animal dung could extend the supply of fertilizer substantially. Thus, documenting local patterns of animal and plant food production are crucial to understanding how rural communities managed to produce surplus products during this time.

Although the economic growth associated with the growth of markets during this period meant that more surpluses were being produced and traded, changing social relationships and burgeoning populations meant that increased production may not have improved quality of life for most of the population. Some historians argue that by the late 13th and early 14th centuries, worsening conditions had led to a social and economic “crisis” (Campbell 1991; Hatcher 1994).

ECONOMIC CONTRACTION (AD 1300-1400)

The early 14th century was a difficult time for Northern Europe. Harvest failure in Scotland from 1308 to 1310 was followed by a widespread famine across Scotland and Scandinavia between 1315 and 1318 (Ditchburn 2000; Hatcher 1994). In 1320 Denmark faced an agrarian crisis, and in 1350 famine led to devastation throughout Scandinavia, with Norway being the hardest hit (Andren 1989). Bubonic plague reached Scandinavia in 1349 by ship from England to Bergen, the Norwegian trade city most directly tied to Orkney (Sawyer and Sawyer 1993; Tanagerlini 1988). The range of estimates for the death rate from the bubonic plague across Northern Europe is from 5% to 50% of the population, but most historians believe that the rate was close to 33% (Poos 1985). Human fertility and economic success are linked in farming villages during this period because of the labor requirements of intensive farming. The plague hit young people and women particularly hard, thus damaging the entire agrarian system by reducing the type of labor most important (Tanagerlini 1988). The direct effects of the plague in Orkney are not known, although the rural nature of Orkney as well as the fact that the

environment is unlikely to have supported large rat populations may have mitigated against the direct effects of bubonic plague (Shrewsbury 1970). Economic changes associated with population drops in England and Europe may have had a greater impact in Orkney.

Some of the effects of these unfortunate events appear in the historical record. For example, in the second half of the 14th century, no new towns were founded in Scandinavia, and many of the minor Norwegian and Danish towns were temporarily or permanently abandoned (Andren 1989). In Norway by 1400 rents had dropped to a quarter of what they were in 1300 (Sawyer and Sawyer 1993). The price of grain dropped dramatically after the plague, while the price of fish, cattle and butter soared. In Denmark and Southern Sweden, many farmers switched to cattle rearing (Sawyer and Sawyer 1993). This trend continued into the late Middle Ages, with the proportion of farmers engaged in livestock production greatly increased from earlier periods (Dyer 1994).

A fuel shortage may have occurred in the treeless Orkney Islands even before the economic slump of the early 14th century, as surplus production of fish oil, dried or malted grain and cheese required large quantities of fuel. In hard times, competition for common resources often intensifies, and peat would be one such resource. In a study of manuring practice in Shetland, which is similar to that used in Orkney, Adderley et al. (2000) found that more fertilizer was applied than necessary to raise the organic content of the soil. Farmers employing hill-land turf were overexploiting this resource past the point where it was producing gains in soil fertility. At St. Boniface on the island of Papa Westray, Orkney, Lowe (1998) found that fuel use changed from use of peat to use of turf. This represents a shift to a less efficient fuel and may have to do with the overexploitation and later scarcity of peat on the island.

Anthropological literature on famines shows that one common response to poor agricultural performance and resulting scarcity is to increase reliance upon wild resources that are in more productive times not exploited either because of difficulty in collecting, extensive processing requirements, poor nutritional value, or unpleasant taste (Colson 1979; Corbett 1988; Clarkson and Crawford 2001). In Iceland during the climatic cooling of the 17th and 18th centuries, archaeology shows increasingly wider exploitation of resources (Amorosi 1992). Famine foods used historically in northern Europe and the British Isles include several species of seaweed, mustard-family seeds, nettles, bedstraw seeds, goosefoot seeds, crowberry, several *Polygonum* and *Rumex* species, as well as crop weeds including corn spurrey, *Spergula arvensis*, and corn cockle, *Agrostemma githago*, which contain saponins and can be toxic in large amounts. Bulbs of Star of Bethlehem (*Ornithogalum umbellatum*) were also used as a famine food, but they require boiling, then drying and pounding to remove the cardiac glycosides they contain (Freedman 2004). In addition to plants, cockles are recorded historically as being used by the poor as a famine food in Orkney (Fenton 1978).

Although written records show that gross urban incomes fell in the 14th century, the consequences in terms of personal income levels, and how rural inhabitants fared, is much more difficult to tell from written accounts (Masschaela 1994). While price changes can be determined during this period, at least in England, the “farmer response” to price change in terms of cultivation practice is poorly understood. A paleoethnobotanical study such as the one proposed will provide archaeological data useful for understanding changes occurring during this time period, at a rural site in the Orkney Islands: an area not represented in the historical literature.

WHY QUOYGREW?

The proposed project will contribute to and benefit from a multidisciplinary project, the Viking Age Transitions Project (VATP), headed by Dr. James Barrett (University of York). The project is designed to investigate relationships between intensification of production, development of long-range trade, state formation, urbanization, and ideological change (Barrett et al. 2000). The proposed paleoethnobotanical study will make a vital contribution to the interdisciplinary project by generating key information on plant production and consumption, land use, and fuel use essential to understanding farmers' strategies for coping with changing physical and market conditions at Quoygrew.

Quoygrew, located on the island of Westray in Orkney, Scotland, represents an economically diverse, high-status farm settlement in the North Atlantic occupied from the Viking age through the post-Medieval period (Figure 1). In 19th century sources the site was called Nether Trenabie, a name associated with early and high-status Norse estates (Simpson et al. 2005). The long occupation of Quoygrew and its island location make it an excellent site at which to study long-term economic effects of intensification. Excavation began in 1997 and was continued in 1999 - 2001, and 2003 - 2005. Portions of the site excavated prior to 2002 include three adjoining house structures, a large coastal fish midden, a farm mound midden, and an area of plaggen soil (Figure 2). Paleoethnobotanical analysis of fish middens eroding from the shore at Quoygrew was completed by other researchers, and data from this analysis are available (Poaps 2000, Poaps and Huntley 2001).

Twenty-five radiocarbon dates on material from the site have been determined (Figure 3), and a general chronology for the site and its contexts has been established based in large part on these dates. Additional contexts excavated in 2004-2005 include two additional possible house structures, a possible kiln, and animal byre. Radiocarbon samples were taken during these field seasons and new dates will be available soon.

Comparative paleoethnobotanical data are available from many surrounding sites in Orkney, Shetland, Scotland, Iceland, Scandinavia, and Europe (Batey 1987; Batey and Morris 1992; Bond 1994; Groenman-Van Waateringe and van Wijngaarden-Bakker 1987; Huntley 2000; Huntley and Turner 1995; Jensen 1979; Jorgensen et al. 1986; van Haaster 1994; van Zeist 1990; van Zeist et al. 1994; Zutter 1992; Zutter 1997; Zutter 1999), and other studies including zooarchaeology, geomorphology, and malacology have been conducted at Quoygrew (Barrett 1997; Barrett et al. 2000; Barrett 2003; Barrett n.d.; Batt 2002; Poaps 2000; Poaps and Huntley 2001; Simpson et al. 1998; Simpson et al. 2005; Welsh 2004). Therefore the data I produce through paleoethnobotanical study of this single site can be put into broad context within the larger dataset acquired by the VATP and that provided by other paleoethnobotanists working in the area.

Previous studies at Quoygrew have identified agricultural intensification through soil studies showing the formation of plaggen soils roughly dated to the medieval period. (Simpson et al. 2005) However, paleoethnobotanical studies can provide more information as to what crops were being grown on the plaggen field, how land use was changing in the "outfield" and hillsides in the periods preceding, contemporaneous with, and following the period of plaggen soil use, and how the presence and frequency of imported foodstuffs changed over time. This information, available only through the study of carbonized plant remains, will substantially improve our understanding of the intensification indicated by the presence of the fertilized plaggen soils. By a systematic study of flotation samples taken from a large number of diverse

contexts at the Quooygrew site, I will use changes in carbonized plant remains among contexts, and over time, to identify changes in economic activity at Quooygrew.

PILOT STUDY

I have completed a pilot study involving analysis of 21 samples of plant remains from Area G at Quooygrew (Adams 2003; Adams and Barrett 2004). Area G is a large farm midden and is divided into two levels based on the relative amount of fish bone in each level. The lower midden is predominantly mammal bone and dates to AD 782-995, while the upper midden contains substantially more fish bone and dates to AD 1004-1262. Because identical methods to those outlined below were used, the pilot study was very useful for gaining experience for the proposed project. It has shown that preservation at the site is variable between contexts, but that identifiable carbonized seeds are present in almost every context. Most contexts provide very well preserved plant materials, including fragile marine plantain, *Plantago maritima*, capsule fragments that rarely survive carbonization.

PILOT STUDY: IMPLICATIONS FOR THE PROPOSED PROJECT

Results from the pilot study raise two questions that will be addressed further in the proposed study. First, how are significant ($p=0.003$) changes in the ratio of oats to barley observed in the pilot study related to changes in agricultural practices (including the formation of plaggen soils) and animal husbandry? More detailed study of weed seeds and chaff will be used to determine how much processing cereals had received (whether they had been hulled, detached from the stalk, how many of the weed seeds had been removed, whether the embryos had been removed, etc), which can be used to infer whether stored grains were intended for local human consumption, export, or animal fodder. In addition, zooarchaeological data analyzed by members of the VATP team can be used to determine the number of animals kept at the site over time, and if an increase in dairying (occurring elsewhere in the Orkney Earldom) was taking place at Quooygrew, and if so, when. This information will be correlated with changes in oat/barley ratios at the site because oat intensification may signal increased foddering tactics.

Secondly, the pilot study samples included carbonized plant rhizomes, Ericaceae (Heather family) leaves, and vitrified silica particles. This combination of remains suggests that the assemblage may have been produced in part by burning peat and/or turf as fuel (Hall 2003). If this is the case, many of the carbonized seed remains might have been brought to the site as part of these fuels.

THE STUDY

The proposed study is designed to meet three objectives. Hypotheses related to each of these objectives, as well as specific, testable predictions following from them and the methods used to test the predictions are discussed in this section and summarized in Figure 4.

OBJECTIVE #1

The first objective of this study is to identify changes in economic activity patterns at the site across time and space. I predict that both production and consumption of commercial goods will increase at the site during the period of economic expansion AD 900-1300, but decrease after AD 1300. This hypothesis leads to several specific predictions testable by the proposed paleoethnobotanical study. First, the number of imported exotic seeds found at Quooygrew (from

plants not native to the Orkneys, and which are unlikely to grow in such a habitat, including wheat, *Triticum* spp.) will increase in contexts dating from AD 900 to 1300 and decrease thereafter. Second, caches of cleaned grains, particularly of those grains preferred for human consumption (wheat and barley), will increase in contexts dating from AD 900 to 1300 and also decrease after 1300. To test these predictions, several methods will be used, including identification of exotic seeds, study of crop production and consumption indicators, and analysis of crop weed assemblages (see below).

OBJECTIVE #2

The second objective is to understand the relationship between fishing, farming, and animal husbandry practices during this period of drastic economic change in the North Atlantic. My hypothesis is that the degree of interaction increased along with the demand for surplus between AD 900 and 1300, and decreased after AD 1300. Later, as in other areas of Northern Europe, the occupants of Quoygrew focused more on the production of animal products: fish, livestock and dairy. Specifically, I predict that weed seed assemblages will indicate specially grown hayfields or more oat production to accommodate more livestock, and that plaggen soil fields will be at their largest and coincide with the maximum number of livestock at the site. I also predict that an increase in flax production will accompany fishing intensification as a means of meeting increased demand for fishing tackle. Finally, I predict that cultigen chaff will decrease after AD 1300, which would indicate less grain production compared to consumption at the site. The study of crop production and consumption patterns and an analysis of crop weed seeds will also be used to test these predictions, as will correlation of paleoethnobotanical remains with data provided by the VATP zooarchaeology and geoarchaeology specialists.

OBJECTIVE #3

The third objective is to understand environmental impacts of the increased production of commodities in an island environment. I hypothesize that fuel shortages will begin to occur in Orkney prior to the bubonic plague of AD 1349. I predict that fuel use will shift from more efficient fuels (peat) to less efficient fuels (turf) as they did elsewhere in the Orkney earldom (Lowe 1998). I also predict that the exploitation of labor-intensive wild resources (so called “famine foods”) will increase to supplement agricultural supplies after AD 1300, and that more arable weeds will be included in grain intended for human consumption. Testing these predictions will benefit from an experimental study to recognize seed assemblages common in peat and turf, and will also involve identification of wild food sources, including charred seeds and possibly bulbs and tubers.

METHODS

Studies show that given consistent methods of sampling across a site, it is often possible to interpret spatial and temporal changes in activity (Jones 1991; Lennstrom and Hastorf 1995; McGovern 1992; Metcalfe and Heath 1990; Smith et al. 2001). Flotation samples were taken from nearly all secure contexts at the site and processed during the 1997-2005 field seasons (Barrett and Gerrard 2002; Williams 1972). I will analyze charred macrobotanical remains from a large variety of contexts (including hearths, storage features, drying kilns, floor layers, byre areas where animals were kept, plaggen soils, and several large middens) and times of occupation (c. 900-1400 AD) according to procedures outlined in Poaps and Huntley (2001), ensuring compatibility with a corpus of published data from the site and region. I will identify

seeds using the comparative collection housed at Washington University's Paleoethnobotany Laboratory, identification texts, and in collaboration with British archaeobotanists during visits to Britain and via electronic conference. Several methods of analysis, described below, will be applied to the raw data I obtain from paleoethnobotanical identifications.

IDENTIFICATION OF EXOTIC SEEDS

Exotic seeds found at medieval sites in Scotland include foods such as figs and raisins, and spices like mace and coriander (Dickson and Dickson 2000). Because of the probable high status of the farm, figs and raisins would not be unreasonable finds at Quoygrew. Mace is usually found in towns and sites of higher status such as priories, and is unlikely to be found at Quoygrew. Wheat (*Triticum* sp.) does not ripen in Orkney today, and, although it is possible that wheat could be grown further north during the Medieval Warm Period, it is likely that wheat found in Orkney was imported from elsewhere. One possible wheat caryopsis and a piece of chaff was already identified in the samples from the coastal midden at Quoygrew (Poaps and Huntley 2001), and although none appeared in the samples I analyzed in the pilot study, it is likely that more will be found at the site. Very small amounts of wheat have also been found at the Viking sites of Robert's Haven (Huntley 2000), Freswick Links (Batey 1987; Huntley and Turner 1995), and Earl's Bu (Batey and Morris 1992). Exotic crop weeds have also been used to identify foreign production of imported cereals (van Zeist 1990). The presence of exotic seeds and nuts in the paleoethnobotanical assemblage is most likely to represent importation along trading networks.

INTERPRETATION OF CROP PRODUCTION AND CONSUMPTION

I will interpret changes in crop production and consumption by analyzing changes in crop seed remains through time and by context type. Measures of absolute amount, density, frequency, ubiquity, and percent dominance will be used to describe changes in crop seeds and processing residues over time (G. Jones 1991, Pearsall 2000, Fritz in press). Crop weeds and chaff can be used to identify the degree to which cereals like oat and barley have been "cleaned" or separated from chaff elements and weed seeds (Dennell 1976, Hillman 1981, 1984, Stevens 2003). This can provide clues to the purpose of the crop, whether for trade, local human consumption, or use as fodder. This must be cautiously done in Orkney, however, since there is historical evidence to suggest that straw was an important commodity in post-medieval Orkney (Fenton 1978). It was used as thatch, for making rope and baskets, and as animal fodder and bedding. It was sometimes traded between areas. If this were the case in earlier time periods as well, then determining the chaff-to-grain ratio at a particular site in Orkney may not have much bearing on the amount of cereal processing taking place there. Crop processing "waste" can be an important commodity in many areas of the world, including Orkney (Smith 2001). Another complication is that rachis internodes of free-threshing grains (like the 6-row barley species found at Quoygrew) are the least-well preserved part of the plant, and are often underrepresented in carbonized assemblages because they have been completely burned away, while the caryopses are able to withstand higher temperatures for longer periods of time (Boardman and Jones 1990). While these complications mean that detailed numerical analysis of chaff to grain ratios are unlikely to be directly attributable to crop activity at the site, general frequency of chaff in a given context can still give clues to whether crop production was taking place at the site (Huntley 2000).

ANALYSIS OF CROP WEED SEED ASSEMBLAGES

Crop weed seeds in archaeobotanical samples can be used to identify ecological conditions in fields, and thus the agricultural practices contributing to them (Bogaard et al. 2001; Charles et al. 1997; Engelmark 1989, Henricksen et al. 1996; Huntley 2000; Jones et al. 2000; van Zeist et al. 1994). Some weed species thrive in wet environments, others in dry ones. Some will grow in nutritionally poor environments, while others appear only in rich ones. Acidity of the soil is a third factor determining which weeds will thrive among crops in a particular field. If marginal land is taken into cultivation, the change may appear in the archaeobotanical record as a shift in the weed assemblage reflecting integration of new soil types. I will analyze the weed seed assemblage from Quoygrew in terms of the environmental preferences of different weed species, and determine if the weed seed assemblage shows a significant shift from one set of environmental preferences to another over time. Changes in weed seed assemblages may show, for example, an increase in nitrophilous weeds, suggesting that fields were being more heavily fertilized.

EXPERIMENTAL STUDY OF SEED ASSEMBLAGES IN FUEL TYPES

It is important to be able to detect change in the use of various fuels over time. Increasing demand for fuel to produce fish oil and malt barley, and provide cooking and heating for the household, as well as demand for ash byproducts used in fertilizer, all may have caused intense competition over fuel sources, overexploitation, and adverse environmental effects (McGovern et al. 1988). Dung fuel can be recognized using archaeobotanical data (Bottema 1984; Carter 1998; Hally 1981; Miller 1984; Miller and Smart 1984). Distinguishing peat from turf is more difficult, because these fuels are often used together, and both turf and peat can be taken from areas with similar vegetation, although turf is also gathered from areas with grassland vegetation (Dickson 1998; Hall 2003). In times of fuel shortage, however, we should see a shift from the use of peat and peaty turf towards use of the less efficient grassland turf, which may look very different in terms of the seeds it contains. In order to test whether distinguishable botanical “signatures” - assemblages of seeds that signal the presence of a particular fuel type in an archaeological sample –exist between peat and grassland turf, I will experimentally char equal volumes of each fuel type using a muffle furnace. Fuel samples will be collected from areas surrounding the Quoygrew site, as will seeds and voucher specimens to use as comparative material. ANOVA statistical tests including Tukey’s HSD will be conducted to determine if assemblages of weed seeds from different fuel types differ significantly.

PLACING DATA IN CONTEXT

Because of the large amount of data available from other sites in the region, changes occurring in the macrobotanical assemblage at Quoygrew can be statistically compared with those occurring at other sites can be done. This will need to be cautiously done, however, as methods used to collect and analyze archaeobotanical data can vary substantially from site to site (for a discussion of some of the difficulties with such syntheses, see Groenman-van Waateringe 1994). However, a comparative analysis made with conscious acknowledgement of the limitations imposed by disparate methods of collection and analysis, as well as possible differences in taphonomy of samples, can be a useful way to better differentiate regional changes from those specific to Quoygrew.

Other methods of analysis will involve correlation of paleoethnobotanical data with data available from other VATP specialists, including zooarchaeologists, geoarchaeologists, and malacologists. Also, AMS radiocarbon dating of important contexts will greatly enhance my ability to understand the chronology of economic change at the site, supplementing radiocarbon dates already available with those of special interest to me as a paleoethnobotanist.

CONCLUSIONS AND SIGNIFICANCE

The proposed study will improve understanding of how economic changes occurring across Northern Europe were expressed at the site level in a largely undocumented rural region. This study will provide other archaeologists working in the North Atlantic not only with paleoethnobotanical data related to economic trends at the site, but also with an integrated picture of economic activity across the site, a rare opportunity provided by the many specialist studies produced by the VATP. Important details on how intensification evidenced by plaggen soil and fish middens affected agriculture, and on interactions between animal husbandry, agriculture, and land use, can only be provided by in-depth analysis of charred remains. This study will also remedy a dearth of research on seed remains in peat and turf, which will influence interpretation of charred seed assemblages in many areas of the North Atlantic where other fuel sources are rare.

TIMETABLE

Spring 2006: Analysis of archaeological samples from 2005 field season

Summer 2006: Field season in Orkney: collection of comparative material, experimental fuel study; further collection of archaeobotanical samples

Fall 2006: Analysis of archaeological samples

Spring 2007: Completion of analysis

Summer 2007: Consultation trip to York/Durham: confirm identifications in archaeobotany labs

Fall 2007-Spring 2008: Write dissertation

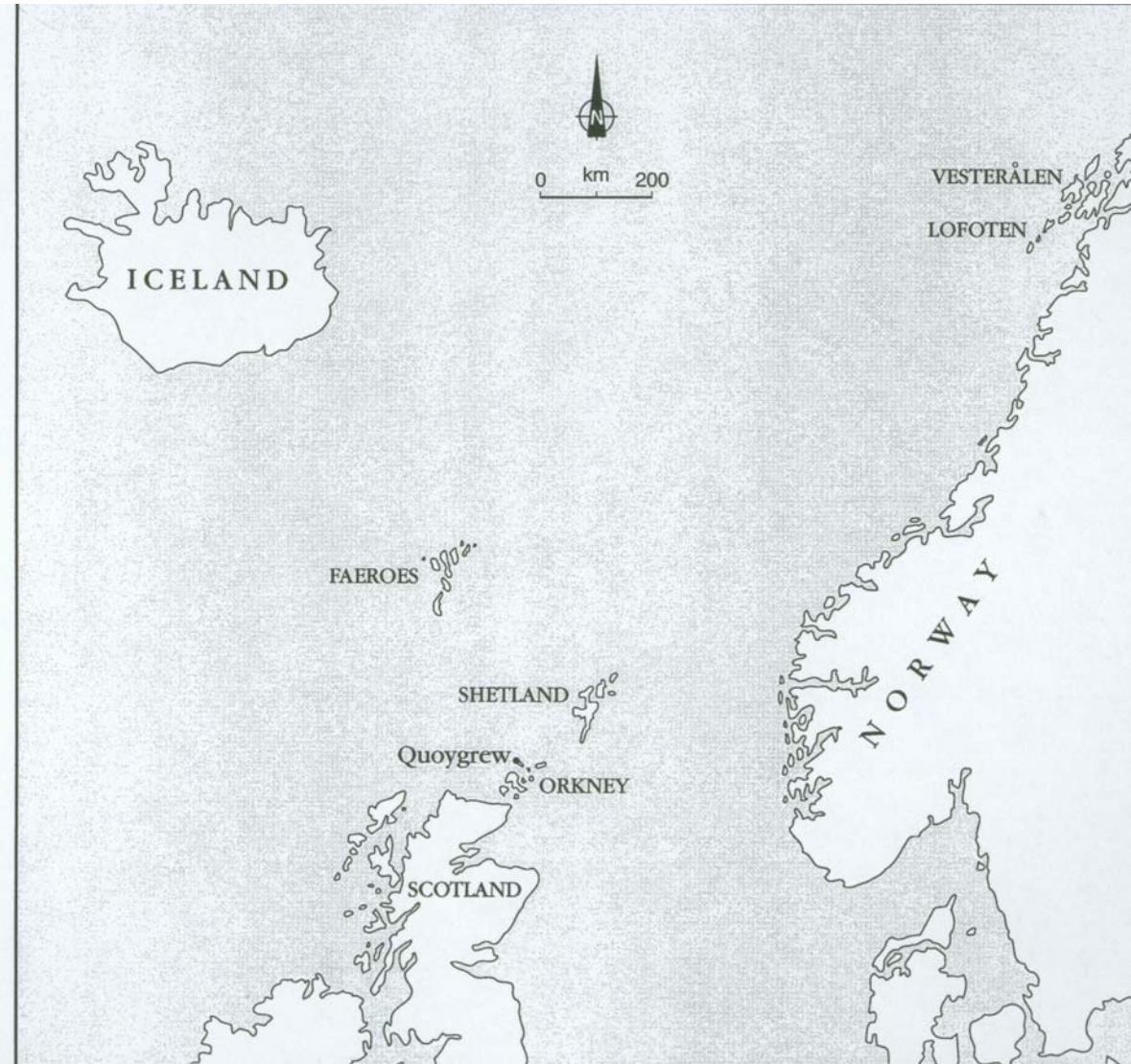


Figure 1. Location of Quoygrew site

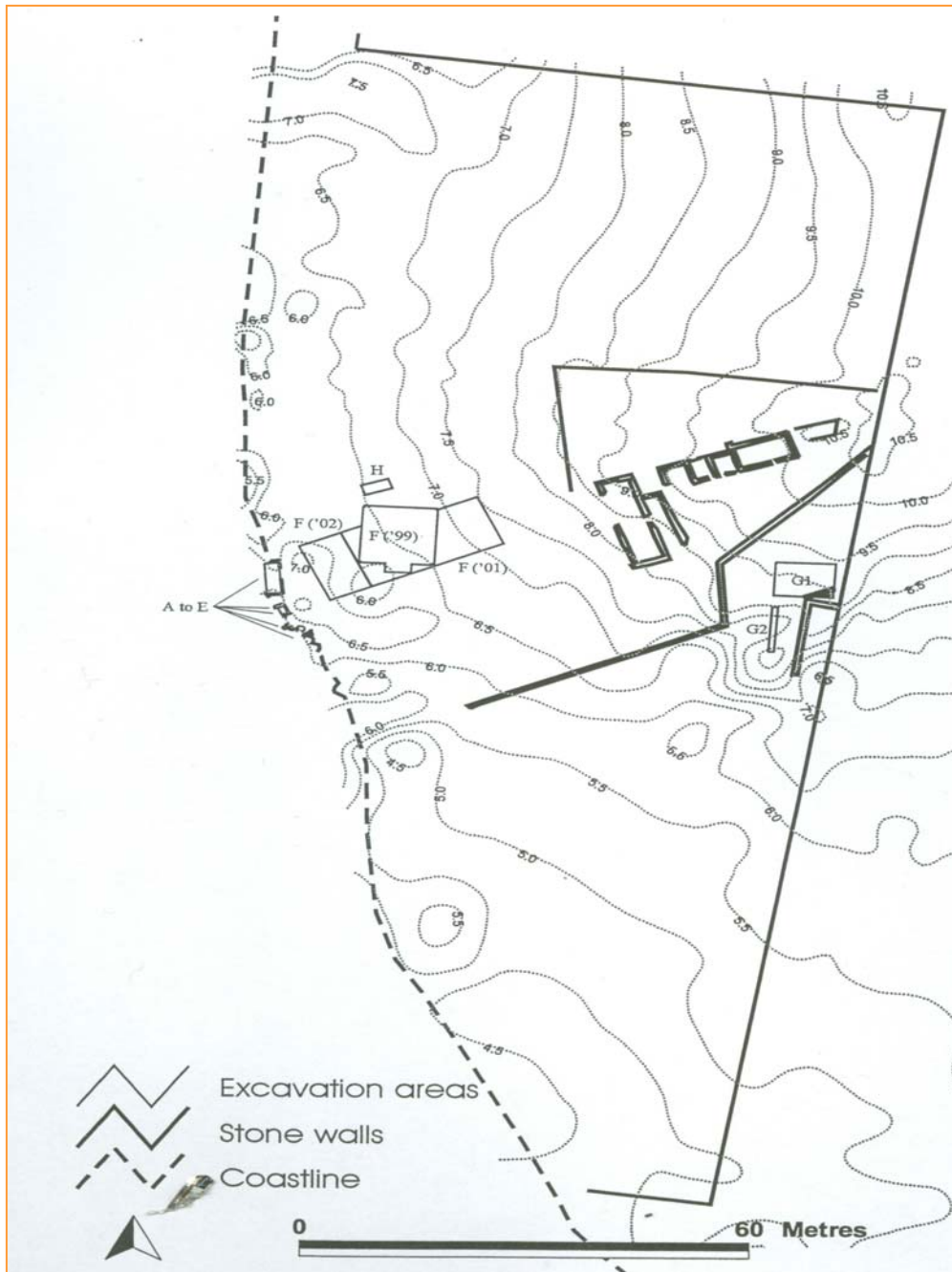


Figure 2. Map of Quoygrew 2002 excavation, includes fish middens (A-E), house structures (F), and farm midden (G). Approximately 1.5 ha. of plaggen soil exists to the south and west of the farm midden.

Figure 3. Radiocarbon dates from Quoygrew

Lab code	Context ¹	bp	±	δ13C	Material	95% range	Bayesian calibration 95% range	Stratigraphic interpretation
Farm Mound (Area G1)								
AA-50702	G037	1130	35	-19.5	pig skull	AD 782-995	AD 779-981	base of farm mound
AA-39135	G020/G021	905	60	-22.2	horse pelvis	AD 1004-1262	AD 1035-1261	base of block G026
Pre-midden Soil at Shore (Column A)								
TO-7118	A026	1220	50		barley	AD 677-959	AD 676-896	predates fish midden
Fish Midden (Columns A and E)								
TO-7529	E030 (022)	970	40	?	articulated calf	AD 996-1162	AD 1018-1191	near base of midden, predates A023
AA-52329	A023 (007)	877	45		cereal grain	AD 1028-1262		near base of midden, predates A005
AA-52330	A023 (007)	833	38		cereal grain	AD 1070-1278		near base of midden, predates A005
AA-52331	A023 (007)	832	49		cereal grain	AD 1042-1282		near base of midden, predates A005
AA-52332	A023 (007)	946	53		cereal grain	AD 995-1217		near base of midden, predates A005
AA-52329, AA-52330, AA-52331, AA-52332	A023 (007) combined	865	24		cereal grain	AD 1066-1241	AD 1066-1223	near base of midden, predates A005
TO-7530	A005 (005)	860	40		barley	AD 1039-1264	AD 1161-1264	near top of midden, predates A004
TO-7117	A004 (003)	800	50		barley	AD 1159-1291		near top of midden, postdates A005
AA-52325	A004 (003)	709	79		cereal grain	AD 1188-1406		near top of midden, postdates A005
AA-52358	A004 (003)	722	38		cereal grain	AD 1243-1381		near top of midden, postdates A005
AA-52325, AA-52358, TO-7117	A004 (003) combined	747	30		cereal grain	AD 1223-1296	AD 1217-1294	near top of midden, postdates A005
AA-52327	A004 (003)	587	64		cereal grain	AD 1284-1439		intrusive, excluded from Bayesian calibration
AA-52326	A004 (003)	519	40		cereal grain	AD 1326-1444		intrusive, excluded from Bayesian calibration
TO-7044	D017	870	50	-17.92	cow pelvis	AD 1027-1276		post-dates midden, but marine reservoir effect, excluded from Bayesian calibration
Plaggen Soil (Test Pit 2 and Area G2)								
TO-7116	TP2	2760	60		cereal grain	1045-803 BC		redeposited (residual) sediment
TO-7528	TP2	1690	50		heather	AD 240-435		burnt peat (old wood)
AA-54914	G025	685	55		cereal grain	AD 1256-1400		manuring of soil or bioturbation from midden

¹ For samples from excavation columns in the fish midden the equivalent cliff section context is given in parentheses.

Figure 4. Summary of Proposed Project: Objectives, Predictions, Hypotheses and Methods

Objective	Hypotheses	Specific Predictions	Methods Used
1) to identify economic activity patterns at the site across time and space	Production and consumption of trade goods will increase over the period AD900-1300 and decrease thereafter.	1) the number of imported exotic seeds in samples will increase AD900-1300 and decrease thereafter; 2) caches of cleaned grains, particularly barley and wheat, will increase AD900-1300 and decrease thereafter	1) identification of exotic seeds; 2) study of crop production/consumption; 3) analysis of weed seed assemblages 3) AMS radiocarbon dating of critical samples
2) to understand the relationship between fishing, farming, and animal husbandry practices during a period of drastic economic change in the North Atlantic	The degree of interaction between fishing, farming, and animal husbandry practices will increase AD900-1300 and decrease thereafter, with more focus on production of animal products after AD1300	1) weed seed assemblages will suggest specially grown hayfields or expansion of oat growing outfields as livestock kept at the site increases; 2) flax seeds found at the site will increase along with the expansion of fishing activities; 3) plaggen soils will be at their largest when the number of animals kept at the site is largest 4) weed seeds and chaff at the site will decrease after AD1300	1) study of crop production/consumption; 2) analysis of weed seed assemblages; 3) correlation with data provided by VATP zooarchaeology and geoarchaeology specialists 3) AMS radiocarbon dating of critical samples
3) to understand environmental impacts of the increased production of these commodities in an island environment	Signs of overproduction and resource stress will occur prior to the arrival of the Black Death c. AD1349	1) fuel use will shift from more efficient peat to less efficient turf prior to AD1349; 2) exploitation of labor-intensive wild resources will increase to supplement agricultural supplies after AD1300	1) experimental study of seed assemblages in common turf and peat fuels; 2) analysis of weed seed assemblages; 3) AMS radiocarbon dating of critical samples